INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (Data Science)**				
Course Title	**LINEAR ALGEBRA AND CALCULUS**				
Course Code	AHSC02				
Program	B.Tech				
Semester	I				
Course Type	Foundation				
Regulation	UG - 22				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. P Shantan Kumar, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of Algebra and Calculus

II COURSE OVERVIEW:

The Linear algebra is a sub-field of mathematics concerned with vectors, matrices, and linear transforms. Calculus is the branch of mathematics which majorly deals with derivatives and integrals. Linear algebra is a key foundation to the field of machine learning. The course includes types of Matrices, Rank, methods of finding rank, Eigen values and Eigen vectors, maxima and minima of functions of several variables, solutions of higher order ordinary differential equations and Fourier series. Matrices are used in computer animations, color image processing. Eigen values are used by engineers to discover new and better designs for the future. The laws of physics are generally written down as differential equations. So, differential equations and Fourier series expansions have wide applications in various engineering and science disciplines. This course enables the students to gain basic knowledge on the mathematics which is used in modeling the real time engineering problems very often.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Linear Algebra and Calculus	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Table 1: The expected percentage of cognitive level of questions in SEE.

10 %	Remember
30 %	Understand
60 %	Apply
0 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

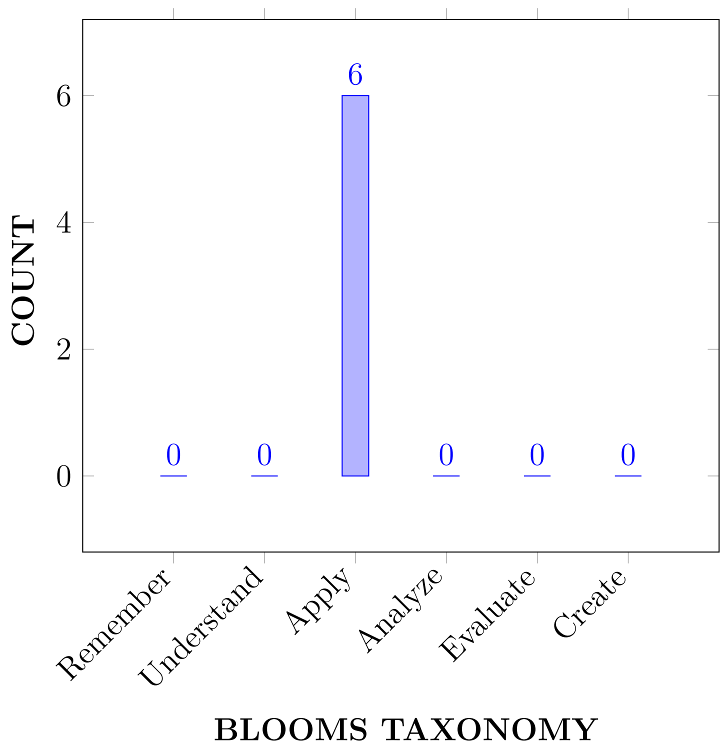
I	The principles of Eigen value analysis and linear transformations, Matrix rank finding methods.
II	The calculus of functions of several variables and the concept of maxima-minima for a three-dimensional surface.
III	The analytical methods for solving higher order differential equations with constant coefficients.
IV	Fourier series expansions in standard intervals as well as arbitrary intervals.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Calculate** the rank and inverse of real and complex matrices with elementary transformation methods.	Apply
CO 2	**Make Use of** the Eigen values, Eigen vectors for developing modal and Spectral matrices from the given matrix..	Apply
CO 3	**Use** Cayley Hamilton theorem for finding inverse and powers of the matrix.	Apply
CO 4	**Utilize** the mean–value theorems and partial derivatives in estimating the extreme values for functions of several variables	Apply
CO 5	**Solve** the Second and higher order linear differential equations with constant coefficients by using substitution and method of variation of parameters..	Apply
CO 6	**Apply** the Fourier Series expansion of periodic, even and odd functions in analyzing the square wave, sine wave rectifiers.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	**Explain** the role of rank and inverse of real and complex matrices in solving **complex engineering problems** by using elementary transformation methods **(principles of mathematics).**	2
CO 2	PO 1	**Determine** the Eigen values, Eigen vectors, Spectral matrix **complex engineering problems modeled by matrices** with help of Characterstic Equation **(principles of mathematics).**	2
	PO 2	**Model** the problem into matrices, prepare precise **statement** of the problem and apply the concepts of Eigen values and Eigen vectors to **develop the solution** and **interpret, validate** the results through proper **documentation**	6
CO 3	PO 1	**Make use of** Cayley Hamilton theorem for finding positive and negative powers of the matrix and apply them in the **complex engineering problems** modeled by matrices **(principles of mathematics).**	2
CO 4	PO 1	**Explain** the mean–value theorems for the single variable functions andthe extreme values for functions of several variables apply them in the **complex engineering problems** Ordinary and Partial derivatives .	2
CO 5	PO 1	**Determine**the solution of **complex engineering problems** modeled by Second and higher order linear differential equations with constant coefficients by using substitution method and method of variation of parameters.	2

	PO 2	**Model** the problem with the help of ordinary differential equations, prepare precise **statement** of the problem and apply method of variation of parameters and other analytical methods to **develop the solution** and **interpret, validate** the results through proper **documentation**	6
CO 6	PO 1	**Build** the Fourier series expansion **for the complex engineering problems** modeled by given periodic, even and odd functions in various intervals with the help of Fourier coefficients formulae **(principles of mathematics).**	2
	PO 2	**Model** the problem with the help of suitable periodic functions, prepare precise **statement** of the problem and apply Fourier series expansions to **develop the solution** and **interpret, validate** the results through proper **documentation**	6

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/No.of Key Competencies Matched												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	67	60	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	67	60	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	67	60	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0\% \leq C \leq 5\%$ – No correlation
1 - $5\% < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	9	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assign-ments	-	Seminars	-
Labora-tory Practices	-	Student Viva	-	Mini Project	-	Certifica-tion	-
Term Paper	-	Tech - talk	✓	Concept Video	✓	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	THEORY OF MATRICES
	Real matrices: Symmetric, Skew-Symmetric and Orthogonal matrices; Complex matrices: Hermitian, Skew- Hermitian and Unitary matrices; Elementary row and column transformations, finding rank of a matrix by reducing to Echelon form and Normal form; Finding the inverse of a matrix using Gauss-Jordan method

MODULE II	LINEAR TRANSFORMATIONS
	Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and Eigen vectors of a matrix; Diagonalization of matrix.
MODULE III	FUNCTIONS OF SINGLE AND SEVERAL VARIABLES
	Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, Jacobian, functional dependence, maxima and minima of functions with two variables and three variables. Method of Lagrange multipliers.
MODULE IV	HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS
	Linear differential equations of second and higher order with constant coefficients. Non-homogeneous term of the type f(x) = e^{ax} , sinax , cosax , x^n , e^{ax}v(x) and Method of variation of parameters.
MODULE V	FOURIER SERIES
	Fourier expansion of periodic function in a given interval of length 2π; Fourier series of even and odd functions; Fourier series in an arbitrary interval;

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36^{th} Edition, 2010
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint 2010.

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9^{th} Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, Linear Algebra: A Modern Introduction, 2^{nd} Edition, Brooks/Cole, 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/108/111108157/

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	In Outcome Based Education (OBE),we discussed about course delivery assesment that are planned to achieve stated objectives and oucomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO), Program Outcomes(PO) and Program Specific Outcomes(PSO) and also mapping of CO's to PO's, PSO's and their attainments are discussed.	-	-
CONTENT DELIVERY (THEORY)			
2	Theory of Matrices: Types of Real Matrices	CO 1	T2:32.1 R1:4.1
3	Real Matrices: Symmetric, Skew-Symmetric Matrices	CO 1	T2:32.1 R1:4.2
4	Real Matrices: Orthogonal Matrices	CO 1	T2:32.1 R1:4.3
5	Complex Matrices: Hermitian, Skew- Hermitian	CO 1	T2:32.1 R1:4.3
6	Complex Matrices: Unitary Matrices	CO 1	T2:32.5 R1:4.6
7	Elementary Operations: Elementary Row and Column Transformations	CO 1	T2:32.5 R1:4.6
8	Rank of a Matrix by Echelon Form	CO 1	T2:32.4 R1:4.5
9	Rank of a Matrix by Normal Form	CO 1	T2:32.7 R1:4.8
10	Inverse of a Matrix by Gauss-Jordan Method	CO 1	T2-7.1 R1:7.4
11	Eigen Values of a Matrix	CO 2	T2-7.1 R1:7.4
12	Eigen Vectors of a Matrix	CO 2	T2-7.1 R1:7.4
13	Diagonalization of Matrix by Linear Transformation.	CO 2	T2:7.1 R1:7.4
14	Cayley-Hamilton Theorem- Statement, Verification	CO 3	T2:7.1 R1:7.4
15	Applications of Cayley – Hamilton: Finding Inverse and Powers of a Matrix	CO 3	T3-2.9 R1:2.1

16	Linear Dependence and Independence of Vectors	CO 2	T3-2.5 R1:2.8
17	Mean Value Theorems:1: Rolle's Theorem	CO 4	T3-2.5 R1:2.8
18	Mean Value Theorems:2: Lagrange's Theorem	CO 4	T3-2.5 R1:2.8
19	Mean Value Theorems:3: Cauchy's Theorem	CO 4	T3-2.5 R1:2.8
20	Functions of Several Variables: Partial Differentiation	CO 4	T3-2.5 R1:2.8
21	Jacobian Transformations	CO 4	T3-2.61 R1:2.10
22	Functional Dependence	CO 4	T1-7.1 R2:7.5
23	Maxima and Minima of Functions with Two Variables	CO 4	T3-2.61 R1:2.10
24	Maxima and Minima of Functions with Three Variables	CO 4	T1-7.1 R2:7.6
25	Application Method of Lagrange Multipliers	CO 4	T1-7.1 R2:7.7
26	Method of Lagrange Multipliers	CO 4	T3-2.5 R1:2.8
27	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 5	T3-2.5 R1:2.8
28	Linear Differential Equations of Second and Higher Order with Constant Coefficients	CO 5	T3-2.5 R1:2.8
29	Non-Homogeneous term of the type F (X) = e^{ax}	CO 5	T3-2.5 R1:2.8
30	Non-Homogeneous term of the type F (X) = Sinax , Cosax	CO 5	T2-7.1 R1:7.4
31	Non-Homogeneous term of the type F (X) = X^n	CO 5	T2:7.1 R1:7.4
32	Non-Homogeneous term of the type F (X) = e^{ax}v(X)	CO 5	T2:7.1 R1:7.4
33	Method of Variation of Parameters	CO 5	T3-2.9 R1:2.1
34	Fourier Expansion of Periodic Function in a Given Interval of Length 2π	CO 6	T3-2.5 R1:2.8
35	Fourier Expansion of Periodic Function in a Given Interval of Length (-π,π)	CO 6	T3-2.5 R1:2.8
36	Fourier Series of Even Functions in a Given Interval of Length (-π,π)	CO 6	T2:7.1 R1:7.4
37	Fourier Series of Odd Functions in a Given Interval of Length (-π,π)	CO 6	T3-2.9 R1:2.1

38	Fourier Series in an Arbitrary Interval (0,2l)	CO 6	T3-2.5 R1:2.8
39	Fourier Series in an Arbitrary Interval (-l,l)	CO 6	T2:7.1 R1:7.4
40	Half- Range Fourier Sine Expansions in a Given Interval of Length (0,π)	CO 6	T3-2.9 R1:2.1
41	Half- Range Fourier Cosine Expansions in a Given Interval of Length (0,π)	CO 6	T3-2.5 R1:2.8
PROBLEM SOLVING/ CASE STUDIES			
42	Rank of the Matrix by Echelon and Normal Form	CO 1	T2:32.1 R1:4.2
43	Eigen Values and Eigen Vectors of The Matrix	CO 2	T2:32.1 R1:4.3
44	Finding Powers of the Matrix by Cayley Hamilton Theorem	CO 3	T2:32.1 R1:4.3
45	Finding Spectral Matrix by Linear Transformation.	CO 2	T2-7.1 R1:7.4
46	Jacobian Transformation in Cartesian and Polar Forms	CO 4	T2-7.1 R1:7.4
47	Finding Functional Relationship.	CO 4	T2:7.1 R1:7.4
48	Finding Critical Points.	CO 4	T2:7.1 R1:7.4
49	Solving Non-Homogeneous Differential Equations.	CO 5	T3-2.5 R1:2.8
50	Solving Second Order Non-Homogeneous Differential Equations by Method of Variation of Parameters.	CO 5	T3-2.5 R1:2.8
51	Finding Fourier Series	CO 6	T3-2.5 R1:2.8
52	Fourier Expansion of Periodic Function in a Given Interval of Length 2π	CO 6	T3-2.5 R1:2.8
53	Fourier Expansion of Periodic Function in a Given Interval of Length (-π,π)	CO 6	T3-2.61 R1:2.10
54	Fourier Series in An Arbitrary Interval (-l,l)	CO 6	T2:7.1 R1:7.4
55	Finding Fourier Sine Series in Interval (0,l)	CO 6	T3-2.9 R1:2.1
56	Finding Fourier Cosine Series in Interval (0,l)	CO 6	T3-2.5 R1:2.8
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Real, Complex Matrices and Rank of a Matrix	CO 1	T3-2.5 R1:2.8
58	Eigen Values and Eigen Vectors, Diagonalization	CO 2,C0 3	T3-2.5 R1:2.8

59	Mean Value Theorems, Jacobian Transformations, Functionally Dependent and Independent	CO 4	T3-2.5 R1:2.8
60	Higher Order Differential Equations	CO 5	T3-2.5 R1:2.8
61	Fourier Series (Even, Odd, Neither Functions)	CO 6	T3-2.61 R1:2.10
DISCUSSION OF QUESTION BANK			
62	Theory of Matrices	CO 1	T2:7.1 R1:7.4
63	Linear Transformations	CO 2,C0 3	T3-2.9 R1:2.1
64	Functions of Several Variables	CO 4	T3-2.5 R1:2.8
65	Higher Order Differential Equations	CO 5	T2:32.1 R1:4.3
66	Fourier Series.	CO 6	T2-7.1 R1:7.4

Signature of Course Coordinator **HOD, CSE (Data Science)**
Mr. P Shantan Kumar, Assistant Professor

COURSE DESCRIPTION

Course Title	**CHEMISTRY**				
Course Code	AHSC06				
Program	B.Tech				
Semester	I	DS			
Course Type	FOUNDATION				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	2	-	-
Course Coordinator	Dr M S N A Prasad, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of chemistry

II COURSE OVERVIEW:

The course discusses elements and compounds and their applied industrial applications. It deals with topics such as batteries, corrosion and control of metallic materials, water and its treatment for different purposes, engineering materials such as plastics, elastomers and biodegradable polymers, their preparation, properties and applications, energy sources and environmental science. Sustainable chemistry that focuses on the design of the products and processes that minimize or eliminate the use and generation of hazardous substances is also included.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Chemistry	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	✓	Chalk & Talk	x	Assignments	x	MOOCs
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

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The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
50%	Understand
50%	Apply
0%	Analyze

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CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

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CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

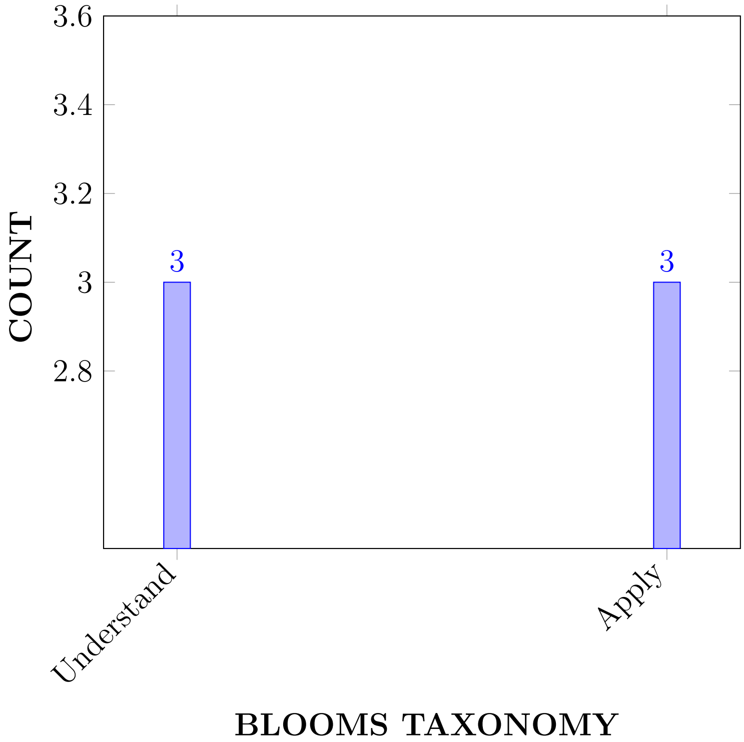
I	The concepts of electrochemical principles and causes of corrosion in the new development and breakthroughs efficiently in engineering and technology.
II	The different parameters to remove causes of hardness of water and their reactions towards the complexometric method.
III	The polymerization reactions with respect to mechanisms and its significance in industrial applications.
IV	The significance of green chemistry to reduce pollution in environment by using natural resources.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the electrochemical principles, corrosion process in metals for protection of different metals from corrosion.	Understand
CO 2	**Utilize** electrochemical cell parameters, electrochemical active surface area, current and over potential under given condition for calculating the electromotive force and electrode potential.	Apply
CO 3	**Identify** the hardness of water by different treatment methods for finding the hardness causing salts in water.	Apply
CO 4	**Compare** different types of polymerization reactions, mechanism of lubrication for utilizing in industries.	Understand
CO 5	**Make use of** green synthesis methods, different types of solid, liquid and gaseous fuels in terms of calorific value for utilizing in industries and automobiles.	Apply
CO 6	**Outline** the different types of natural resources and their applicability for understanding the effect of pollutants on air, water and soil that cause the environmental pollution.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	CIE/SEE/AAT
PO 7	**Environment and sustainability:** understand the impact of the professional engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development. .	3	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓		-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-
CO 6	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

Course Outcomes	POs / PSOs	Justification for mapping (Students will be able to)	No. of key competencies
CO 1	PO 1	**Explain** the operation of electrochemical systems in batteries, corrosion process in metals for protecting the metals from corrosion by using **principles of** science for solving **engineering problems**.	2
CO 2	PO 1	**Choose** different electrodes for finding pH of unknown solutions by applying **mathematical** expressions of cell potential by using **principles of science** and mathematics for solving **engineering** problems	3
	PO 2	**Identify** the problem **formulation and abstraction** for calculating electrode potential under non standard conditions by applying Nernst equation from the provided **information.**	2

CO 3	PO 1	**Explain** different treatment methods to produce soft water from raw water for solving **engineering problems** by applying the **principles of science.**	2
	PO 2	**Identify** the problem and formulate for finding the hardness of water in terms of CaCO3 equivalents with given **information and data** by applying **principles of science.**	2
CO 4	PO 1	**Illustrate** different types of polymerization reactions for synthesizing polymers from monomers, different types of lubricants to reduce friction in machines working under various temperature conditions by using **principles of science** for solving **engineering** problems	2
CO 5	PO 1	**Explain** the importance of green synthesis to minimize the generation of hazardous substances, different types of solid, liquid and gaseous fuels with their characteristics and calorific value by applying **mathematical** expressions for finding calorific value using **principles of science** and mathematics for solving engineering problems.	3
	PO 2	**Identify the given problem** and **formulate** for finding the calorific value of fuel with the given **information and data** by applying principles of science.	2
	PO 7	Make use of gaseous fuels like LPG, CNG to reduce the pollutants in atmosphere and know the impact in **socio economic and environmental** contexts for sustainable development.	2
CO 6	PO 1	**Explain** the concept of **living** and non living resources and the utility of these resources, effect of pollutants on air, water and soil that causes the environmental pollution for solving engineering problems by applying the **principles of science**	2
	PO 7	**Make use** of renewable and non renewable resources, control measures for air pollution, water pollution, soil pollution and noise pollution in **socio economic** an **environmental** contexts for sustainable development.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 6	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	2	2	2
CO 1	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.6	20	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	20	-	-	-	-	66.6	-	-	-	-	-	-	-	-
CO 6	66.6	-	-	-	-	-	66.6	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
2 - 40 % $<C <$ 60% –Moderate
1-5 $<C \leq$ 40% – Low/ Slight
3 - 60% $\leq$ C $<$ 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-
CO 6	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
TOTAL	18	3	-	-	-	-	6	-	-	-	-	-	-	-	-
AVERAGE	3	1	-	-	-	-	3	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-				

XVII ASSESSMENT METHODOLOGY INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
✓	Assessment of activities/modeling & experimental tools in engineering by experts		

XVIII SYLLABUS:

MODULE I	**ELECTROCHEMISTRY AND BATTERIES**
	Electro chemical cells: Electrode potential, standard electrode potential, Calomel electrode and Nernstequation; Electrochemical series and its applications; Numerical problems; Batteries: Primary (Dry cell) and secondary batteries (Lead-acid storage battery, Li-ion battery). Corrosion: Causes and effects of corrosion: Theories of chemical and electrochemical corrosion, mechanism of electrochemical corrosion; Corrosion control methods: Cathodic protection, sacrificial anode and impressed current Cathodic protection; Surface coatings: Metallic coatings- Methods of coating- Hot dipping- galvanization and tinning, electroplating
MODULE II	**WATER TECHNOLOGY**
	Introduction: Hardness of water, causes of hardness; types of hardness: temporary and permanent hardness, expression and units of hardness; estimation of hardness of water by complexometric method; potable water and its specifications, Steps involved in the treatment of water, disinfection of water by chlorination and ozonization; External treatment of water; Ion-exchange process; Desalination of water: Reverse osmosis, numerical problems
MODULE III	**ENGINEERING MATERIALS**
	Polymers-classification with examples, polymerization-addition, condensation and co-polymerization; Plastics: Thermoplastics and thermosetting plastics; Compounding of plastics; Preparation, properties and applications of polyvinyl chloride, Teflon, Bakelite and Nylon-6, 6; Biodegradable polymers. Elastomers: Natural rubber, processing of natural rubber, vulcanization; Buna-s and Thiokol rubber; Lubricants: characteristics of lubricants, mechanism of lubrication – thick film, thin film, extreme pressure lubrication, properties – flash and fire point, cloud and pour point, viscosity and oiliness of lubricants.

MODULE IV	**GREEN CHEMISTRY AND FUELS**
	Introduction: Definition of green chemistry, methods of green synthesis: aqueous phase, microwave method, phase transfer catalyst and ultra sound method. Fuels: definition, classification of fuels ; Solid fuels: coal; analysis of coal: proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Gaseous fuels: Composition, characteristics and applications of LPG and CNG; Calorific value: Gross Calorific value(GCV) and Net Calorific value(NCV), numerical problems.
MODULE V	**NATURAL RESOURCES AND ENVIRONMENTAL POLLUTION**
	Natural resources: Classification of resources, living and nonliving resources; Water resources: Use and over utilization of surface and ground water, floods and droughts, dams, benefits and problems; Land resources; Energy resources: renewable and non-renewable energy sources, use of alternate energy source. Environmental pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution and noise pollution.

TEXTBOOKS

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company, 16th Edition, 2017.
2. Shashi Chawla, “Engineering Chemistry”, Dhanat Rai and Company, 2011, 1st Edition.
3. Prashanth rath, B.Rama Devi, Ch.Venkata Ramana Reddy, Subhendu Chakroborty, Cengage Learning Publishers, 1st Edition, 2018
4. Anubha Kaushik, C.P.Kaushik, “Environmental Studies” New Age International publishers, 4th Edition, 2015.
5. Dr B.N.Srinivas, P.Kishore, K.Subba Rao “Engineering Chemistry” University Science Press,2015,1st Edition.

REFERENCE BOOKS:

1. 1. Dr.Bharathi Kumari, “A text book of Engineering Chemistry”, VGS Book Links, 8th Edition,2016.
2. 2. B. Siva Shankar, “Engineering Chemistry”, Tata McGraw Hill Publishing Limited, 3rd Edition, 2015.
3. 3. S. S. Dara, Mukkanti, “Text of Engineering Chemistry”, S. Chand & Co, New Delhi, 12thEdition, 2006.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO’s	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	W1
CONTENT DELIVERY (THEORY)			
1	Outcome Based Education.		

2	Recall the concept of electro chemical cells.	CO 1	T1:6.1,R1: 2.6
3	Explain the electrode potential, standard electrode potential, electrochemical series and its applications.	CO 2	T1:6.2,R1: 2.9
4	Derive Nernst equation , numerical problems on cell potential.	CO 2	T1:6.5,R1: 2.6.3
5	Demonstate about calomel electrode. Batteries: primary (dry cell).	CO 1	T1: 6.7, R1:2.12
6	Explain the secondary batteries (Lead-acid storage battery), Li-ion battery.	CO 1	T1:6.12,R1: 2.12
7	Recognize the causes and effects of corrosion, chemical corrosion.	CO 1	T1:7.1, R1:2.14
8	Explain the electrochemical corrosion, mechanism of electrochemical corrosion.	CO 1	T1:7.2, R1:2.17
9	Explain about cathodic protection, sacrificial anode and impressed current.	CO 1	T1:7.14, R1:2.20
10	Apply metallic coatings, methods of coatings, hot dipping, galvanizing , tinning and electroplating.	CO 1	T1:7.14,R1: 2.22
11	Recall the hardness of water, causes of hardness.	CO 3	T1:1.3,R1: 1.4
12	Explain the types of hardness, temporary and permanent, units of hardness.	CO 3	T1:1.3,1.5,
13	Estimation of hardness of water by complexometric method,	CO 3	T1:1.5,R1: 1.6.2
14	Estimation of hardness of water by complexometric method.	CO 3	T1:1.14,R1: 1.6.4
15	Define potable water and its specifications, steps involved in treatment of water, disinfection of water by chlorination and ozonization.	CO 3	T1:1.12,R1: 1.6.5
16	Explain about external treatment of water; ion-exchange process.	CO 3	T1:1.11, R1:1.8.1
17	Explain about desalination of water: reverse osmosis.	CO 3	T1:1.13, R1:1.10
18	Recall polymers-classification with examples and Explain about the polymerization-addition, condensation and co- polymerization	CO 4	T1: 3.5,R1: 3.1
19	Explain the concept of compounding of plastics.	CO 4	T1:1.4, R1: 3.1.4
20	Expalin the preparation, properties and applications of polyvinyl chloride, teflon.	CO 4	T1:3.5,R1: 3.2
21	Explain the bakelite and nylon-6, 6.	CO 4	T1: 3.12,R1: 3.2.2
22	Define biodegradable polymers, synthetic biodegradable polymers.	CO 4	T1:3.14,R1: 3.2.3
23	Explain rubbers, natural rubber its process and vulcanization, Buna-s and thiokol rubber.	CO 4	T1: 3.15, R1:3.2.3
24	Elastomers: Synthetic rubbers,Buna-s and thiokol rubber.	CO 4	T1: 3.22, R1:3,3.4

25	Lubricants: characteristics of lubricants, mechanism of lubrication – thick film, thin film, extreme pressure lubrication.	CO 4	T1: 3.24,R1: 3.5
26	Properties–flash and fire point, cloud and pour point, viscosity and oiliness of lubricants.	CO 4	T1: 3.25,R1: 3.7
27	Definition and importance of green chemistry, methods of green synthesis: aqueous phase method.	CO 5	T5:6.8, T2:1.1
28	Explain the microwave method and phase transfer catalyst.	CO 5	T5: 6.8.3,T2: 8.1
29	Explain the ultra sound method.	CO 5	T5: 6.8.3, T2:9.2
30	Define fuels, classification of fuels and characteristics of a good fuels.	CO 5	T1:4.2, R1:6.2.1
31	Explain solid fuels, coal, Analysis of coal, proximate and ultimate analysis.	CO 5	T1:4.4.1, R1:7.1
32	Explain liquid fuels, petroleum and its refining.	CO 5	T1:4.5.2, R1:15.2
33	Explain the gaseous fuels, Composition, characteristics and applications of LPG and CNG.	CO 5	T1:4.6, R1:9.2
34	Apply the concept of calorific value, gross calorific value (GCV) and Net calorific value(NCV) to find calorific value of fuel, numerical problems.	CO 5	T1:4.8, R1:5.2
35	Recall natural resources: classification of resources, living and nonliving resources.	CO 6	T4:2.1
36	Explain the water resources: use and over utilization of surface and ground water, floods and droughts, Dams, benefits and problems.	CO 6	T4:2.2
37	Define energy resources, renewable and non-renewable energy sources.	CO 6	T4:2.3
38	Explain the alternate energy sources, land resources	CO 6	T4:2.5,5.2
39	Define environmental pollution, causes, effects and control of air pollution.	CO 6	T4: 4.2
40	Explain the causes, effects and control of water pollution.	CO 6	T4: 4.6
41	Explain the causes, effects and control of soil pollution and noise pollution.	CO 6	T4:4.12
PROBLEM SOLVING/ CASE STUDIES			
42	Problems on EMF of voltaic cell	CO 2	T1:6.2,R1: 2.9
43	Problems on EMF of a cell	CO 2	T1:6.5,R1: 2.6.3
44	Problems on electrode potential of the half cell by using Nernst equation	CO 2	T1:6.2,R1: 2.9
45	Problems on electrode potential of EMF of the cell by using Nernst equation.	CO 2	T1:6.5,R1: 2.6.3
46	Problems on temporary and permanent hardness in Degree French.	CO 3	T1:1.5, R1: 1.6.2
47	Problems on temporary, permanent and total hardness in ppm	CO 3	T1:1.14,R1: 1.6.4
48	Problems on the temporary, permanent and total hardness of water in Degree Clark.	CO 3	T1:1.5,R1: 1.6.2

49	Problems on the temporary, permanent and total hardness of water in Mg/L.	CO 3	T1:1.14,R1: 1.6.4
50	Problems on the total hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.5,R1: 1.6.2
51	Problems on the permanent hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.14,R1: 1.6.4
52	Problems on the temporary hardness in terms of calcium carbonate equivalents by using EDTA method.	CO 3	T1:1.5,R1: 1.6.2
53	Problems on the higher and lower calorific values of the fuel.	CO 5	T1:4.8, R1:5.2
54	Problems on the gross and net calorific values of the fuel.	CO 5	T1:4.8, R1:5.2
55	Problems on HCV and LCV	CO 5	T1:4.8, R1:5.2
56	Problems on GCV and NCV	CO 5	T1:4.8, R1:5.2
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions & terminology discussion on electrochemistry and corrosion	CO 1	T1:1.3,R1: 1.4
58	Definitions & terminology discussion on water technology	CO 3	T1: 3.5,R1: 3.1
59	Definitions & terminology discussion on engineering	CO 4	T1: 3.5,R1: 3.1
60	Definitions & terminology discussion on green chemistry and fuels	CO 5	T1:4.2, R1:6.2.1
61	Definitions & terminology discussion on natural resources and environmental pollution	CO 1, CO 6	T4:2.1,2.8
DISCUSSION OF QUESTION BANK			
62	Question bank discussion on electrochemistry and Corrosion	CO 1	T1: 6.1, R1:2.12
63	Question bank discussion on water technology	CO 3	T1:1.3, R1: 1.4
64	Question bank discussion on engineering materials	CO 4	T1: 3.5,R1: 3.1
65	Question bank discussion on green chemistry and fuels	CO5	T1:4.2, R1:6.2.1
66	Question bank discussion on natural resources and environmental Pollution	CO 6	T4:2.1,2.8

Course Coordinator: **HOD, DS**
Dr. M S N A Prasad, Associate Professor

COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">Computer Science And Engineering (Data Science)</td></tr>
<tr><td>Course Title</td><td colspan="5">Python Programming</td></tr>
<tr><td>Course Code</td><td colspan="5">ACSC01</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td colspan="5">I CSE-DS</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">UG-20</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>0</td><td>3</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Ms M Siva Swetha Reddy, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course introduces students to write computer programs. This course presents the principles of structured programming using the Python language, one of the most increasingly preferred languages for programming today. Because of its ease of use, it is ideal as a first programming language and runs on both the PC and Macintosh platforms. However, the knowledge gained in the course can be applied later to other languages such as C and Java. The course uses iPython Notebook to afford a more interactive experience. Topics include fundamentals of computer programming in Python,object-oriented programming and graphical user interfaces.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Python Programming	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
33.3 %	Remember
50 %	Understand
16.66 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

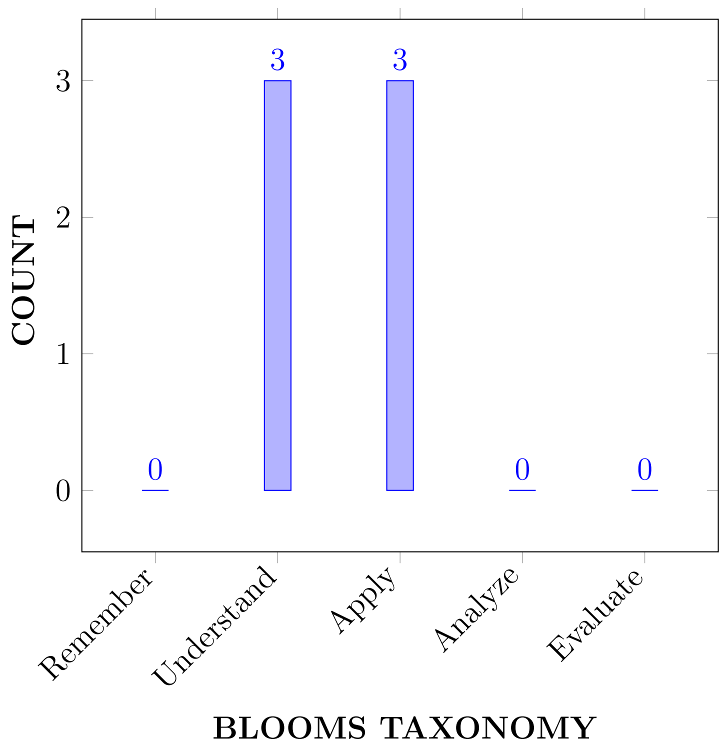
I	Acquire programming skills in core Python
II	Acquire Object-oriented programming skills in Python.
III	Develop the skill of designing graphical-user interfaces (GUI) in Python.
IV	Develop the ability to write database applications in Python.
V	Acquire Python programming skills to move into specific branches - Internet of Things (IoT), Data Science, Machine Learning (ML), Artificial Intelligence (AI) etc .

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** the basic concepts of python programming with the help of data types,operators, expressions, and console input/output.	Understand
CO 2	**Make use of** control statements for altering the sequential execution of programs in solving problems.	Apply
CO 3	**Demonstrate** operations on built-in container data types (list, tuple, set, dictionary) and strings.	Understand
CO 4	**Illustrate** operations and applications on strings with the help of built in functions.	Understand
CO 5	**Solve** the problems by using modular programming concepts through functions.	Apply
CO 6	**Identify** object oriented programming constructs for developing large, modular and reusable real-time programs.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature,and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques,resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3	CIE/SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,and give and receive clear instructions..	2	Tech Talk/Open Ended Experiments/Concept Vedios
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	CIE/SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	Tech talk /Open ended experiments
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3	Tech talk /Open ended experiments

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	✓	-	-	-	-	✓	-	-	✓	-	-
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	-	✓	-	✓
CO 3	✓	-	✓	-	✓	-	-	-	-	-	-	-	✓	-	✓
CO 4	✓	-	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 5	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand (knowledge) the basic concept of operators, precedence of operators and associativity while evaluating mathematical expressions in program statements. These concepts provide an insight into expression evaluation by applying the principles of mathematics and science.	3
CO 1	PO 5	With the help of modern engineering tools we can easily Understand the basic concept of operators, precedence of operators and associativity while evaluating mathematical expressions in program statements These concepts provide an insight into expression evaluation by applying the principles of mathematics and science.	1
CO 1	PO 10	Extend the knowledge of Python programming to communicate effectively with the Engineering community.	1
CO 1	PSO 1	Understand features of procedural as well as object-oriented programming while writing and analyzing computer programs in the areas related to Machine Learning, Big data and Artificial Intelligence	4
CO 2	PO 1	By applying the knowledge of mathematics,science and engineering fundameentals we can effectively use control statements.	3
CO 2	PO 2	Apply control statements in problem indentification,statement and validation .	5
CO 2	PO 3	Apply control statements to investigate and understand different complex engineering problems complex problems efficiently.	8
CO 2	PO 5	By applying control statements to model complex engineering activities	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	3
CO 2	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5
CO 2	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	2
CO 3	PO 1	Summarize indexing and slicing mechanisms for extracting a portion of data in a sequence using principles of mathematics, and engineering fundamentals.	8
CO 3	PO 3	Demonstrate the importance of indexing mechanisms in sequences such as lists, strings, sets, tuple and dictionary while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	6
CO 3	PO 5	Demonstarte lists,tuples and dictionaries With the usage of modern tools	1
CO 3	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	6
CO 3	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	2
CO 4	PO 1	Demonstrate different modules/packages in Python while developing solutions using the fundamentals of mathematics, science, and engineering.	3
CO 4	PO 3	Understand the usage of modules/packages while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	8
CO 4	PO 5	Interpret different string functions by using modern tools	1
CO 4	PO 10	Extend the focus to understand the usage of modules/packages and communicate effectively with the Engineering community .	2
CO 4	PO 12	Summarize string handling functions to implement in project management	7
CO 4	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 4	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 5	P0 1	Make use of parameter passing and different types of arguments in user-defined functions to design efficiently modular programs by applying the knowledge of mathematics, science, Engineering fundamentals.	3
CO 5	P0 2	Apply modular programming concepts for problem identification,formulation and data collection .	8
CO 5	PO 3	Select strong foundation of writing efficient modular programs using parameter passing mechanisms for career building by understanding the requirements and communicating effectively with engineering community.	7
CO 5	PO 5	Develop different functions by using modern tools	1
CO 5	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	6
CO 6	PO 1	Apply scientific principles and methodologies, Mathematical principles and other engineering disciplines for the procedural and object-oriented programming concepts used in Python.	3
CO 6	PO 2	Apply object oriented concepts in problem indentification,statement and validation .	7
CO 6	PO 3	Identify the need of object-oriented concepts while developing solutions for complex engineering problems and design system using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions..	7
CO 6	PO 5	Develop object oriented principles using modern tools	1
CO 6	PO 10	Apply the knowledge of Python programming to communicate effectively with the Engineering community.	2
CO 6	PO 12	Identify the need of object oriented principles for preparation ad ability to engage in independent and lifelong learning	6
CO 6	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	6
CO 6	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	1	-	-	-	-	1	-	-	4	-	-
CO 2	3	5	8	-	1	-	-	-	-	3	-	-	5	-	2
CO 3	3	-	6	-	1	-	-	-	-	-	-	-	6	-	2
CO 4	3	-	8	-	1	-	-	-	-	2	-	7	5	-	2
CO 5	3	8	7	-	1	-	-	-	-	-	-	-	6	-	-
CO 6	3	7	7	-	1	-	-	-	-	2	-	6	6	-	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	3	3	12	5	12	8	6	2	2
CO 1	100	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	20	0.0	0.0	66.6	0.0	0.0
CO 2	100	50	80	0.0	100	0.0	0.0	0.0	0.0	60	0.0	0.0	83.3	0.0	100
CO 3	100	0.0	60	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	100
CO 4	100	0.0	80	0.0	100	0.0	0.0	0.0	0.0	40	0.0	88	83.3	0.0	100
CO 5	100	80	70	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0
CO 6	100	80	70	0.0	100	0.0	0.0	0.0	0.0	40	0.0	75	100	0.0	100

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	-	-	1	-	-	3	-	-
CO 2	3	2	3	-	3	-	-	-	-	3	-	-	3	-	3
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	3	-	3
CO 4	3	-	3	-	3	-	-	-	-	2	-	3	3	-	3
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	3	3	-	3
TOTAL	18	7	15	-	18	-	-	-	-	8	-	6	18	-	12
AVERAGE	3.0	2.3	3	-	3.0	-	-	-	-	2.0	-	3.0	3.0	-	3.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	case studies	-
Assignments	-	Open ended experiments	✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

-	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**Introduction to Python**
	Introduction to Python: Features of Python, History and Future of Python, Working with Python – interactive and script mode, Identifiers and Keywords, Comments, Indentation and Multi-lining, Data types – built-in data types, Operators and Expressions, Console Input/Output, Formatted printing,Built-in Functions, Library Functions.
MODULE II	**DECISION CONTROL STATEMENTS**
	Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s), Basic Loop Structures/ Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops..
MODULE III	**CONTAINER DATA TYPES**
	Lists: Accessing List elements, List operations, List methods, List comprehension; Tuples: Accessing Tuple elements, Tuple operations, Tuple methods, Tuple comprehension, Conversion of List comprehension to Tuple, Iterators and Iterables, zip() function. Sets: Accessing Set elements, Set operations, Set functions, Set comprehension;Dictionaries: Accessing Dictionary elements, Dictionary operations, Dictionary Functions, Nested Dictionary, Dictionary comprehension.s.
MODULE IV	**STRINGS AND FUNCTIONS**
	Strings: Accessing string elements, string properties, string operations. Functions: Communicating with functions, Variable Scope and lifetime, return statement, Types of arguments, Lambda functions, Recursive functions..

MODULE V	**CLASSES AND OBJECTS**
	Classes and Objects – Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self Argument, Class variables and Object variables, init() and de () method, Public and private data members, Built-in Class Attributes, Garbage Collection. OOPs Features:Abstraction, Encapsulation, Inheritance, and Polymorphism.

TEXTBOOKS:

1. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
2. Dusty Philips, "Python 3 Object Oriented Programming", PACKT Publishing, 2nd Edition,2015.

REFERENCE BOOKS:

1. Yashavant Kanetkar, Aditya Kanetkar, "Let Us Python", BPB Publications, 2nd Edition, 2019.
2. Martin C. Brown, "Python: The Complete Reference", Mc. Graw Hill, Indian Edition, 2018.
3. Michael H. Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
4. Taneja Sheetal, Kumar Naveen, "Python Programming – A Modular Approach", Pearson, 1st Edition, 2017
5. Nageswar Rao, "Core Python Programming", Dreamtech Press, 2018.

COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	**Topics to be covered**	**CO's**	**Reference T1: 4.1**
OBE DISCUSSION			
	Discussion on mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to Python: Features of Python, History and Future of Python	CO 1	T1:3.1 –3.3
3-4	Working with Python – interactive and script mode, Identifiers and Keywords, Comments, Indentation and Multi-lining, Databtypes – built-in data types	CO 1	T1:3.4-3.9
5-8	Operators and Expressions	CO 1	T1:3.12
9-10	Console Input/Output, Formatted printing, Built-in Functions, Library Functions	CO 1	T1:3.15
11-14	Control Statement(s)	CO 2	T1: 4.1 –4.8
15-17	Lists and Tuples	CO 3	T1:3.15
18-19	Conversion of List comprehension to Tuple, Iterators and Iterables, zip() function	CO 3	T1:3.15

20-21	Sets, Dictionaries:	CO 3	T1:3.15
22-23	Nested Dictionary, Dictionary comprehension	CO 3	T1:3.15
24-25	Strings: Accessing string elements, string properties, string operations	CO 4	T1: 6.1 –6.8
26-27	Functions: Communicating with functions, Variable Scope and lifetime, return statement	CO 5	T1:5.1 –5.5
28-29	Types of arguments, Lambda functions, Recursive functions	CO 5	T1:5.6 –5.8
30-31	Classes and Objects – Defining Classes, Creating Objects	CO 6	T1 : 9.1 – 9.3
32-33	Data Abstraction and Hiding through Classes, Class Method and self Argument	CO 6	T1: 9.2 – 9.4
34-36	Class variables and Object variables, init() and del () method	CO 6	T1:9.5 – 9.7
37-38	Public and private data members, Built-in Class Attributes, Garbage Collection	CO 6	T1:9.8 – 9.13
39-41	OOPs Features: Abstraction, Encapsulation, Inheritance, and Polymorphism	CO 6	T1:10.1-10.3
PROBLEM SOLVING/ CASE STUDIES			
1	Data Types	CO 1	T1:3.7.1-3.7.4
2	Operators and Expressions	CO 1	T1:3.12.1-3.12.10
3	Built-in Functions , Library functions	CO 1	T1:6.4-6.10
4	Conditional branching Statements	CO 2	T1:4.1-4.2
5	Iterative Statements	CO 2	T1:4.3-4.8
6	Lists	CO 3	T1:8.2-8.2.10
7	Tuples	CO 3	T1:8.4.1
8	Sets	CO 3	T1:8.5.1
9	Dictionaries	CO 3	T1:8.6.1-8.6.12
10	Strings	CO 4	T1:6.1-6.10
11	Functions	CO 5	T1:5.1:5.10
12	Classes and Objects	CO 6	T1:9.1-9.15
13	__init()__and __del__() method	CO 6	T1:9.4-9.6
14	Inheritance	CO 6	T1:10.1-10.4
15	Polymorphism	CO 6	T1:10.2.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Define bound and unbound variable.	CO 1	T1:9.1

2	Define a control structure	CO 2	T1:4.1-4.8
3	How to slice lists in Python	CO 3	T1:8.2-8.6
4	Write the syntax of defining a function	CO 5	T1:5.1-5.2
5	List out the features of object oriented programming.	CO 6	T19.1-9.3
DISCUSSION OF QUESTION BANK			
1	Write the features and applications of Python programming language	CO 1	T1:3.1-3.3
2	Write a program to calculate the roots of a quadratic equation	CO 1	T1:3.5-3.7
3	Write a program to remove all duplicate elements from a list	CO 3	T1:8.2-8.6
4	Write a program that accepts a string from user and redisplays the same string after removing vowels from it	CO 4	T1:6.1-6.3
5	Write a program that has a class Person string name and date of birth (DOB) of a person. The program should subtract the DOB from today's date to find out whether a person is eligible for vote or not	CO 6	T1:9.1-9.3

Course Coordinator **HOD,CSE-DS**
Ms M Siva Swetha Reddy, Assistant Professor

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	**BASIC ELECTRICAL ENGINEERING**				
Course Code	AEEC01				
Program	B.Tech				
Semester	I	Data Science			
Course Type	Foundation				
Regulation	IARE - UG22				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. T Saritha Kumari, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	Linear Algebra and Calculus

II COURSE OVERVIEW:

The Basic Electrical Engineering enables knowledge on electrical quantities such as current, voltage, and power, energy to know the impact of technology in global and societal context. This course provides knowledge on basic DC and AC circuits used in electrical and electronic devices, highlights the importance of transformers, electrical machines in generation, transmission and distribution of electric power, identify the types of electrical machines suitable for particular applications.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Basic Electrical Engineering	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
16.7%	Remember
50%	Understand
33.3%	Apply
0 %	Analyze
0%	Evaluate

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

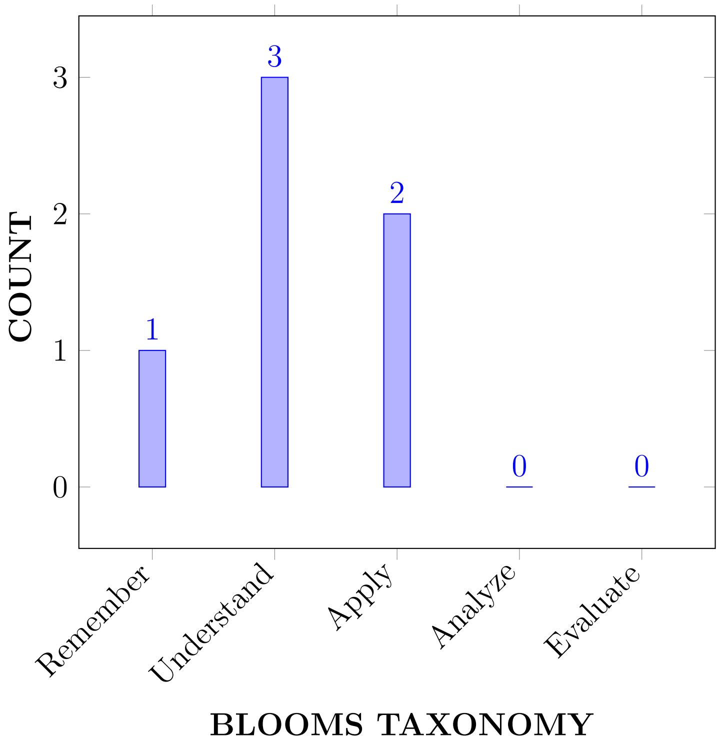
I	The fundamentals of electrical circuits and analysis of circuits with DC excitation using circuit laws.
II	The application of circuit laws in network theorems and graph theory to simplify complex networks.
III	The construction and working principle of DC generator, DC motor, andtypes of DC machines based on field excitation method.
IV	The theory of Faraday's law of mutual induction and working of single phase transformer.
V	The concept of rotating magnetic field and constructional features, principle and types of AC machines.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** complex electrical circuits by applying network reduction techniques for reducing into a simplified circuit.	Apply
CO 2	**Define** basic nomenclature of single phase AC circuits for obtaining impedance, admittance of series and parallel circuits.	Remember
CO 3	**Make use of** various network theorems and graph theory for simplifying complex electrical networks.	Apply
CO 4	**Demonstrate** the construction, principle and working of DC machines for their analysis.	Understand
CO 5	**Illustrate** working , construction and obtain the equivalent circuit of single phase transformers.	Understand
CO 6	**Explore** electromagnetic lawsused for the construction and opertaion of synchronous and asynchronous machines.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
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Program Outcomes	
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IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/AAT
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	**PO 1**	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematics, engineering fundamentals and various source transformation techniques are adopted for solving complex circuits.	3
	PO 2	Derive standard expressions for equivalent resistances, inductances and capacitance by using series-parallel networks i.e mathematical calculations.	1
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs.	1
CO 2	**PO 1**	Make use of Alternating quantity for obtaining form, peak factor concept of impedance and admittance using the knowledge of mathematics, science, and engineering fundamentals.	3
CO 3	**PO 1**	Demonstrate various network theorems in order to determine the same using principles of mathematics, science, and engineering fundamentals.	3
	PO 2	Verify various network theorems for their validation using mathematical calculations.	1
	PSO 1	Simplify complex electrical networks by applying various circuit theorems by using computer programs.	1
CO 4	**PO 1**	The principle of operation and characteristics of DC machines are explained by applying engineering fundamentals including device physics.	3
CO 5	**PO 1**	Understand how classification DC machines are done and their power flow with the knowledge of mathematics and engineering sciences.	3
	PSO 1	Develop equivalent circuit of single phase transformer referred to both sides by developing computer programs.	1
CO 6	**PO 1**	Understand the working of induction motors and alternators using engineering principles and mathematical equations.	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	10	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 4	100	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	25	-	-
CO 6	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	2	-	-	-	-	-	-	-	-	-	-	3	-	-
AVERAGE	3.0	0.3	-	-	-	-	-	-	-	-	-	-	0.5	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO ELECTRICAL CIRCUITS**
	Circuit concept: Ohm's law, Kirchhoff's laws, equivalent resistance of networks, Source transformation, Star to delta transformation, mesh and nodal analysis; Single phase AC circuits: Representation of alternating quantities, RMS, average, form and peak factor, concept of impedance and admittance.
MODULE II	**NETWORK THEOREMS AND NETWORK TOPOLOGY**
	Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum power transfer for DC excitations circuits. Network Topology: Definitions, Graph, Tree, Incidence matrix, Basic Cut Set and Basic Tie Set Matrices for planar networks.
MODULE III	**DC MACHINES**
	DC generators: Principle of operation, construction, EMF equation, types of DC generators. Losses and efficiency. DC motors: Principle of operation, back EMF, torque equation, types of DC motors, Losses and efficiency, numerical problems.
MODULE IV	**SINGLE PHASE TRASNFORMERS**
	Single Phase Transformers: Principle of operation, construction, types of transformers, EMF equation, operation of transformer under no load and on load, Phasor diagrams, equivalent circuit, efficiency, regulation and numerical problems.
MODULE V	**AC MACHINES**
	Three Phase Induction motor: Principle of operation, slip, slip -torque characteristics, efficiency and applications; Alternators: Introduction, principle of operation, constructional features, calculation of regulation by synchronous impedance method and numerical problems.

TEXTBOOKS

1. A Chakrabarti, "Electric Circuits", DhanipatRai and Sons, 6th Edition, 2010.
2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010.
3. V K Mehta, Rohit Mehta, —Principles of electrical engineering, S CHAND, 1st Edition, 2003.
4. A E Fitzgerald and C Kingsley, "Electric Machinery", McGraw Hill Education, 2013.

5. I J Nagrath, DP Kothari, "Electrical Machines", Tata McGraw-Hill publication, 3rd Edition, 2010.

REFERENCE BOOKS:

1. David A Bell, "Electric Circuits", Oxford University Press, 9thEdition,2016.
2. U A Bakshi,Atul P Godse "Basic Electrical and Electronics Engineering" TechnicalPublications, 9thEdition,2016.
3. A Bruce Carlson, "Circuits", Cengage Learning, 1stEdition,2008.
4. M Arshad, "Network Analysis and Circuits", Infinity Science Press, 9thEdition,2016.

WEB REFERENCES:

1. http://www.igniteengineers.com
2. http://www.ocw.nthu.edu.tw
3. http://www.uotechnology.edu.iq

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/computer-science-engineering-autonomous/basic-electrical-engineering

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Electrical Circuits: Basic definitions, Types of elements	CO 1	T1-5.2 to 5.3
3	Ohm's Law, Kirchhoff Laws	CO 1	T1-5.4 to 5.5
4	Series, parallel circuits	CO 2	T1-5.5 to 5.8
5	Derivation for Star-delta and delta-star transformations	CO 2	T1-5.8 to 5.9
6	Mesh analysis and Nodal Analysis	CO 2	T1-5.11 to 5.12
7	Representation of alternating quantities	CO 3	T1-5.14 to 5.15
8	RMS and Average values of an AC signal	CO 2	T1-5.16 to 5.16
9	Form and peak factor, concept of impedance and admittance	CO 2	T1-5.16 to 5.16

10	Superposition theorem for DC excitations circuits	CO 3	T1-6.1 to 6.3
11	Reciprocity theorem for DC excitation	CO 3	T1-6.8 to 6.9
12	Thevenin's theorem for DC excitations circuits	CO 3	T1-6.2 to 6.3
13	Norton's theorem for DC excitations circuits	CO 3	T1-6.3 to 6.4
14	Maximum power transfer theorem for DC excitations circuits	CO 3	T1-11.1
15	Incidence matrix for planar networks	CO 3	T1-11.2 to 11.3
16	Basic Cut Set matrix for planar networks	CO 4	T1-11.2 to 11.3
17	Basic Tie Set matrix for planar networks	CO 3	T1-11.9 to 11.10
18	Principle of operation for DC generators	CO 4	R2-7.1 to 7.2
19	Construction and EMF equation for DC generators	CO 4	R2-7.4
20	Types of DC generators	CO 4	R2-7.3
21	Principle of operation for DC motors	CO 4	R2-7.3.1 to 7.3.2
22	Back EMF, torque equation for DC motors	CO 4	R2-7.3.3 to 7.3.6
23	Types of DC motors	CO 4	R2-7.6
24	Losses and efficiency for DC generators, motors	CO 4	T1-13.1 to 13.3
25	Principle of operation for Single Phase Transformers	CO 5	T1-13.1 to 13.3
26	Construction and EMF equation for Single Phase Transformers	CO 5	T1-13.5 to 13.6
27	Types of transformers and turns ratio	CO 5	T1-13.6 to 13.7
28	Operation of transformer under no load	CO 5	T1-13.7 to 13.9
29	Operation of transformer under on load	CO 5	T1-13.8
30	Equivalent circuit for Transformers	CO 5	T1-17.1 to 17.2
31	Phasor diagrams of transformer	CO 5	T1-17.3 to 17.4
32	Losses of Transformers	CO 5	T1-17.6 to 17.7
33	Efficiency of Transformers	CO 5	T1-13.11
34	Regulation for Transformers	CO 5	T1-13.12
35	Three Phase Induction motor: Principle of operation	CO 5	T1-13.13
36	slip, slip -torque characteristics	CO 6	T1-13.14
37	Efficiency of Induction motor	CO 6	T1-13.16 to 13.18

38	Applications of Induction motor	CO 6	T1-13.19
39	Alternators: Introduction, principle of operation	CO 6	T1-13.19
40	Constructional features	CO 6	T1-13.20
41	Calculation of regulation by synchronous impedance method and numerical problems.	CO 6	T1-13.20
PROBLEM SOLVING/ CASE STUDIES			
42	Numerical Examples on electrical quantities, Ohm's law, KCL, KVL	CO 2	T1-5.8 to 5.9
43	Numerical Examples on series, parallel elements and star to delta transformation and mesh analysis	CO 2	T1-5.5 to 5.8
44	Numerical Examples on nodal analysis and alternating quantities	CO 3	T1-6.8 to 6.9
45	Numerical Examples on Superposition theorem	CO 3	T1-6.2 to 6.3
46	Numerical Examples on reciprocity and maximum power transfer theorems	CO 3	R2-7.1 to 7.2
47	Numerical Examples on Thevenin's and Norton's theorems	CO 3	T1-13.1 to 13.3
48	Numerical Examples on Basic cut set and Tie set matrices	CO 3	T1-13.5 to 13.6
49	Numerical Examples on EMF equation and types of DC generators	CO 4	T1-13.6 to 13.7
50	Numerical Examples on torque equation of DC motor	CO 4	T1-13.1 to 13.3
51	Numerical Examples on types of DC motors	CO 4	T1-13.13
52	Numerical Examples on EMF equation and equivalent circuit of 1 phase transformer	CO 5	T1-13.16 to 13.18
53	Numerical Examples on, efficiency for Transformers	CO 5	T1-13.14
54	Numerical Examples on, regulation for Transformers	CO 5	T1-13.16 to 13.18
55	Numerical Examples on EMF of Alternators	CO 6	T1-13.19
56	Numerical Examples on regulation of Alternators	CO 6	T1-13.20
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions and terminology from basics of electrical circuits	CO 1	T1-5.1 to 5.3
58	Definitions on network theorems	CO 3	T1-6.1 to 6.3
59	Definitions on DC machines	CO 4	R2-7.1 to 7.2
60	Definitions on single phase transformers	CO 5	T1-13.1 to 13.3
61	Definitions on AC machines	CO 6	T1-13.11
DISCUSSION OF QUESTION BANK			
62	Questions from electrical circuits	CO 1	T1-5.1 to 5.3
63	Questions from network theorems	CO 3	T1-6.1 to 6.3

64	Questions from DC machines	CO 4	R2-7.1 to 7.2
65	Questions from single phase transformers	CO 5	T1-13.1 to 13.3
66	Questions from AC machines	CO 6	T1-13.11

Ms. T Saritha Kumari, Assistant Professor **HOD,CSE**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (Data Science)
COURSE DESCRIPTION

Course Title	PYTHON PROGRAMMING LABORATORY				
Course Code	ACSC02				
Program	B.Tech				
Semester	I	CSE-DS			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms K LAXMINARAYANAMMA, Assistant Professor IT				

I COURSE OVERVIEW:
This course introduces students to writing computer programs. This course presents the principles of structured programming using the Python language, one of the most increasingly preferred languages for programming today. Because of its ease of use, it is ideal as a first programming language and runs on both the PC and Macintosh platforms. However, the knowledge gained in the course can be applied later to other languages such as C and Java.The course uses iPython Notebook to afford a more interactive experience. Topics include fundamentals of computer programming in Python, object-oriented programming and graphical user interfaces.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC02	I	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
PYTHON PROGRAMMING LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:
Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	Acquire programming skills in core Python.
II	Acquire Object-oriented programming skills in Python.
III	Develop the skill of designing graphical-user interfaces (GUI) in Python.
IV	Develop the ability to write database applications in Python
V	Acquire Python programming skills to move into specific branches - Internet of Things (IoT), Data Science, Machine Learning (ML), Artificial Intelligence (AI) etc.

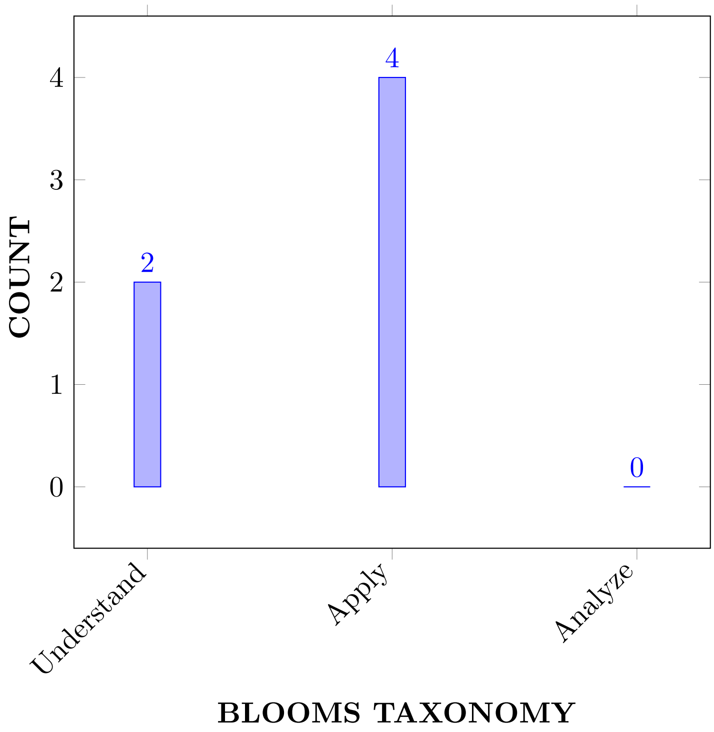
VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** the basic concepts of python programming with the help of data types, operators and expressions, console input/output	Understand
CO 2	**Make use of** control statements for altering the sequential execution of programs in solving problems.	Apply
CO 3	**Demonstrate** operations on built-in container data types (list, tuple, set, dictionary) and strings.	Understand

CO 4	**Make use of** operations and applications on strings with the help of built in functions	Apply
CO 5	**Solve** the problems by using modular programming concepts through functions.	Apply
CO 6	**Identify** object-oriented programming constructs for developing large, modular and reusable real-time programs	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / SEE/ Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE / SEE/ Lab Exercises
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	CIE / SEE/ Lab Exercises

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.		
PSO 2	Focus on improving software reliability, network security or information retrieval systems.		
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	Demonstrate the data types of Python Programming by understating their importance and applicability (apply) in. **solving (complex) engineering problems by applying the principles of Mathematics and Engineering.**	3
	PO 2	Demonstrate the data types of Python Programming **with provided information and data in reaching substantiated conclusions by the interpretation of results.** .	3

	PO 5	Demonstrate the data types,operators,expressions and console I/O of Python Programming **for solving problems with the help of built in functions in Python programming**.	3
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3
CO 2	PO 1	Illustrate the usage of control statements in solving real world problems **by applying principles of Mathematics, Science and Engineering.**	3
	PO 2	Illustrate the usage of control statements in solving real world problems **for visualizing the distribution of data in solving analysis problems.** .	2
	PO 5	Illustrate the usage of control statements along with built in functions of Python programming **for visualizing distribution of data with the help of built in function in Python programming language** .	3
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	3
CO 3	PO 1	Illustrate the operations on built in container data types and strings **by applying the principles of Mathematics, Science and Engineering.** .	3
	PO 2	Illustrate the operations on built in container data types and strings in solving (complex) data centric engineering problems **from the provided information and substantiate with the interpretation of variations in the results.** .	3
	PSO 3	Implement the Python Programming basics **by exploring data analysis to solve complex problems.** .	3
CO 4	PO 1	Conclude the insights of data using exploratory data analysis **by applying the principles of Mathematics, Science and Engineering.**.	3
	PO 5	Define the list of operations on strings using built in functions **Find the different ways to model data and understand the limitations.**.	2
	PSO 3	Implement all string related operations using Python Programming programming **by exploring data limitations for generating predictions.** .	3
CO 5	PO 1	Apply the Modular Approach real world problems **by understanding the concepts of functions and code reusability**.	3
	PO 3	Understand the given problem statement and formulate (complex) engineering system **for developing a modular approach in solving problems that meet specified needs**.	2
	PO 5	Make use of functions **for creating the concept of code reusability**.	3

	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3
CO 6	PO 1	Apply the knowledge of **engineering fundamentals**, and an **Mathematics and Engineering fundamentals principles to create a object oriented model on real time problems**.	3
	PO 3	Apply object oriented and modular concepts on **solving real world problems** reaching **and reusable conclusions**.	3
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				PROGRAM OUTCOMES		
	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 3
CO 1	2		2	3			3
CO 2	3		3				3
CO 3	3	2	3				3
CO 4	3		3				3
CO 5	3	2	3				3
CO 6	3	2	3				3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK 1	**OPERATORS**
	a.Read a list of numbers and write a program to check whether a particular element is present or not using membership operators. b. Read your name and age and write a program to display the year in which you will turn 100 years old c. Read radius and height of a cone and write a program to find the volume of a cone d.Write a program to compute distance between two points taking input from the user (Hint: use Pythagorean theorem)
WEEK 2	**CONTROL STRUCTURES**
	a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if…elif…else statement. b. Write a program to create and display a dictionary by storing the antonyms of words. Find the antonym of a particular word given by the user from the dictionary using while loop c. Write a Program to find the sum of a Series 1/1! + 2/2! + 3/3! + 4/4! +.......+ n/n!. (Input :n = 5, Output : 2.70833)
WEEK 3	**LIST**
	a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5). b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24) c. Read a list of numbers and print numbers present in odd index position. (Ex: [10, 25, 30, 47, 56, 84, 96], The numbers in odd index position: 25 47 84) d. Read a list of numbers and remove the duplicate numbers from it. (Ex: Enter a list with duplicate elements: 10 20 40 10 50 30 20 10 80, The unique list is: [10, 20, 30, 40, 50, 80])
WEEK 4	**TUPLE**
	a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. testlist = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)] b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: testlist = [(”GFG”, ”IS”, ”BEST”), (”GFg”, ”AVERAGE”), (”GfG”,), (”Gfg”, ”CS”)], Output : [(”GFG”, ”IS”, ”BEST”)]) c. Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input : tuple = (’a’, ’a’, ’c’, ’b’, ’d’), list = [’a’, ’b’], Output : 3)
WEEK 5	**SET**

	a.Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x). b.Write a program to perform union, intersection and difference using Set A and Set B. c.Write a program to count number of vowels using sets in given string (Input : "Hello World", Output: No. of vowels : 3) d.Write a program to form concatenated string by taking uncommon characters from two strings using set concept (Input : S1 = "aacdb", S2 = "gafd", Output : "cbgf").
WEEK 6	**DICTIONARY**
	a. Write a program to do the following operations: i. Create a empty dictionary with dict() method ii. Add elements one at a time iii. Update existing key's value iv. Access an element using a key and also get() method v. Deleting a key value using del() method b. Write a program to create a dictionary and apply the following methods: i. pop() method ii. popitem() method iii. clear() method c.Given a dictionary, write a program to find the sum of all items in the dictionary
WEEK 7	**STRINGS**
	a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward. b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'. c. Write a program to read a line of text and remove the initial word from given text. (Hint: Use split() method, Input : India is my country. Output : is my country) d. Write a program to read a string and count how many times each letter appears. (Histogram)
WEEK 8	**USER DEFINED FUNCTIONS**
	a. A generator is a function that produces a sequence of results instead of a single value. Write a generator function for Fibonacci numbers up to n. b.Write a function mergedict(dict1, dict2) to merge two Python dictionaries. c.Write a fact() function to compute the factorial of a given positive number. d.Given a list of n elements, write a linearsearch() function to search a given element x in a list.
WEEK 9	**BUILT-IN FUNCTIONS**

	a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library b. Write a program to demonstrate the working of built-in trignometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module c. Write a program to demonstrate the working of built-in Logarithmic and Power functions exp(), log(), log2(), log10(), pow() by importing math module.
WEEK 10	**CLASS AND OBJECTS**
	a.Write a program to create a BankAccount class. Your class should support the following methods for i) Deposit ii) Withdraw iii) GetBalanace iv) PinChange b.Create a SavingsAccount class that behaves just like a BankAccount, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint:use Inheritance). c.Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employeeinfo() method and also using dictionary dict. d.Access modifiers in Python are used to modify the default scope of variables. Write a program to demonstrate the 3 types of access modifiers: public, private and protected.
WEEK 11	**MISCELLANEOUS PROGRAMS**
	Write a program to find the maximum and minimum K elements in Tuple using slicing and sorted() method (Input: testtup = (3, 7, 1, 18, 9), k = 2, Output: (3, 1, 9, 18)) b. Write a program to find the size of a tuple using getsizeof() method from sys module and built-in sizeof() method c.Write a program to check if a substring is present in a given string or not d. Write a program to find the length of a string using various methods: i. Using len() method ii. Using for loop and in operator iii. Using while loop and slicing
WEEK 12	**ADDITIONAL PROGRAMS - FILE HANDLING**
	a. Write a program to read a filename from the user, open the file (say firstFile.txt) and then perform the following operations: i. Count the sentences in the file. ii. Count the words in the file. iii. Count the characters in the file. b. Create a new file (Hello.txt) and copy the text to other file called target.txt. The target.txt file should store only lower case alphabets and display the number of lines copied c.Write a Python program to store N student's records containing name, roll number and branch. Print the given branch student's details only.

TEXTBOOKS

1. Michael H Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, "Let us Python", BPB publication, 1st Edition, 2019

3. Ashok Kamthane, Amit Kamthane, “Programming and Problem Solving with Python”, McGraw Hill Education (India) Private Limited, 2018.
4. Taneja Sheetal, Kumar Naveen, “Python Programming – A modular approach”, Pearson, 2017

REFERENCE BOOKS:

1. www.oikostat.ch.
2. https://realpython.com/python3-object-oriented-programming//
3. https://python.swaroopch.com/oop.html#syllabus.
4. https://python-textbok.readthedocs.io/en/1.0/ObjectOrientedProgramming.html/

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Operators	CO 1	R1: 1
2	Control structures	CO 1	R3: 2
3	List	CO 2	R1: 7
4	Tuple	CO 2	R1: 8
5	Set	CO 3	R1: 2.4
6	Dictionary	CO 3	R1: 9
7	Strings	CO 4	R1: 10
8	User Defined Functions	CO 4	R3: 15
9	Built in Functions	CO 5	R1: 9
10	Class and Objects	CO5	R1: 10
11	Miscelaneous Programs	CO 6	R4:7
12	Additionaal programs - File Handling	CO 6	R4:10

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Python program to Right rotate a numpy array to n.
2	Python program to multiply all elements in a Dictionary.
3	Python Program to put positive and negative numbers in a seperate list.
4	Python program to remove given key from a Dictionary.

Signature of Course Coordinator **HOD, CSE(DS)**
Ms K LAXMINARAYANAMMA, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE ENGINEERING (DS)
COURSE DESCRIPTION

Course Title	**BASIC ELECTRICAL ENGINEERING LABORATORY**				
Course Code	AEEC04				
Program	B.Tech				
Semester	I	CSE/CSE(AI&ML)/CSE(CS)/CS&IT/CSE(DS)/IT			
Course Type	Foundation				
Regulation	IARE - R20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr V Chandra Jagan Mohan, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHSC02	I	Linear ALgebra and Calculus

II COURSE OVERVIEW:

The objective of the Basic Electrical Engineering Laboratory lab is to expose the students to the electrical circuits and give them experimental skill. The purpose of lab experiment is to continue to build circuit construction skills using different circuit element. It provides hands-on experience by examining the electrical characteristics of various AC and DC machines.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Basic Electrical Engineering Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

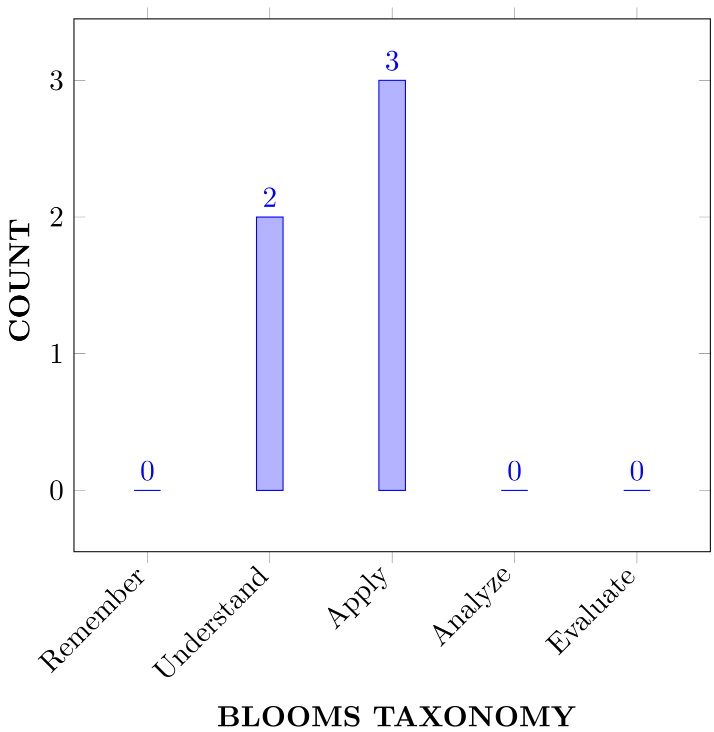
I	Implement different circuits and verify circuit concepts for DC circuits.
II	Measure the impedance of series RL, RC and RLC circuits.
III	Prove the various theorems used to reduce the complexity of electrical network.
IV	The operation and characteristics of AC machines and DC machines.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Solve** the electrical circuit source resistance, currents, voltage and power by applying various network reduction techniques.	Apply
CO 2	**Apply** various network theorems to reduce complex network into simple equivalent network with DC excitation.	Apply
CO 3	**Examine** the alternating quantities for different periodic wave forms and the impedance of series RC, RL and RLC circuits.	Understand
CO 4	**Apply** magnetization characteristics of dc shunt generator for calculating the critical resistance and speed control methods and performance characteristics of DC Shunt machine for efficiency.	Apply
CO 5	**Examine** the performance of single-phase transformers, induction motors and alternator by calculating efficiency and regulation .	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Laboratory experiments internal and external lab exam

PO 9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Laboratory experiments internal and external lab exam
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Laboratory experiments internal and external lab exam
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change		

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	-	-

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using **knowledge of mathematics, science and engineering fundamentals.**and various source transformation techniques are adopted for solving complex circuits.	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving the circuits**	3
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving the circuits**.	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving the circuits**.	3
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits**.	3

	PSO 1	Solve complex electrical circuits by applying basic circuit concepts **by using computer programs.**	1
CO 2	PO 1	Demonstrate the various network theorems in order to determine the same **using principles of mathematics, science and engineering fundamentals.**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in solving complex circuits by using theroems**	3
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in solving complex circuits by using theroems**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in solving complex circuits by using theroems**	3
	PO 12	The preparation and ability to engage in independent and life-long learning in the broadest context of technological change **in solving the circuits by using theroems**	3
	PSO 1	Simplify complex electrical networks by applying various circuit theorems **by using computer programs.**	1
CO 3	PO 1	Understand the concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits by **knounderstanding and applying the fundamentals of mathematics, science and engineering.**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuit**	3
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in understanding concept of alternating quantities with peak, average and root mean square values for different periodic wave forms and impedance of series RC,RL and RLC circuits**	3
CO 4	PO 1	Apply (knowledge) magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine by **analyzing complex engineering problems using the principles of mathematics, engineering science.**	3

	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	3
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **in applying magnetization characteristics DC shunt generator and performance characteristics of DC shunt machine**	3
CO 5	PO 1	Understand the performance characteristics of transformer, Imduction motors and alternator by using principles of **mathematics and engineering science**	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **by understanding the performance characteristics of transformer, Imduction motors and alternator**	3
	PO 9	Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **by understanding the performance characteristics of transformer, Imduction motors and alternator**	3
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society **by understanding the performance characteristics of transformer, Imduction motors and alternator**	3
	PSO 1	Understand the performance characteristics of transformer, Imduction motors and alternator **by using computer programs.**	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES					PROGRAM SPECIFIC OUTCOMES
	PO 1	PO 8	PO 9	PO10	PO12	PSO1
CO 1	3	3	3	3	3	1
CO 2	3	3	3	3	3	1
CO 3	3	3	3	3		
CO 4	3	3	3	3		
CO 5	3	3	3	3		1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**OHM'S LAW, KVL AND KCL**
	Verification of Ohm's, Verification of Kirchhoff's current law and Voltage law using hardware and digital simulation.
WEEK II	**MESH ANALYSIS**
	Determination of mesh currents using hardware and digital simulation
WEEK III	**NODAL ANALYSIS**
	Measurement of nodal voltages using hardware and digital simulation.
WEEK IV	**IMPEDANCE OF SERIES RL AND RC CIRCUIT**
	Examine the impedance of series RL and RC circuit using hardware and digital simulation
WEEK V	**IMPEDANCE OF SERIES RLC CIRCUIT**
	Measure the impedance of series RLC Circuit using hardware and digital simulation.
WEEK VI	**SINGLE PHASE AC CIRCUITS**
	Determination of average value, RMS value, form factor, peak factor of sinusoidal wave using digital simulation.
WEEK VII	**SUPERPOSITION AND MAXIMUM POWER TRANSFER THEOREM**
	Verification of superposition and maximum power transfer theorem using hardware and digital simulation.
WEEK VIII	**THEVENIN'S AND NORTON'S THEOREM**
	Verification of Thevenin's and Norton's theorem using hardware and digital simulation.
WEEK IX	**SWINBURNE'S TEST**
	Predetermination of efficiency of DC shunt machine.

WEEK X	**MAGNITETIZATION CHARACTERISTICS**
	Determine the critical field resistance from magnetization characteristics of DC shunt generator.
WEEK XI	**BRAKE TEST ON DC SHUNT MOTOR**
	Study the performance characteristics of DC shunt motor by brake test
WEEK XII	**SPEED CONTROL OF DC SHUNT MOTOR**
	Verify the armature and field control techniques of DC shunt motor.
WEEK XIII	**OPEN CIRCUIT AND SHORT CIRCUIT TEST ON SINGLE PHASE TRANSFORMER**
	Determination of losses and efficiency of single-phase transformer.
WEEK XIV	**SYNCHRONOUS IMPEDENCE METHOD**
	Determine the regulation of alternator using synchronous impedance method.

TEXTBOOKS

1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 20103
2. P S Bimbhra, "Electrical Machinery", Khanna Publishers, 1 st Edition,2011.

REFERENCE BOOKS:

1. A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2006.
2. K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013.
3. Etter, "Introduction to MATLAB 7", Pearson Education, 1st Edition, 2008.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Verification of Ohm's, Verification of Kirchhoff's current law and voltage law using hardware.	CO 1	T1:1.1
2	Determination of mesh currents using hardware.	CO 2	T1:2.1
3	Measurement of nodal voltages using hardware.	CO 2	T1:2.4
4	Examine the impedance of series RL and RC circuit.	CO 3	T1:6.1
5	Measure the impedance of series RLC Circuit using hardware.	CO 3	T1:4.6
6	Determination of average value, RMS value, form factor, peak factor of sinusoidal wave.	CO 3	T1:5.1
7	Verification of superposition and maximum power transfer theorem using hardware and digital simulation.	CO 2	R3: T1:4.1
8	Verification of Thevenin's and Norton's theorem using hardware.	CO 2	T1:4.7
9	Predetermination of efficiency of DC shunt machine.	CO 4	T2:4.11

10	Determine the critical field resistance from magnetization characteristics of DC shunt generator.	CO 4	T2:4.11
11	Study the performance characteristics of DC shunt motor by brake test.	CO 4	T2:4.12
12	Speed control of DC shunt motor.	CO 4	T2:4.14
13	Determination of losses and efficiency of single-phase transformer.	CO 5	T2:1.1
14	Determine the regulation of alternator using synchronous impedance method.	CO 5	T2:5.4

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Verification of reciprocity theorem..
2	Determination of efficiency by load test in DC shunt generator.
3	Determination of efficiency by load test on DC series generator.
4	Determination of efficiency by load test on DC compound generator.
5	Determination of efficiency by load test on a single-phase transformer

Signature of Course Coordinator **HOD,DS**
Dr V Chandra Jagan Mohan, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DS)
COURSE DESCRIPTION

Course Title	**ENGINEERING WORKSHOP PRACTICE LABORATORY**				
Course Code	AMEC02				
Program	B.Tech				
Semester	I & II				
Course Type	Foundation				
Regulation	IARE-UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	1
Course Coordinator	Mr.B.Vijaya Krishna, Assistant Professor.				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC04	I & II	-

II COURSE OVERVIEW:

Engineering workshop Practice is intended to enhance the learning experience of the student about Engineering tools for cutting and measuring used in a workshop. Students are expected to gain experience in hands on training as well as knowledge to carry out a particular process for making a product using the basic manufacturing devices used in Workshop.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Engineering Workshop Practice Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	To test the preparedness for the experiment.	-
20 %	To test the performance in the laboratory.	-
20 %	To test the calculations and graphs related to the concern experiment.	-
20 %	To test the results and the error analysis of the experiment.	-
20 %	To test the subject knowledge through viva – voce.	-

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

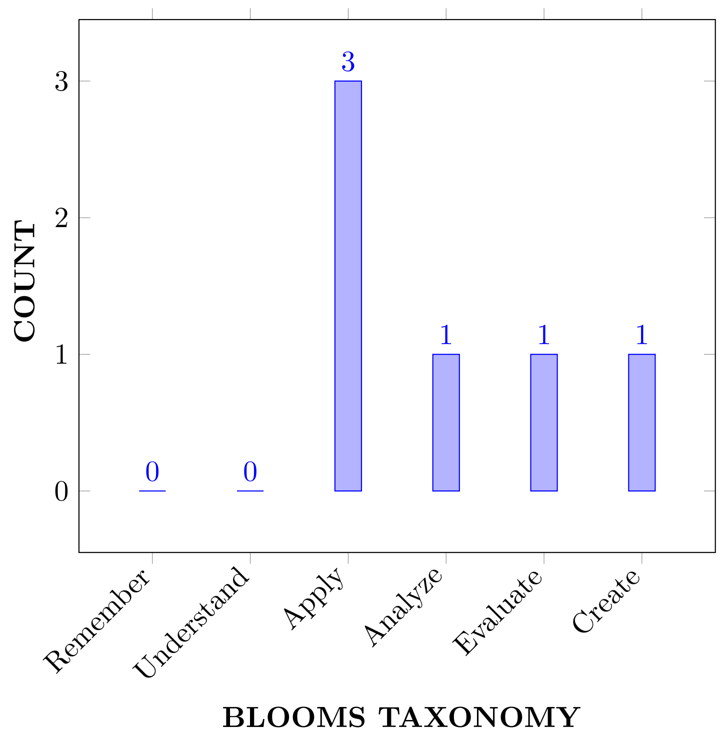
I	Use of common instruments including measuring, marking and cutting tools in various types of manufacturing processes.
II	Basic manufacturing concepts used in carpentry, fitting, black-smithy and tin-smithy.
III	Demonstrating skills by converting electrical circuit's diagrams into electrical wiring.
IV	Compare experimental results with diagrammatic measurements and to determine the source of any apparent differences.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Identify** the ability to work from drawings and blueprints and demonstrate proficiency with hand tools common to carpentry.	Apply
CO 2	**Determine** the ability to Produce Fitting jobs as per specified dimensions in addition to demonstrating proficiency with hand tools common to fitting.	Evulate
CO 3	**Create** works of metal art using fire and furnace to convert given shape into useable elements using basic blacksmith techniques .	Create
CO 4	**Organisze** the moulding techniques for producing casting of different and complex shapes using various patterns.	Apply
CO 5	**Develop** various engineering and household articles such as tin boxes, cans, funnels, ducts etc., from a flat sheet of metal.	Apply
CO 6	**Compare** various wiring diagrams using conduit system of wiring and Prepare different types of wiring joints on the given circuit boards using appropriate electrical tools.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Lab Experiments / CIE / SEE
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Lab Experiments / CIE / SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	2	Lab Experiments / CIE / SEE
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	Lab Experiments / CIE / SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions. / CIE / SEE		

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	✓	-	✓	-	-	-	-	-	✓	-	-	-	✓
CO 2	✓	-	-	-	✓	-	-	-	-	-	✓	-	-	-	✓
CO 3	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	✓
CO 4	✓	-	✓		-	-	-	-	-	-	✓	-	-	-	-
CO 5	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-
CO 6	✓	-	-	-	✓	-	-	-	-	-	✓	-	-	-	✓

XII JUSTIFICATIONS FOR CO – PO / PSO) MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies matched.
CO 1	PO 1	Apply the knowledge of **engineering fundamentals** to join given wooden pieces according to given sketch to develop required joint..	1
	PO 3	Conversion of given design into a practical output using design solution for **complex engineering problems** and **design system components**.	2
	PO 5	Develop the given **resources and engineering tools** into proper fitment as given in the diagrammatical representation .	2
	PO 11	**Demonstrate** knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in **multidisciplinary environments.** .	2
	PS03	Make use of **Experimental tools** for Building Career Paths towards **Innovation Startups**, Employability in different mechanical trades.	2
CO 2	PO 1	the knowledge of **engineering fundamentals**to join given metal pieces according to given sketch to develop required joint.	1
	PO 5	Develop the given **resources and engineering tools** into proper fitment as given in the diagrammatical representation..	2
	PO 11	**Demonstrate** knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
	PSO 3	Make use of **Experimental tools** for Building Career Paths towards **Innovation Startups**, Employability in different mechanical trades.	2
CO 3	PO 1	Apply the knowledge of **engineering fundamentals** to make metal rod into given required shape according to given sketch to develop required joint.	1
	PO5	Develop the given **resources and engineering tools**into required shape as given in the diagrammatical representation..	2
	PSO3	Make use of **Experimental tools** for Building Career Paths towards **Innovation Startups**, Employability in different mechanical trades..	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies matched.
CO 4	PO 1	Apply the knowledge of **engineering fundamentals** to make the casting product from given materials according to given sketch to develop required shape..	1
	PO 3	Conversion of given design into a practical output using design solution for **complex engineering problems and design system components**.	2
	PO11	**Demonstrate** knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in **multidisciplinary environments.**.	2
CO 5	PO 5	Develop the given **resources and engineering tools** into required shape as given in the diagrammatical representation	2
	PO 11	**Demonstrate**knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in **multidisciplinary environments** .	2
CO 6	PO 1	Apply the knowledge of **engineering fundamentals** to make the required electrical connection according to given circuit diagram to develop connection..	1
	PO 5	Develop the given **resources and engineering tools** into proper fitment as given in the diagrammatical representation.	2
	PO 11	**Demonstrate** knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in **multidisciplinary environments.**	2
	PSO 3	Make use of **Experimental tools** for Building Career Paths towards Innovation Startups, Employability in different mechanical trades. .	2

Note: For Key Attributes refer **Annexure - I**

XIII MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**8**	**5**	**11**	**7**
CO 1	1	-	2	-	2	-	-	-	-	-	2	-	-	-	2
CO 2	1	-	-	-	2	-	-	-	-	-	2	-	-	-	2
CO 3	1	-	2	-	-	-	-	-	-	-	-	-	-	-	2
CO 4	1	-	2	-	-	-	-	-	-	-	2	-	-	-	-
CO 5	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-
CO 6	1	-	-	-	2	-	-	-	-	-	2	-	-	-	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO–(PO / PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**8**	**5**	**11**	**7**
CO 1	33.3	-	20	-	100	-	-	-	-	-	16.6	-	-	-	66.6
CO 2	33.3	-	-	-	100	-	-	-	-	-	-	-	-	-	66.6
CO 3	33.3	-	20	-	100	-	-	-	-	-	-	-	-	-	66.6
CO 4	33.3	-	20	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 5	-	-	-	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 6	33.3	-	-	-	100	-	-	-	-	-	16.6	-	-	-	66.6

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - 0≤ C<5% – No correlation
1 -5 <C< 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% < C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	3	-	-	-	-	-	1	-	-		3
CO 2	1	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO 3	1	-	1	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	1	-	1	-	3	-	-	-	-	-	1	-	-	-	-
CO 5	1	-	-	-	3	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	3	-	-	-	-	-	1	-	-	-	3

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
TOTAL	**6**	**0**	**3**	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**12**
AVERAGE	**1**	**0**	**1**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**3**

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

WEEK-I	**CARPENTRY-I**
	Batch I: Preparation of Tenon joint as per given dimensions. Batch II: Preparation of Mortise joint as per given taper angle.
WEEK-II	**CARPENTRY-II**
	Batch I: Preparation of dove tail joint as per given taper angle. Batch II: Preparation of lap joint as per given dimensions.
WEEK-III	**FITTING - I**
	Batch I: Make a straight fit for given dimensions. Batch II: Make a square fit for given dimensions.
WEEK-IV	**FITTING - II**
	Batch I: Make a V fit for given dimensions. Batch II: Make a semicircular fit for given dimensions.
WEEK-V	**BLACKSMITHY- I**
	(Batch I: Prepare S-bend for given MS rod using open hearth furnace. Batch II: Prepare J-bend for given MS rod using open hearth furnace.
WEEK-VI	**BLACKSMITHY- II**
	Batch I: Prepare Fan hook for given dimensions. Batch II: Prepare Round to Square for given dimensions.
WEEK-VII	**MOULD PREPARATION-I.**
	Batch I: Prepare a wheel flange mould using a given wooden pattern. Batch II: Prepare a bearing housing using an aluminum pattern.
WEEK-VIII	**MOULD PREPARATION-II**

	Batch I: Prepare a bearing housing using an aluminum pattern. Batch II: Prepare a wheel flange mould using a given wooden pattern.
WEEK-IX	**TINSMITHY- I**
	Batch I: Prepare the development of a surface and make a rectangular tray for given dimensions. Batch II: Prepare the development of a surface and make a round tin for given dimensions.
WEEK-X	**TINSMITHY- II**
	Batch I: Prepare the development of a surface and make a Square Tin, for given dimensions. Batch II: Prepare the development of a surface and make a Conical Funnel for given dimensions.
WEEK-XI	**ELECTRICAL WIRING-I**
	Batch I: Make an electrical connection of two bulbs connected in series. Batch II: Make an electrical connection of two bulbs connected in parallel.
WEEK-XII	**ELECTRICAL WIRING-II**
	Batch I: Make an electrical connection of one bulb controlled by two switches connected. Batch II: Make an electrical connection of tube light.

REFERENCE BOOKS:

1. Gowri P. Hariharan, A. Suresh Babu," Manufacturing Technology – I", Pearson Education, 2018.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", Prentice Hall India, 4th Edition, 2018.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2019.
4. Workshop technology by K.L.Narayana, 2020.

WEB REFERENCE BOOKS:

http://www.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Tenon joint and Mortise joint.	CO 1	R1:11.1-11.5
2	Dove tail joint and Lap joint.	CO 2	R1:11.1-11.5
3	Straight fit and Square fit.	CO 3	R1:4.8 , R1:7.2
4	V fit and Semicircular fit.	CO 4	R1:4.8 , R1:7.2

5	S-bend and J-bend.	CO 3	R2:10.4 , R2:7.2
6	(a)Fan and Round to Square shape.	CO 4	R2:10.4 , R1:7.2
7	Wheel flange and bearing housing.	CO 4	R2:10.4 , R1:7.2
8	Bearing housing and Wheel flange .	CO 5	R1:8.2-8.5
9	(Rectangular tray and Round tin.	CO 5	R1:11.1-11.5
10	Make a Square Tin and Conical Funnel.	CO 5	R1:10.1 , R1:10.2
11	Series connection and parallel Connection.	CO 6	R1:11.1-11.5
12	One bulb controlled by two switches and tube light connection..	CO 6	R3:3.12 , R1:12.7

XX EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Connecting & Verifying Bell Circuit through House wiring trade.
2	Making of semitriangular fit using fitting trade.
3	Making of star shape using blacksmithy trade.
4	Preparation of hexognal tin using tinsmithy trade.
5	Preparation of dumbell shape using .

Course Coordinator **HOD,CSE(DS)**
Mr. B.VijayaKrishna, Assistant Professor

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions	**10**

	5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**

PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project.	**12**

	6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	
PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**
PO 11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**

PO 12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

KEY ATTRIBUTES FOR ASSESSING PROGRAM SPECIFIC OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PSO1	Formulate and evaluate engineering concepts of design, thermal and production to provide solutions for technology aspects in digital manufacturing.	**3**
PSO2	Formulate and Evulate the concept of thermo fluid.	**3**
PSO3	Make use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	**3**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	**ENGLISH**				
Course Code	AHSC01				
Program	B. Tech				
Semester	I				
Course Type	Foundation				
Regulation	UG-22				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	2	-	2	-	-
Course Coordinator	Ms.Waheeda Begum Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The principle aim of the course is that the students will have awareness about the importance of English language in the contemporary times and also it emphasizes the students to learn this language as a skill (listening skill, speaking skill, reading skill and writing skill). Moreover, the course benefits the students how to solve their day-to-day problems in speaking English language. Besides, it assists the students to reduce the mother tongue influence and acquire the knowledge of neutral accent. The course provides theoretical and practical knowledge of English language and it enables students to participate in debates about informative, persuasive, didactic, and commercial purposes.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
English	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	LCD / PPT	x	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
37%	Remember
63 %	Understand
-	Apply
-	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

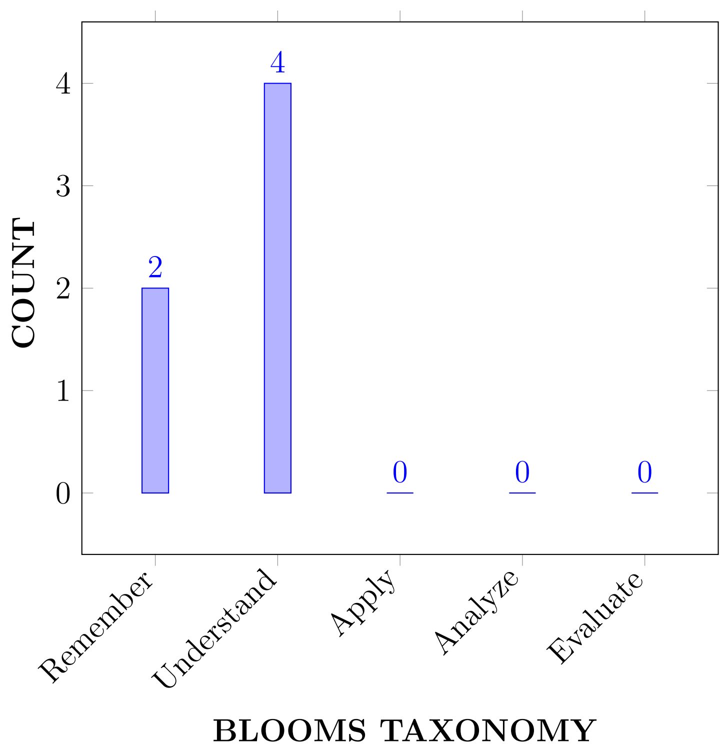
I	Standard pronunciation, appropriate word stress, and necessary intonation patterns for effective communication towards achieving academic and professional targets.
II	Appropriate grammatical structures and also using the nuances of punctuation tools for practical purposes.
III	A critical aspect of speaking and reading for interpreting in-depth meaning between the sentences.
IV	A conceptual awareness on writing in terms of unity, content, coherence, and linguistic accuracy.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the key requirements of listening skills for personal , academic and professional purposes.	Remember
CO 2	**Interpret** soutable speaking techniques and strategies to understand the core idea of a subject clearly.	Understand
CO 3	**Illustrate** permissible language for developing life skills to overcome the challenges at professional platform.	Understand
CO 4	**Classify** the grammatical aspects effectively in speaking and writing at functional usage.	Understand
CO 5	**Describe** the significance of reading skills and various strategies to enhance professional success.	Remember
CO 6	**Compare** the writing skills for accomplishing the academic and non-academic demands of various written communicative functions.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 10	**Communication :** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication). “Students should demonstrate the ability to communicate effectively in writing / Orally.” 1. Clarity (Writing); 2. Grammar/Punctuation (Writing); 3. References (Writing); 4. Speaking Style (Oral); 5. Subject Matter (Oral).	5	Seminar/ Conferences/ Research Papers IE/AAT / Discussion

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO’S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 10	Discuss the heeds of functional grammar and punctuation tools in speaking and writing by generating the clarity of an audio text.	5
CO 2	PO 10	Illustrate essential aspects of grammar as well as punctuation marks for speaking or writing towards a discussion on a topic to give the clarity.	5
CO3	PO 10	Choose suitable grammatical structures and punctuation marks at speaking and writing areas maintaining clarity at professional platform.	5
CO4	PO 10	Interpret the grammatical knowledge and punctuation marks systematically towards providing the clarity in speaking and writing.	5
CO5	PO 10	Demonstrate the role of grammar and punctuation marks understanding the meaning between the sentences as well as paragraphs in speaking or writing for a clarity.	5
CO6	PO 10	Describe the clarity of grammatical usage and the obligation of punctuation marks in speaking and writing.	5

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 4	-	-	-	-		-	-	-	-	5	-		-	-	-
CO 5	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	5	-		-	-	- -

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	100	-		-	-	-
CO 2	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 3	-		-	-	-	-	-	-	-	100	-	-	-	-	-
CO 4	-	-	-	-		-	-	-	-	100	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	100	-	-	- -	-	-
CO 6	-	-	-	-		-	-	-	-	100	-		-	-	- -

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $<C\leq 40\%$ – Low/ Slight
2 - 40 % $<C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	
CO 2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-
AVERAGE	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	✓
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**GENERAL INTRODUCTION AND LISTENING SKILL**
	Introduction to communication skills; Communication process; Elements of communication; Soft skills vs. hard skills; Importance of soft skills for engineers; Listening skills; Significance; Stages of listening; Barriers and effectiveness of listening; Listening comprehension.
MODULE II	**SPEAKING SKILL**
	Significance; Essentials; Barriers and effectiveness of speaking; Verbal and non-verbal communication. Generating talks based on visual prompts; Public speaking; Exposure to structured talks; Addressing a small group or a large formal gathering; Oral presentation; Power point presentation.
MODULE III	**VOCABULARY AND GRAMMAR**
	The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms; Antonyms; Standard abbreviations; Idioms and phrases; One-word substitutes Sentence structure; Uses of phrases and clauses; Punctuation; Subject verb agreement; Modifiers; Articles; Prepositions.
MODULE IV	**READING SKILL**
	Significance, Techniques of reading, Skimming-Reading for the gist of a text, Scanning - Reading for specific information, Intensive, Extensive reading, Reading comprehension, Reading for information transfer, Text to diagram, Diagram to text.
MODULE V	**WRITING SKILL**
	Significance; Effectiveness of writing; Organizing principles of Paragraphs in documents; Writing Introduction and conclusion; Techniques for writing precisely, Letter writing; Formal and Informal letter writing, E-mail writing, Report Writing.

TEXTBOOKS

1. Handbook of English (Prepared by the faculty of English, IARE).

REFERENCE BOOKS:

1. 1. Norman Whitby, Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary, Cambridge University Press, 2nd Edition,2008.
2. Devaki Reddy, Shreesh Chaudhary, Technical English, Macmillan, 1st Edition,2009.
3. Rutherford, Andrea J, Basic Communication Skills for Technology, Pearson Education,2nd Edition, 2010.
4. Raymond Murphy, Essential English Grammar with Answers, Cambridge University Press, 2nd Edition,2010.
5. Dr. N V Sudershan, President Kalam's Call to the Nation, Bala Bharathi Publications, Secunderabad, 1st Edition,2003

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
2	Introduction to communication skills.	CO 1	T1:06.06
3	Communication process.	CO 1	T1:06.09
4	Soft skills vs hard skills.	CO 3	T1:09.10
5	Significance of LSRW skills.	CO 1	T1:10.11
6	Significance of listening skill.	CO 1	TI:12.16
7	Different stages of listening.	CO 1	T1:16.18
8	Barriers of listening skill.	CO 1	TI:18.21
9	Different types of listeners.	CO 1	TI:21.22
10	Effectiveness of listening skill.	CO 1	T1:22.24
11	Phonetics: Listening to the sounds of English language.	CO 1	T1:24.29
12	Introduction to speaking skills.	CO 2	T1:30.32
13	Effectiveness of speaking skills.	CO 2	T1:33.34
14	Verbal and non-verbal communication.	CO 2	T1:34.35
15	Generating talks based on visual or written prompts.	CO 2	T1:36.37
16	Developing public speaking skills.	CO 2	T1:38.39
17	Oral presentation with power-point.	CO 3	TI:39.42
18	The concept of word formation.	CO 4	T1:43.100
19	Antonyms and synonyms.	CO 4	TI:49.56
20	Idioms and phrases.	CO 4	TI:57.60
21	One-word substitutes.	CO 4	TI:60.62
22	Root words from foreign languages and their usage in English.	CO 4	TI:60.62
23	Sentence structure.	CO 4	T1:58.62
24	Punctuation tools and their role in a language.	CO 4	TI:63.66
25	Subject-verb agreement.	CO 4	TI:66.69
26	Usage of Adjectives.	CO 4	TI:70.73
27	Significance of articles and their usage.	CO 4	TI:74.75
28	The usage of prepositions.	CO 4	T1:76.77
29	Significance of reading skill.	CO 5	T1:78.79
30	Different techniques of reading skill.	CO 6	T1:80.82
31	How to Read Your Textbook More Efficiently.	CO 6	TI:83.85
32	Different types of reading comprehension.	CO 6	TI:85.86
33	Reading for information transfer.	CO 6	TI:85.96
34	Significance and effectiveness of writing skill.	CO 6	TI:96.98

35	Organizing principles of a paragraph in documents and types of paragraphs.	CO 5	T1:101.103
36	Writing introduction and conclusion.	CO 5	T1:103.103
37	Techniques for writing precis.	CO 6	T1:103.103
38	Introduction to informal letters.	CO 5	TI:105.108
39	Introduction to formal letters.	CO 5	TI:109.110
40	Introduction of email writing and formal and informal emails.	CO 5	TI:111.112
41	Significance of Report Writing.	CO 6	TI: 113. 114
PROBLEM SOLVING/ CASE STUDIES			
42	The aspects to improve listening comprehension Discuss in detail.	CO 1	TI:10,11
43	Different types of listeners with examples.	CO 1	TI: 19,21
44	The sounds of English language	CO 1	TI:23,27
45	verbal communication or written communication.	CO 2	TI: 27,30
46	Various difficulties in public speaking.	CO 2	TI: 32,33
47	Different ways of greeting people in formal and informal situation and discuss how do they matter in communication?	CO 2	TI: 35,37
48	'Oral presentation requires a good planning'.	CO 2	TI:36,38
49	Power point presentation and the ways to make Power point presentation.	CO 2	TI: 37,38
50	Methods that are used to establish the process of building vocabulary with examples from the most used words in spoken English.	CO 4	TI:39,41
51	The usage of idioms and phrases in spoken English.	CO 4	TI: 47,50
52	'Structure proposition-evaluation' -Reading technique.	CO 5	TI:56,58
53	Active reading, detailed reading, and speed-reading techniques used in different situations.	CO 5	TI: 79,81
54	The elements of paragraph writing in detail.	CO 6	TI:100,102
55	Logical bridges and Verbal bridges in writing.	CO 6	TI:102,104
56	Soft skills and Interpersonal Communication.	CO 6	TI:102,104
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Soft skills and Interpersonal Communication.	CO 1	TI 8,9
58	Language acquisition is a process.	CO 1	TI: 11,12
59	Communication.	CO 1	TI: 14,16
60	Time management.	CO 3	TI:9,10
61	Stress management.	CO 3	TI:9,10

DISCUSSION OF QUESTION BANK			
62	Soft Skills for difficult situations in terms of reassurance and reliability.	CO 3	TI:9,10
63	Verbal and non-verbal communication.	CO 2	TI: 34,35
64	Honesty, Respect, Self-Control and Accountability their role in building long lasting interpersonal skills?	CO 3	TI: 9,10
65	Etiquette and manners. Its importance in social, personal and professional communication.	CO 3	TI: 9,10
66	Problem solving and decision making.	CO 3	TI: 9,10

Signature of Course Coordinator **HOD**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUER SCIENCE AND ENGINEERING (DS)**				
Course Title	**PROBABILITY AND STATISTICS**				
Course Code	AHSC08				
Program	B.Tech				
Semester	II	CSE(DS)			
Course Type	Foundation				
Regulation	UG-22				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Ms. P Naga Lakshmi Devi, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Fundamentals of Statistics

II COURSE OVERVIEW:

Probability theory is the branch of mathematics that deals with modelling uncertainty. Inferential Statistics and regression analysis together with random variate distributions are playing an exceptional role in designing data driven technology which is familiarly known as data centric engineering. They also have wide variety applications in telecommunications and other engineering disciplines. The course covers advanced topics of probability and statistics with applications. The course includes: random variables, probability distributions, hypothesis testing, confidence intervals, and linear regression. There is an emphasis placed on real-world applications to engineering problems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Probability and Statistics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
30 %	Understand
60%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

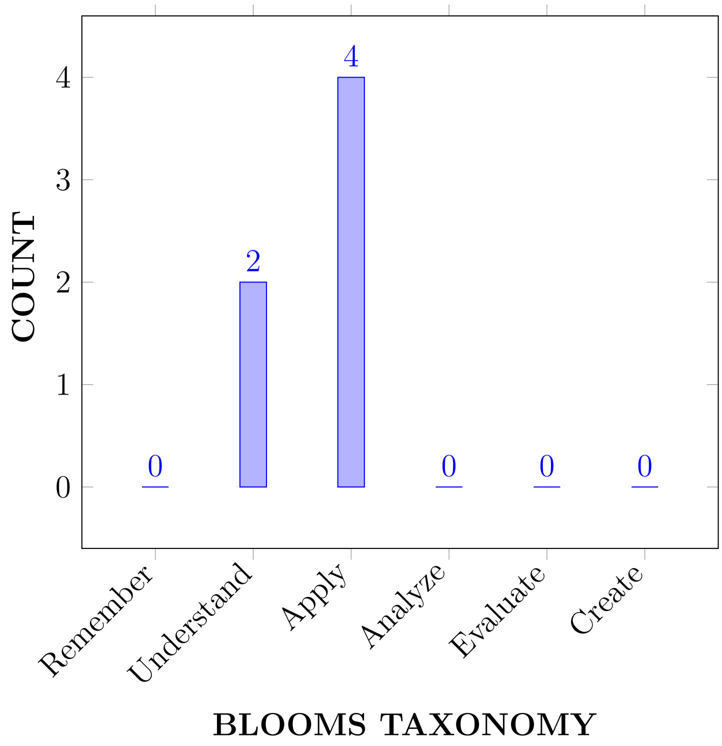
I	The theory of random variables, basic random variate distributions and their applications.
II	The Methods and techniques for quantifying the degree of closeness among two or more variables and the concept of linear regression analysis.
III	The Estimation statistics and Hypothesis testing which play a vital role in the assessment of the quality of the materials, products and ensuring the standards of the engineering process.
IV	The statistical tools which are essential for translating an engineering problem into probability model.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the role of random variables and types of random variables, expected values of the discrete and continuous random variables under randomized probabilistic conditions.	Understand
CO 2	**Interpret** the parameters of random variate Probability distributions such as Binomial, Poisson and Normal distribution by using their probability functions, expectation and variance.	Understand
CO 3	**Apply** Bivariate Regression as well as Correlation Analysis for statistical forecasting.	Apply
CO 4	**Make Use of** estimation statistics in computing confidence intervals, Regression analysis and hypothesis testing.	Apply
CO 5	**Identify** the role of statistical hypotheses, types of errors, confidence intervals, the tests of hypotheses for large samplein making decisions over statistical claims in hypothesis testing	Apply
CO 6	**Identify** the tests of hypothesis for small sample in making decisions over statistical claims in hypothesis testing	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Seminar/ Conferences/ Research Papers
PO 5	**Modern Tool Usage:** Use research-based knowledge and research methods including design of eConduct investigations of complex problems:xperiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Assignments/ Discussion

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	-	-	✓	✓	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	**PO 1**	Explain (understanding) the concept of random variables and their role in solving complex engineering problems involving random events and uncertainty by using Mathematical functions (principles of mathematics).	2
	PO 4	The expected values, variances for the given discrete random variables will be quantitatively measured by using statistical computer software (R-software).	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	**PO 1**	Interpret the Probability distributions such as Binomial, Poisson and Normal distribution (Understanding) with the support of evaluation of integrals (principles of mathematics) and appreciate their importance and applicability (Apply) in solving complex engineering problems involving uncertainty.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which involves the events of uncertainty, Model it with suitable probability distribution and Apply the concepts of discrete or continuous distributions along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
CO 3	**PO 1**	Interpret (Understand) the results of Bivariate and Correlation Analysis by using ratios, square roots, straight lines and planes (principles of mathematics) for statistical forecasting (Apply)in complex engineering problems involving bivariate or multivariate data.	2
CO 4	**PO 1**	Select appropriate statistical methods (understand) for solving some real-time complex engineering problems governed by correlation with the knowledge of fundamental principles of mathematics.	2
	PO 4	Interpret the results of Bivariate and Multivariate Regression and quantifying the degree of closeness between two or more variables by using statistical computer software (R-software, SPSS-software).	1
CO 5	**PO 1**	Apply tests of hypotheses which involves the role of mathematical tools like statements, sets, ratios and percentages (principles of mathematics) for both large samples and small samples (knowledge) in making decisions over statistical claims that arise in complex engineering problems which requires sampling inspections.	2
	PO 2	Understand the statement and formulation of a complex engineering problem which needs verification of truth values of numerical or statistical hypothesis, collect the necessary information and data through sampling techniques, apply tests of hypotheses (both large and small samples) along with basic principles of mathematics to develop the solution and reaching substantiated conclusions by the interpretation of results	5
	PO 4	Make Use of R software package in computing confidence intervals, statistical averages and hypothesis testing. (Computer software relevance)	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 6	**PO 1**	Identify the role of types of statistical hypotheses, types of errors, sampling distributions of means and confidence intervals with the aid of statements and sets, percentages (principles of mathematics) in hypothesis testing of complex engineering problems which requires sampling inspections.	2
	PO 4	Test for the assessment of goodness of fit of the given probability distribution model by using statistical quantitative methods and statistical computer software (R-software).	1
	PO 5	Make Use of R software package a in modeling complex Engineering activities which involves computation of confidence intervals, statistical averages and regression analysis, hypothesis testing.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	1	-	-	-	-	-	-	-		-	-	-
CO 5	2	5	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	-	-	1	1	-	-	-	-	-	-		-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	-	-	9.0	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	66.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	-	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.7	50.0	-	9.0	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.7	-	-	9.0	100	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 - $5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	-	-	1	3	-	-	-	-	-	-		-	-	-
TOTAL	18	4	-	4	3	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	1	3	-	-	-	-	-	-	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Tech Talk	✓	Concept video	✓
Assignments	-				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**PROBABILITY AND RANDOM VARIABLES**
	Random variables: Basic definitions, discrete and continuous random variables; Probability distribution: Probability mass function and probability density functions; Mathematical expectation.
MODULE II	**PROBABILITY DISTRIBUTION**
	Binomial distribution; Mean and variances of Binomial distribution, Recurrence formula for the Binomial distribution; Poisson distribution: Poisson distribution as a limiting case of Binomial distribution, mean and variance of Poisson distribution, Recurrence formula for the Poisson distribution; Normal distribution; Mean, Variance, Mode, Median, Characteristics of normal distribution.
MODULE III	**CORRELATION AND REGRESSION**
	Correlation: Karl Pearson's Coefficient of correlation, Computation of correlation coefficient, Rank correlation, Repeated Ranks; Properties of correlation. Regression: Lines of regression, Regression coefficient, Properties of Regression coefficient, Angle between two lines of regression.

MODULE IV	**TEST OF HYPOTHESIS – I**
	Sampling: Definitions of population, Sampling, Parameter of statistics, standard error; Test of significance: Null hypothesis, alternate hypothesis, type I and type II errors, critical region, confidence interval, level of significance. One sided test, two-sided test. Large sample test: Test of significance for single mean, Test of significance for difference between two sample means, Tests of significance single proportion and Test of difference between proportions.
MODULE V	**TEST OF HYPOTHESIS – II**
	Small sample tests: Student t-distribution, its properties: Test of significance difference between sample mean and population mean; difference between means of two small samples. Snedecor's F-distribution and its properties; Test of equality of two population variances Chi-square distribution and it's properties; Chi-square test of goodness of fit.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.

WEB REFERENCES:

1. http://e4uhu.com/down/Applied/9th
2. https://toaz.info/32fa2f50-8490-42cf-9e6a-f50cb7ea9a5b
3. http://www.mathworld.wolfram.com

COURSE WEB PAGE:

https://www.youtube.com/playlist?list=PLzkMouYverAJ1gjLBz4sA5O0ymIi01or6

REFERENCE BOOKS:

1. N. P. Bali, "Engineering Mathematics", Laxmi Publications, 9th Edition, 2016.
2. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand and Co., 10th Edition, 2000.
3. Richard Arnold Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Prentice Hall, 8th Edition, 2013.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	Course outcomes	Reference
OBE DISCUSSION			
1	Identify the types of sampling (random, stratified, systematic, cluster). Identify the misuses of statistics. Student will use appropriate statistical methods to collect, organize, display, and analyze relevant data. Probability & Statistics introduces students to the basic concepts and logic of statistical reasoning and gives the students introductory-level practical ability to choose, generate, and properly interpret appropriate descriptive and inferential methods. Identify the types of data (qualitative, quantitative, discrete, and continuous).		
CONTENT DELIVERY (THEORY)			
2	Probability Basic definitions	CO 1	T2:26.3
3	Probability	CO 1	R2:21.48
4	Axioms of Probability	CO 1	T2:26.6 R2:21.50
5	Conditional Probability	CO 1	T2:26.7 R2:21.51
6	Random Variables	CO 1	T2:26.8
7	Discrete and Continuous random variables	CO 1	T2:26.10
8	Probability distribution	CO 1	T2:26.14 R2:21.55
9	Probability mass function	CO 1	T2:26.15 R2:21.58
10	Probability Density Function	CO 1	T2:26.16 R2:21.61
11	Mathematical Expectation	CO 2	T2:25.12 R2:21.24
12	Binomial Distribution	CO 2	T2:25.16 R2:21.29
13	Mean, Variance and Mode of Binomial Distribution	CO 2	T2:25.14 R2:21.31
14	Expected Frequency of Binomial Distribution	CO 2	T2:25.14 R2:21.33
15	Poisson Distribution	CO 2	R2:21.33
16	Mean, Variance and Mode of Poisson distribution	CO 2	T2:27.2 R2:21.64
17	Expected Frequency of Poisson Distribution	CO 2	T2:27.2
18	Normal distribution – I	CO 2	T2:27.2 R2:21.67

19	Mean and Variance of Normal Distribution	CO 2	T2:27.2
20	Mode and Median of Normal distribution	CO 2	T2:27.3 R2:21.71
21	Normal distribution – II	CO 2	T2:27.4 R2:21.68
22	Correlation	CO 3	T2:27.7 R2:21.74
23	Rank Correlation	CO 3	T2:27.12 R2:21.75
24	Rank Correlation for Repeated Ranks	CO 3	T2:27.8 R2:21.72
25	Regression Lines-I	CO 4	T2:27.8 R2:21.73
26	Regression Lines-II	CO 4	T2:27.14 R2:21.78
27	Regression Lines-III	CO 4	T2:27.19 R2:21.814
28	Sampling distribution – I	CO 5	T2:27.12 R2:21.82
29	Sampling distribution – II	CO 5	T2:27.18 R2:21.82
30	Testing of hypothesis for Large Samples	CO 5	T2:26.15 R2:21.58
31	Test of hypothesis for single mean	CO 5	T2:26.16 R2:21.61
32	Test of hypothesis for difference of means	CO 5	T2:25.14 R2:21.33
33	Test of hypothesis for single proportion	CO 5	R2:21.33
34	Test of hypothesis for difference of proportions	CO 5	T2:27.2 R2:21.64
35	Testing of hypothesis for small samples	CO 6	T2:27.2
36	Student's t-distribution for single mean	CO 6	T2:26.16 R2:21.61
37	Student's t-distribution for difference of means	CO 6	T2:25.12 R2:21.24
38	F-distribution	CO 6	T2:25.16 R2:21.29
39	Chi-Square distribution – I	CO 6	T2:27.14 R2:21.78
40	Chi-Square distribution – II	CO 6	T2:27.19 R2:21.814
41	Chi-Square distribution – III	CO 6	T2:27.12 R2:21.82
PROBLEM SOLVING/ CASE STUDIES			
42	Problems on Probability	CO 1	T2:26.3
43	Problems on Discrete and Continuous random variables	CO 1	R2:21.48

44	Problems on Probability mass function	CO 1	T2:26.6 R2:21.50
45	Problems on Probability density function	CO 1	T2:26.7 R2:21.51
46	Problems on Binomial Distribution	CO 2	T2:26.8
47	Problems on Poisson Distribution	CO 2	T2:26.10
48	Problems on Normal Distribution	CO 2	T2:26.14 R2:21.55
49	Problems on Correlation	CO 3	T2:26.15 R2:21.58
50	Problems on Regression	CO 4	T2:26.16 R2:21.61
51	Problems on Sampling distribution	CO 5	T2:25.12 R2:21.24
52	Problems on Test of hypothesis for single mean and difference of means	CO 5	T2:25.16 R2:21.29
53	Problems on Test of hypothesis for single proportion and difference of proportions	CO 6	T2:25.14 R2:21.31
54	Problems on t-distribution	CO 6	T2:25.14 R2:21.33
55	Problems on F-distribution	CO 6	R2:21.33
56	Problems on Chi-Square distribution	CO 6	T2:27.2 R2:21.64
DISCUSSION OF DEFINITION AND TERMINOLOGY			
57	Definitions terminology discussion on probability and random variables	CO 1	T2:26.6 R2:21.50
58	Probability and Random variables	CO 2	T2:26.7 R2:21.51
59	Definitions& terminology discussion on correlation and regression.	CO 3, CO 4	T2:25.14 R2:21.33
60	Definitions & terminology discussion on Tests of Hypothesis.	CO 5	R2:21.33
61	Definitions & terminology discussion on Tests of significance.	CO 6	R2:21.33

DISCUSSION OF QUESTION BANK			
62	Question bank discussion on Probability, Random variables and Probability Distributions	CO 1	T2:26.6 R2:21.50
63	Question bank discussion on probability distributions.	CO 2	T2:26.7 R2:21.51
64	Question bank discussion on correlation and regression.	CO 3,CO 4	T2:25.14 R2:21.33
65	Question bank discussion on Tests of Hypothesis.	CO 5	R2:21.33
66	Question bank discussion on Tests of significance.	CO 6	R2:21.33

Course Coordinator: **HOD CSE(DS)**
Ms. P Naga Lakshmi Devi

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	**APPLIED PHYSICS**				
Course Code	**AHSC09**				
Program	**B. Tech**				
Semester	**II**				
Course Type	**FOUNDATION**				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	4	-	-
Course Coordinator	Dr. Surya Sharma NVSS, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	-	Basic Principles of Semiconductors

II COURSE OVERVIEW:

This course is structured specifically to make the students understand some of the core topics in physics essential for further studies in engineering. It focuses on illustrating and developing an understanding of the interplay between problem solving and their practical applications which include experimental techniques and modern equipment. The topics include quantum mechanics, semiconductors, opto-electronic devices, magnetism, dielectrics, LASER and fiber optics. At the end, this course helps students to appreciate the diverse real-time applications in technological fields in respective branches.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Applied Physics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in Table: 1.

Percentage of Cognitive Level	Blooms Taxonomy Level
0 %	Remember
60 %	Understand
40 %	Apply
0 %	Analyze

Table 1: The expected percentage of cognitive level of questions in SEE

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 2), with 20 marks for Continuous Internal Examination (CIE), 10 marks for Alternative Assessment Tool (AAT) (Table 3).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Table 2: Assessment pattern for CIA

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT):
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table 3.

Concept Video	Tech-talk	Complex Problem Solving
50%	50%	-

Table 3: Assessment pattern for CIA

VI COURSE OBJECTIVES:

The students will try to learn:

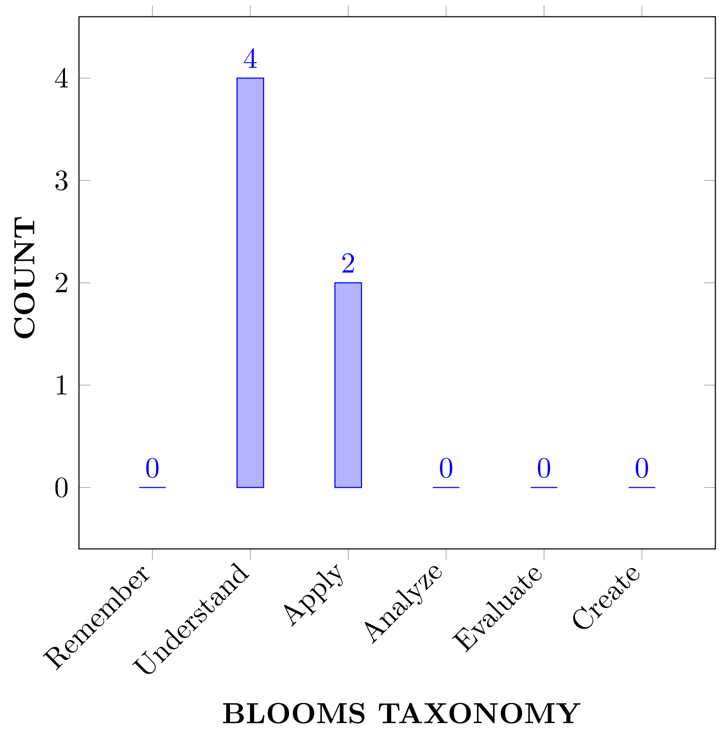
I	Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
II	Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and transport mechanisms.
III	The metrics of optoelectronic components, LASER, optical fiber communication and be able to incorporate them into systems for optimal performance.
IV	The appropriate magnetic and dielectric materials required for various engineering applications.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Apply** the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.	Apply
CO 2	**Demonstrate** the classification of Solids and important aspects of semiconductors in terms of carrier concentration and Fermi level.	Understand
CO 3	**Make use of** the key concepts of semiconductors to explain the basic working mechanism of optoelectronic device characteristics of light-emitting diodes, photodetectors and solar cells.	Apply
CO 4	**Illustrate** the properties of dielectric and magnetic materials suitable for engineering applications.	Understand
CO 5	**Compare** the concepts of LASER and normal light in terms of mechanism and working principles for applications in different fields and scientific practices.	Understand
CO 6	**Explain** functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems..	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Seminar

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation..	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1	AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH POs, PSOs:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	✓
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

XII JUSTIFICATIONS FOR CO – (PO/PSO) MAPPING -DIRECT:

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Outline** drawbacks of classical mechanics, basic principles **dual nature** of matter wave, **derive** mathematical wave equation of matter waves and come to **conclusion** of quantization of energy used in quantum dots.	3
	PO 2	**Explain** the given **problem statement** and formulate quantum confinement problems related to particle enclosed in small dimension from the provided **information** and **data** in reaching substantial conclusions by the **interpretation of results**.	4
CO 2	PO 1	**Illustrate** the charge transport mechanism in intrinsic and extrinsic semiconductors using energy level diagrams, calculate their charge carrier concentration and use those expressions to integrate with other engineering disciplines .	3
	PO 4	**Identify** the use of these semiconductors under study and their conduction mechanism for the **research based knowledge** and **technological development**.	2
	PO 2	**Explain** the given **problem statement** and formulate mobility and conductivity aspects of a material from the provided **information** and **data** in reaching substantial conclusions by the **interpretation of Hall coefficient value**.	4
CO 3	PO 1	**Acquire** detailed **knowledge** of fundamental and applied aspects of optoelectronic device physics, **analyze** key parameters and **apply** them to the functioning of electronic devices.	3

Course Outcomes	POs PSOs	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 2	**Illustrate** the given **problem statement** and **formulate** light interaction aspects of direct band gap materials from the provided **information** and **data** by the **interpretation of carrier generation and recombination** in opto-electronic devices	4
CO 4	PO 1	**Relate** principles of different types of polarization mechanism and expression for polarizability to the properties of functional materials and for solving engineering problems by applying these principles of science.	3
	PO 2	**Explain** the given **problem statement** and **formulate** polarization versus applied electric field related to ferroelectric materials from the provided **information** and **data** by the **interpretation of hysteresis loop**.	4
	PO 1	**Utilize** spin and orbital motion of electrons in determining **magnetic moment** of materials in terms of Bohr magneton materials having specific **engineering applications**.	3
	PO 4	**Identify** the use of magnetic materials and their magnetization values for the **research based knowledge** and **technological development.**	2
	PSO 3	**Make use of** modern computer tools to determine remnant magnetization and coercivity values from B-H curve and gain knowledge helpful for **higher studies**.	1
CO 5	PO 1	**Compare** the concepts of LASER and normal light in terms of mechanism and **working principle** for applications in different fields and scientific practices.	3
CO 6	PO 1	**Explain** functionality of components in optical fiber communication **system** by using the **basics** of signal propagation, attenuation and dispersion.	3
	PO 2	**Identify the given problem** and **formulate** expressions for acceptance angle and numerical aperture with the given **information** and **data** by applying principles of information propagation through optical waveguides.	4

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO/PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	4	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	4	-	-	-	-	-	-	-	-	-		-	-	-
CO 4	3	4	-	2	-	-	-	-	-	-	-	-	-	-	1
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO/PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	40	-	20	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	40	-	20	-	-	-	-	-	-	-	-	-	-	30
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	40	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (CO-PO/PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1-5 $<C \leq 40\%$ – Low/ Slight

2 - 40 % $<C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	1		-	-	-	-	-	-		-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-		-	-	-
CO 4	3	2	-	1	-	-	-	-	-	-	-	-	-	-	1
CO 5	3		-	-	-	-	-	-	-	-	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	10	-	2	-		-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	1	-		-	-	-	-	-	-	-	-	1

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

x	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**QUANTUM MECHANICS**
	Introduction to quantum physics, de broglie hypothesis, Wave-particle duality, Davisson and Germer's experiment, Time-independent Schrödinger equation for wave function, Physical significance of the wave function, Schrödinger equation for one dimensional problems - particle in a box.
MODULE II	**INTRODUCTION TO SOLIDS AND SEMICONDUCTORS**
	Introduction to classical free electron theory and quantum theory, Bloch's theorem for particles in a periodic potential (Qualitative treatment), Kronig-Penney model (Qualitative treatment), classification: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Hall effect.
MODULE III	**SEMICONDUCTOR DEVICES**
	Direct and indirect band gaps, p-n junction, V-I characteristics, Energy Band diagram, Biasing of a junction, Zener diode. Construction and working of LED, Photo detectors, PIN, Avalanche photodiode, Solar cell.
MODULE IV	**ENGINEERED ELECTRIC AND MAGNETIC MATERIALS**
	Polarisation, Permittivity, Dielectric constant, Internal field in solids, Clausius Mosotti equation, Electronic, Ionic and Orientational polarization (Qualitative) Ferroelectricity;Magnetisation, Permeability, Susceptibility, Classification of dia, para and ferro magnetic materials on the basis of magnetic moment, Hysteresis curve.

MODULE V	**LASERS AND FIBER OPTICS**
	Characteristics of LASER, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby LASER, He-Ne LASER and applications of LASER.Principle and construction of an optical fibre, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index), Optical fibre communication system with block diagram and Application of optical fibres.

TEXTBOOKS

1. Dr. K Vijay Kumar and Dr. S Chandralingam — Modern Engineering Physics‖ Volume-1 & 2, S Chand. Co, 2018.
2. Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar —A Text Book of Engineering Physics‖, S. Chand.
3. B. K Pandey and S. Chaturvedi —Engineering physics‖, Cengage learning.

REFERENCE BOOKS:

1. J. Singh, —Semiconductor Optoelectronics: Physics and Technology‖, McGraw-Hill Inc. (1995).
2. P. Bhattacharya, —Semiconductor Optoelectronic Devices‖, Prentice Hall of India (1997).
3. Monica Katiyar and Deepak Gupta on NPTEL.Online course: ”Optoelectronic Materials and Devices”.

WEB REFERENCES

1. http://link.springer.com/book
2. http://www.thpys.physics.ox.ac.uk
3. http://sciencedirect.com/science
4. http://www.e-booksdirectory.com

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details & course_id=17

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		

CONTENT THEORY(DELIVERY)			
2	Introduction to Quantum Physics	CO 1	T2:5.15; R1:1.16
3	Wave-Particle duality of radiation	CO 1	T2:5.17; R1:1.13.1
4	De-broglie hypothesis and de-broglie wavcelength	CO 1	T2:5.18; R1:1.13.2
5	Properties of Matter waves	CO 1	T2:5.19 R1:1.13.3,
6	Davisson and Germer's experiment	CO 2	T2:5.20; R1:1.17.1
7	Schrödinger time independent wave equation	CO 1	T2:5.24; R1:1.17.3
8	Physical significance of wavefunction	CO 1	T2:6.1; R1:2.3
9	Particle in a one dimensional potential box	CO 1	T2:6.3; R1:2.6.1
10	Free electron theory and Quantum theory of solids, Electron in a Periodic potential – Bloch's theorem	CO 2	T2:6.5; R1:2.6.2
11	Kronig-Penney model, Band theory of solids	CO 2	T2:7.3; R1:2.8
12	Origin of energy bands in solids, Classification of solids into insulators, conductors and semiconductors	CO 2	T2:7.5,7.6; R1:2.9.2
13	Introduction to intrinsic and extrinsic semiconductors, Intrinsic carrier concentration	CO 2	T2:7.7; R1:2.10
14	Carrier concentration and Fermi level in p-type semiconductors	CO 2	T2:7.7; R1:2.10
15	Carrier concentration and Fermi level in n-type semiconductors	CO 2	T2:7.11; R2:2.10.2
16	Hall effect and its applications	CO 2	T2:7.11; R2:2.32
17	Direct and indirect band gaps	CO 3	T2:7.11; R2:2.10
18	p-n junction, V-I characteristics	CO 3	T2:7.12; R2:2.10.3
19	Energy Band diagram of PN Junction	CO 3	T2:7.12; R2:2.10.3
20	Biasing of PN junction	CO 3	T2:7.13; R1:2.10.4
21	Zener diode	CO 3	T2:7.14 R1:2.10.6
22	Construction and working of LED	CO 3	T2:7.15; R1:2.10.7
23	Construction and working of Photodiode, PIN and Avalanche Photodiode	CO 3	T1:7.15; R2:2.10.7

24	Construction and working of Solar cell	CO 3	T1:7.15; R2:2.10.7
25	Introduction to dielectric materials, Polarization, Permittivity, Dielectric constant	CO 4	T1:7.15; R2:2.10.7
26	Internal fields in solids	CO 4	T1:16.9 R2:8.11.1
27	Clausius – Mosotti equation	CO 4	T1:16.9; R2:8.11.2
28	Ionic, Electronic and Orientational polarization	CO 4	T1:15.2; R4:8.2
29	Ferroelectricity	CO 4	T2:15.7; R4:8.3.3
30	Magnetic materials, Magnetization, Permeability, Susceptibility	CO 4	T2:15.13 R4:8.7.2
31	Diamagnetic and Paramagnetic materials	CO 4	T2:15.13; R4:8.7.2
32	Ferromagnetic materials	CO 4	T2:15.16; R1:8.7.3
33	Hysteresis curve	CO 4	T1:11.9; R2:12.24
34	Characteristics of LASER, Spontaneous and Stimulated emission	CO 5	T1:11.9; R3:12.25
35	Metastable state, Population inversion, Lasing action	CO 5	T1:3.2; R3:3.2
36	Ruby LASER	CO 5	T1:3.3.1; R3:3.2
37	He-Ne LASER, Applications of LASER	CO 5	T2:16.5; R3:8.10
38	Principle and construction of optical fibers	CO 6	T2:16.5; R3:8.10
39	Acceptance angle, Acceptance cone, Numerical Aperture	CO 6	T1:3.3.1; R3:3.2
40	Types of optical fibers	CO 6	T2:16.5; R3:8.10
41	Optical fiber communication system, Applications of optical fibers	CO 6	T2:16.5; R3:8.10
PROBLEM SOLVING			
1	De-broglie wavelength	CO 1	T1:3.3.1; R3:3.2
2	Energies associated with one dimensional potential box	CO 1	T2:16.5; R3:8.10
3	Intrinsic carrier concentration, Fermi level in semiconductors	CO 2	T2:16.5; R3:8.10
4	Carrier concentration based on Hall coefficient	CO 2	T1:3.3.1; R3:3.2

5	Mobility and conductivity based on Hall coefficient	CO 2	T2:16.5; R3:8.10
6	Diffusion and drift	CO 3	T2:16.5; R3:8.10
7	Energy gap in indirect bandgap semiconductors	CO 3	T1:3.3.1; R3:3.2
8	Dielectric constant, capacitance, permittivity	CO 4	T2:16.5; R3:8.10
9	Electric susceptibility, Polarization vector	CO 4	T2:16.5; R3:8.10
10	Polarizability	CO 4	T1:3.3.1; R3:3.2
11	Magnetic moment, Magnetic induction, Permeability	CO 4	T2:16.5; R3:8.10
12	Intensity of magnetization, Magnetic susceptibility	CO 4	T2:16.5; R3:8.10
13	Wavelength and Energy bandgap, Divergence	CO 5	T2:16.5; R3:8.10
14	Relative population of two states, Number of photons emitted	CO 5	T1:3.3.1; R3:3.2
15	Acceptance angle and Numerical Aperture	CO 6	T2:16.5; R3:8.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Quantum Mechanics	CO 1	T2:16.5; R3:8.10
2	Introduction to Solids and Semiconductors	CO 2	T1:3.3.1; R3:3.2
3	Semiconductor devices	CO 3	T2:16.5; R3:8.10
4	Engineered electric and magnetic materials	CO 4	T2:16.5; R3:8.10
5	LASER, Fiber optics	CO 5, CO 6	T2:16.5; R3:8.10

DISCUSSION OF QUESTION BANK			
1	Quantum Mechanics	CO 1	T1:3.3.1; R3:3.2
2	Introduction to Solids and Semiconductors	CO 2	T2:16.5; R3:8.10
3	Semiconductor devices	CO 3	T2:16.5; R3:8.10
4	Engineered electric and magnetic materials	CO 4	T1:3.3.1; R3:3.2
5	LASER, Fiber optics	CO 5, CO 6	T2:16.5; R3:8.10

Signature of Course Coordinator **HOD, CSE(DS)**
Dr. Surya Sharma NVSS, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	PROGRAMMING FOR PROBLEM SOLVING USING C				
Course Code	ACSC04				
Program	B.Tech				
Semester	II				
Course Type	FOUNDATION				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. J Sirisha Devi, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	Basic Programming Concepts

II COURSE OVERVIEW:

The course emphasis on the problem-solving aspects in using C programming. It is the fundamental course and is interdisciplinary in nature for all engineering applications. The students will understand programming language, programming, concepts of loops, reading a set of data, step wise refinements, functions, control structures, arrays, dynamic memory allocations, enumerated data types, structures, unions, and file handling. This course provides adequate knowledge to solve problems in their respective domains.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
PPSC	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
30%	Understand
50%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

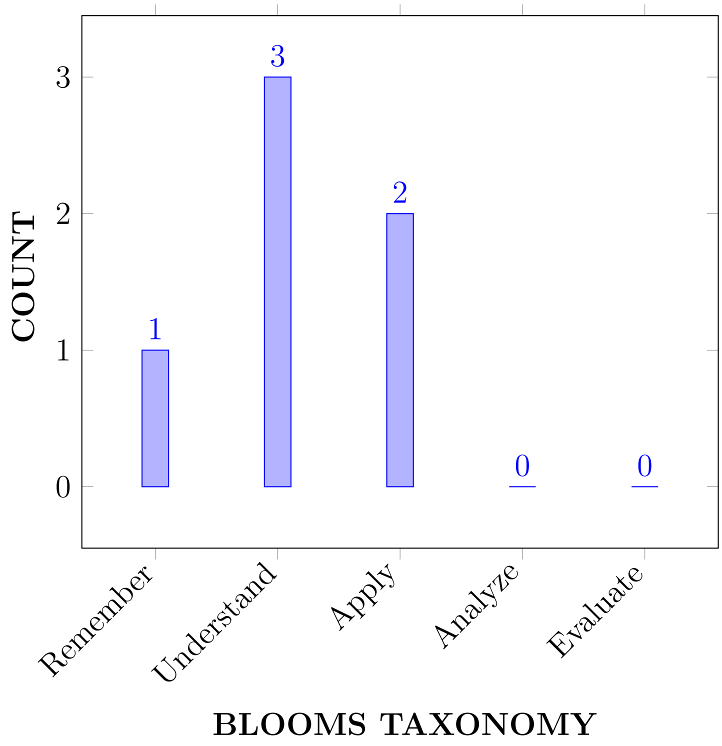
I	Problem-solving through programming.
II	Programming language, programming, reading a set of Data, stepwise refinement, concepts of Loops, Functions, Control structure, Arrays, Structure, Pointer and File concept.
III	To build efficient programs in C language essential for future programming and software engineering courses.
IV	Acquire programming skills in C Programming.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Define** the algorithms and draw flowcharts for solving Mathematical and Engineering problems.	Remember
CO 2	**Construct** programs for decision structures and loops.	Apply
CO 3	**Interpret** various types of functions, arrays, and strings for complex problem solving.	Understand
CO 4	**Illustrate** he dynamic memory allocation, structures, unions and enumerations to solve problems.	Understand
CO 5	**Interpret** file input and output functions to do integrated programming.	Understand
CO 6	**Utilize** the algorithms in C language to real-life computational problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	2	Open Ended Experiments

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	Tech talk/Open ended experiments
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	Tech talk/Open ended experiments

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 2	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	✓	-	-	-	-	-	-		-	-	-
CO 5	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Developing algorithms and draw flowcharts for solving **mathematical** and **engineering problems** related to **areas of computer science.**	3
	PO 2	Understand the various symbols to **draw** a flowchart, **identify** the appropriate symbols to solve a problem, then **formulate** the solution, and **interpret** the result for the **improvement** of the **solution.**	6
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
CO 2	PO 1	Understand branching statements, loop statements, and apply the fundamentals of **mathematics**, **science** and **engineering**.	3
	PO 2	Understand the **problem statement**, **control** the flow of data, **design** the solution and **analyze** the same to **validate** the results in a program to solve **complex** engineering problems.	6
	PO 3	**Recognize** an appropriate control structure to **design** and **develop** a solution for a **real-time** scenario, and **communicating** effectively with engineering community.	5
CO 3	PO 1	Recognize the importance of recursionfor developing programs in real-time scenarios using principles of **mathematics**, and **engineering fundamentals**.	3
	PO 2	Understand the various kinds of **functions**, **identify** the suitable type of function to **solve** a problem, **formulate** the solution, and **interpret** the result for the **improvement** of the solution.	6
	PO 5	Apply techniques of **structured decomposition** to dividea problem into smaller pieces with an understanding of its limitations.	1
CO 4	PO 1	Extend the focus on the usage of heterogeneous data types as a **basic building block** in problem solving using principles of **science**, and **engineering** fundamentals.	3
	PO 2	**Recognize** the representation of the structure, **assess** in solving a problem, **express the solution**, and **analyze** the result for **solution enhancement**.	5

	PO 5	Understand pointers conceptually and apply them in modeling a **complex engineering** activity.	1
CO 5	PO 1	Make a use of an appropriate type of file to store a large volume of **persistent data** and give solution to **engineering problems**.	2
	PO 5	To identify appropriate mode to access a file and run the same **program** multiple times.	1
CO 6	PO 12	**Realize** the need and the desire to **train** and **invest** in autonomous and **lifelong learning** in the widest sense of **technical transition** to achieve **employability expertise** and excel advanced **engineering concepts**.	7
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	6	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	6	5	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	6	-	-	1	-	-	-	-	-	-	-	-		-
CO 4	3	5	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	7	-	-	3

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	60	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 2	100	60	50	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	60	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 4	100	50	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 5	66	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	58	-	-	50

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	3	-	-	-	-	-	-	-	-		-
CO 4	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
TOTAL	15	11	2	-	9	-	-	-	-	-	-	2	2	-	2
AVERAGE	3	2.7	2.5	-	3	-	-	-	-	-	-	2	2	-	2

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

-	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Introduction to components of a computer: Memory, processor, I/O Devices, storage, operating system; Concept of assembler, compiler, interpreter, loader and linker. **Idea of Algorithms:** Algorithms, Flowcharts, Pseudo code with examples, From algorithms to Programs. **Introduction to C Programming Language:** History of C, Basic structure of a C program, Process of compiling and running a C program; C Tokens: Keywords, Identifiers, Constants, Strings, Special symbols, Variables, Data types; Operators, Precedence of Operators, Expression evaluation, Formatted Input/Output functions, Type Conversion and type casting.
MODULE II	**CONTROL STRUCTRES**
	Decision Making Statements: Simple if, if-else, else if ladder, Nested if, switch case statement; **Loop control statements:** for, while and do while loops, nested loops; **Unconditional Control Structures:** break, continue and goto statements.

MODULE III	**ARRAYS AND FUNCTIONS**
	Arrays: Introduction, Single dimensional array and multi-dimensional array: declaration, initialization, accessing elements of an array; Operations on arrays: traversal, reverse, insertion, deletion, merge, search; **Strings:** Arrays of characters, Reading and writing strings, String handling functions, Operations on strings; array of strings. **Functions:** Concept of user defined functions, Function declaration, return statement, Function prototype, Types of functions, Inter function communication, Function calls, Parameter passing mechanisms; Recursion; Passing arrays to functions, passing strings to functions; Storage classes.
MODULE IV	**POINTERS AND STRUCTURES**
	Pointer: Basics of pointers, Pointer arithmetic, pointer to pointers, array of pointers, Generic pointers, Null pointers, Pointers as functions arguments, Functions returning pointers; Dynamic memory allocation. **Structures:** Structure definition, initialization, structure members, nested structures, arrays of structures, structures and functions, structures and pointers, self-referential structures; Unions: Union definition, initialization, accessing union members; bit fields, typedef, enumerations, Preprocessor directives.
MODULE V	**FILE HANDLING AND APPLICATIONS IN C**
	File Handling: Concept of a file, text files and binary files, streams, standard I/O, formatted I/O, file I/O operations, error handling, Line I/O, miscellaneous functions; Applications in C.

TEXTBOOKS

1. Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rd Edition, 2017

2. Reema Thareja, "Programming in C", Oxford university press, 2nd Edition, 2016.

REFERENCE BOOKS:

1. W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988.

2. Yashavant Kanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003.

3. Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014.

4. R. S. Bichkar, "Programming with C", Universities Press, 2 nd Edition, 2012.

5. Dey Pradeep, Manas Ghosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.

6. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.

WEB REFERENCES:

1. https://www.nptel.ac.in/courses/108106073/

2. https://www.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Discussion on Outcome Based Education, CO, PO and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
2	Understand components of a computer	CO 1	T2: 1.1-1.2, R4: 1.1-1.3
3	Identify and apply algorithms and flowcharts for problem solving	CO 1	T2: 2.1-2.2, R4: 1.4
4	Understand pseudo code for a given problem	CO 1	T2: 2.1-2.2
5	Understand the basic structure, process of compiling and running a C program	CO 1	T2: 2.1-2.2,
6	Understand keywords, identifiers, constants, strings, special symbols, variables	CO 1	T2: 1.4 -1.5, R4: 2.1 - 2.4
7	Define the data types, and operators to write C Program	CO 1	T2: 2.1-2.2
8	Understand precedence of operators, expression evaluation	CO 1	T2: 2.3-2.6
9	Understand formatted input/output functions, Type Conversion and type casting in C Programming	CO 1	T2: 2.3-2.7
10	Identify and apply decision making statements in C programming	CO 2	T2: 3.1-3.5
11	Identify and apply loop control structures in C programming	CO 2	T2: 5.2-5.3
12	Identify and apply unconditional control structures in C programming	CO 2	T2: 6.1-6.6
13	Understand single dimensional array and multi-deimensional array: declaration, initialization, accessing	CO 3	T2: 6.7
14	Operations on arrays: traversal, reverse, insertion	CO 3	T2: 8.1-8.2, R4: 15.1
15	Operations on arrays: deletion, merge, search	CO 3	T2: 8.3, R4: 15.1
16	Arrays of characters, Reading and writing strings, String handling functions	CO 3	T2: 11.1-11.5
17	Operations on strings: array of strings	CO 3	T2: 4.1-4.5
18	Concept of user defined functions, Function declaration	CO 3	T1: 7
19	return statement, Function prototype	CO 3	T2: 6.9

20	Types of functions, Inter function communication	CO 3	T1: 10, T2:10.1-10.2
21	Function calls, Parameter passing mechanisms, Recursion	CO 3	T2: 10.3-10.4, R4:8.3-8.4
22	Passing arrays to functions, passing strings to functions	CO 3	T2:10.5
23	Storage classes	CO 3	T1: 8.9, R4:8.6.3
24	Basics of pointers, Pointer arithmetic	CO 4	T2: 3.1, R4:11.1
25	Pointer to pointers	CO 4	T2: 3.2
26	Array of pointers	CO 4	T2: 3.2
27	Generic pointer, Null pointers	CO 4	T2: 3.3
28	Pointers as function arguments, Functions returning pointers	CO 4	T2: 3.4-3.5
29	Dynamic memory allocation	CO 4	T2: 6.1-6.6
30	Structure definition, initialization, structure members	CO 4	T2: 12.3-12.4, R4:13.4
31	Nested structures	CO 4	T2: 12.3-12.4, R4:13.4
32	Arrays of structures, structures and functions	CO 4	T2: 2.1-2.2, R4:13.2
33	Structures and pointers, self-referential structures	CO 4	T2: 2.1-2.2
34	Union, bit fields, typedef	CO 4	T2: 12.4
35	Enumerations, Preprocessor directives	CO 4	T1: 8.9, T2: 2.3-2.5
36	Concept of a file, text files and binary files, streams	CO 5	T2: 10.4, R4:14.1-14.4
37	Standard I/O, formatted I/O, file I/O operations	CO 5	T2: 10.4, R4:14.1-14.4
38	Error handling	CO 5	R3: 12.1 - 12.3
39	Line I/O, miscellaneous functions	CO 5	R3: 12.1 - 12.3
40	Applications of C	CO 6	R4: 17
PROBLEM SOLVING/ CASE STUDIES			
1	Write a program in C that takes minutes as input, and display the total number of hours and minutes.	CO 1	T2:2.3-2.6

2	Write a program in C that reads a forename, surname and year of birth and display the names and the year one after another sequentially.	CO 1	T2:2.3-2.7
3	Write a C program to find the third angle of a triangle if two angles are given.	CO 2	T2:3.1-3.5
4	Write a program in C to display the such a pattern for n number of rows using a number which will start with the number 1 and the first and a last number of each row will be 1.	CO 2	T2:5.2-5.3
5	Write a program in C to find the prime numbers within a range of numbers.	CO 2	T2:5.2-5.3
6	Write a program in C to display the n terms of harmonic series and their sum.	CO 2	T2:6.1-6.6
7	Write a program in C to display the pattern like right angle triangle using an asterisk.	CO 2	T2:5.2-5.3
8	Program to accept N integer number and store them in an array AR. The odd elements in the AR are copied into OAR and other elements are copied into EAR. Display the contents of OAR and EAR	CO 3	T2: 6.7
9	Write a C program to illustrate how user authentication is made before allowing the user to access the secured resources. It asks for the user name and then the password. The password that you enter will not be displayed, instead that character is replaced by '*'	CO 3	T2: 8.3, R4:15.1
10	Write a C program to accept a matric and determine whether it is a sparse matrix. A sparse martix is matrix which has more zero elements than nonzero elements	CO 3	T2: 8.1-8.2, R4: 15.1
11	Write a C program to accept a amtric of order MxN and sort all rows of the matrix in ascending order and all columns in descendng order	CO 3	T2: 6.7
12	Write a C program to accept a set of names and sort them in an alphabetical order, Use structures to store the names	CO 4	T2:12.3-12.4, R4:13.4
13	Write a C program to find the sum of two one-dimensional arrays using Dynamic Memory Allocation	CO 4	T2:6.1-6.6
14	Write a program in C to find the content of the file and number of lines in a Text File.	CO 5	T2:10.4, R4:14.1-14.4
15	Write a program in C to replace a specific line with another text in a file.	CO 5	T2:10.4, R4:14.1-14.4
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module I- Components of computers, C programming language	CO 1	T2:1.1-2.6, R4:1.1-2.4
2	Module II- Control structures	CO 2	T2:3.1-6.6

3	Module III- Arrays, Strings and Functions	CO 3	T1:7, T2:6.7-11.5
4	Module IV- Pointers and Structures	CO 4	T2:3.1-6.6, R4:11.1-13.4
5	Module V- File handling functions	CO 5	T2:10.4, R4:14.1-14.4, R3:12.1-12.3
DISCUSSION OF QUESTION BANK			
1	Module I- Components of computers, C programming language	CO 1	T2:1.1-2.6, R4:1.1-2.4
2	Module II- Control structures	CO 2	T2:3.1-6.6
3	Module III- Arrays, Strings and Functions	CO 3	T1:7, T2:6.7-11.5
4	Module IV- Pointers and Structures	CO 4	T2:3.1-6.6, R4:11.1-13.4
5	Module V- File handling functions	CO 5	T2:10.4, R4:14.1-14.4, R3:12.1-12.3

Signature of Course Coordinator **HOD,CSE(DS)**
Dr. J Sirisha Devi, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DS)
COURSE DESCRIPTION

Course Title	English Language and Communication Skills Laboratory				
Course Code	AHSC04				
Program	B.Tech				
Semester	I	DS			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	0	0	0	3	1
Course Coordinator	Mr. P. Sunil Solomon, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
10+2	-	I	Basic principles of communication skills and concepts of functional English grammar.

II COURSE OVERVIEW:

This lab course is designed to introduce the students to create a wide exposure on language learning techniques regarding the basic elements of Listening, Speaking, Reading and Writing. In this lab the students are trained in communicative English language skills, phonetics, word accent, word stress, rhythm, intonation, oral presentations and extempore The students are also taught in terms of seminars, group-discussions, presenting techniques of writing, participating in role plays, telephonic etiquettes, asking and giving directions, information transfer , debates, description of persons, places and objects etc; . The lab encourages the students to work in a group, engage in peer-reviews and inculcate team spirit through various exercises on grammar, vocabulary, and pronunciation games etc. Students will make use of all these language skills in academic, professional and real time situations.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
English Language and Communication Skills Laboratory	60 Marks	40 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Demo Video	X	Lab Worksheets	X	Viva Questions	X	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	-
20 %	Analysis	-
20 %	Design	-
20 %	Conclusion	-
20 %	Viva	-

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

I	Facilitate computer-assisted multi-media instructions to make possible individualized and independent language learning.
II	The critical aspect of speaking and reading for interpreting in-depth meaning of the sentences.
III	Use language appropriately for social interactions such as public speaking, group discussions and interviews.
IV	Habituate using English speech sounds, word accent, intonation and rhythm.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Discuss** the prime necessities of listening skill for improving pronunciation in academic and non-academic purposes.	Understand
CO 2	**Apply** the knowledge of English phonetics for speaking acceptable language and explain the procedure of phonemic transcriptions and intonation patterns.	Apply
CO 3	**Express** about the necessity of stressed and unstressed syllables in a word with appropriate length and clarity.	Understand
CO 4	**Demonstrate** how writing skill fulfills the academic and non-academic requirements of various written communicative functions	Apply
CO 5	**Generalize** appropriate concepts and methods from a variety of disciplines to solve problems effectively and creatively	Understand
CO 6	**Classify** the roles of collaboration, risk-taking, multi-disciplinary awareness, and the imagination in achieving creative responses to problems	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL

VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 9	**Engineering knowledge:** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	CIE / SEE/ Lab Exercises
PO 10	**Communicate:** effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (Communication)	5	CIE / SEE/ Lab Exercises

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation		
PSO 2	Focus on improving software reliability, network security or information retrieval systems		
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions		

3 = High; 2 = Medium; 1 = Low

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Courses Outcomes	Program Outcomes		Program Specific Outcomes		
	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO 1	-	5	-	-	
CO 2	3	-	-	-	
CO 3	-	5	-	-	
CO 4	-	5	-	-	
CO 5	-	5	-	-	
CO 6	-	5	-		

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**Introduction to Pronunciation**
	Introducing self and introducing others-Feedback Common mispronunciations, Errors committed in self introduction and introducing others. Correct pronunciation of various syllables and words Confidence and fluency in self introduction Confidence and fluency in introducing others
WEEK II	**Introduction to Phonetics, Listening to Sounds, Phonetics and Consonants**
	Describing a person or place or a thing using relevant adjectives – feedback. Difficulty in familiarizing with the sounds of English language, errors in using different kinds of sounds, vowels and consonants. Lack of fluency and ease in describing a person or place or a thing in terms of using adjectives. Ability in recognizing different kinds of vowels and consonant sounds. Ease in listening to different sounds of English language and reproducing them. Fluency and ease in describing a person or place or a thing in terms of using adjectives.

WEEK III	**Structure of syllables.**
	JAM Sessions using public address system. Identifying the number of syllables in words and counting them. Fluency and Confidence in expressing oneself relevantly, grammatically, logically and meaningfully. Using different kinds of methods to count the number of syllables in a word Understand the outcome of JAM session Practicing and presenting oneself confidently and successfully in JAM sessions
WEEK IV	**Word accent and Stress shifts**
	Asking for and giving directions with the help of using appropriate phrases – activities. Accent related difficulties, ability to understand and use the shift in stress patterns in various sentences. Problems encountered in asking for directions and giving directions. Ability to use word accent correctly and appropriately. Noticing different shifts in word and sentences stress use them efficiently in spoken communication. Ease in asking for directions and giving directions in locating a place by using prominent landmarks.
WEEK V	**Past tense and plural markers**
	Role Play on fixed expressions in various situations. Differentiation between past tense and plural markers. Problems in using appropriate acceptable and important fixed expressions used in various situations a. Fluent usage of past tense and plural markers in connected speech b. Potential in recalling and reproducing various important fixed expressions used in various situations
WEEK VI	**Weak forms and strong forms**
	Extempore-Picture Errors in using weak forms in spoken English and recognizing the importance of strong forms. Difficulties in describing a picture. Confidence and fluency in using weak forms and strong forms at ease in connected speech. Overcoming difficulties in describing a picture.
WEEK VII	**Intonation**
	Interpretation of Proverbs and Idioms.. Difficulties in using falling, rising, rise-fall and fall-rise tones in connected speech. Difficulties in interpretation and usage of the figurative meanings of various idioms and proverbs. Ability in using falling, rising, rise-fall and fall-rise tones with relative ease. Understand the figurative meanings of different idioms and proverbs and incorporate them in spoken communication.
WEEK VIII	**Neutralization of Mother Tongue Influence (MTI)**
	Etiquette. Influence of Mother tongue in spoken communication. Poor etiquette in the attitude and approach in terms of behaviour and communication. Overcoming the influence of Mother tongue and neutralizing the accent. Understand and incorporate proper etiquette in terms of behaviour and communication.

WEEK IX	**Common errors in pronunciation and Pronunciation practice through tongue twisters**
	Oral Presentations. Difficulties in pronouncing different tongue twisters which support in neutralizing the accent. Confidence and fluency in delivering different oral presentations. Rigorous practice in pronunciation of tongue twisters helping in neutralizing the accent. Developing the necessary confidence and fluency in delivering different oral presentations.
WEEK X	**Minimal Pairs**
	Debates. Difficulties in understanding and remembering various homonyms, homophones and homographs. Problems in understanding the difference between debates and discussions, participating and contributing. Understand the use of different homonyms, homophones and homographs fluently. Understand the difference between debates and discussions and participate and contribute productively.
WEEK XI	**Listening Comprehension,**
	Group Discussion. Inability in focused listening, understanding the accent, vocabulary and discourse markers in connected speech. Lack of confidence in participating and contributing to Group discussions. Fluent listening, understanding and meaning making of the listening comprehension. Successful and confident participation and contribution to Group discussions.
WEEK XII	**Demonstration on how to write leaflets, messages and Notices,**
	Techniques and methods to write summaries and reviews of videos. Inadequacy and inappropriacy in writing leaflets, messages and notices. Lack of proficiency in writing summaries and reviews of videos. Practice and use of proficient and fluent writing. Overcoming difficulties in writing leaflets, messages, notices, summaries and reviews.
WEEK XIII	**Pronunciation practice**
	Information Transfer. Influence of mother tongue in using English language. Problems in interpreting data from diagram to text and text to diagram. Proficiency in using English language by overcoming mother tongue influence Practice and use of interpreting data from diagram to text and text to diagram
WEEK XIV	**Open Ended Experiments-Phonetics Practice**
	Providing reviews and remarks. Persistent problems in identifying the phonetic symbols, remembering and using them. Lack of proficiency in providing reviews and remarks Practice and accuracy in identifying the phonetic symbols and using them with ease. Proficiency in writing reviews and remarks.

WEEK XV	**Open Ended experiments-Text to Speech**
	Writing slogan related to the image. Difficulties in writing text to Speech. Lack of fluency in writing slogans related to the images. Confidence and fluency in writing text to speeches. Fluency, flair and ease in writing slogans related to the images.

Text books

1. English Language and Communication Skills: Lab Manual

Reference books:

1. . Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles and Practices", Oxford University Press, New Delhi, 3rd Edition, 2015.
2. Rhirdion, Daniel, "Technical Communication", Cengage Learning, New Delhi, 1st Edition, 2009.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Introduction to Pronunciation, Introducing self and introducing others-Feedback	CO 2	R1: 1.2
2	Introduction to Phonetics, Listening to Sounds, Phonetics and Consonants, Describing a person or place or a thing using relevant adjectives – feedback.	CO 2	R2: 25-30
3	Structure of syllables. JAM Sessions using public address system.	CO 2	R1: 28-29,49-54
4	Word accent and Stress shifts, asking for directions and giving directions	CO 3	R1: 23-38
5	Past tense and plural markers, Role Play on fixed expressions in various situations	CO 3	R1: 2.4
6	Weak forms and strong forms, Extempore-Picture	CO 2	R3: 4.5
7	Intonation, Interpretation of Proverbs and Idioms	CO 2	R3: 4.6
8	Neutralization of Mother Tongue Influence (MTI), Etiquette	CO 2	R2: 39-42
9	Common errors in pronunciation and Pronunciation practice through tongue twisters, Oral Presentations	CO 2	R2: 5.2
10	Minimal Pairs, Debates	CO 2	R1:42-43
11	Listening Comprehension, Group Discussion.	CO 5	R1:44-48
12	Demonstration on how to write leaflets, messages and Notices, Techniques and methods to write summaries and reviews of videos	CO 4	R1:107-110

13	Pronunciation practice, Information Transfer	CO 4	R1:7.3
14	Open Ended Experiments-Phonetics Practice, Providing reviews and remarks	CO 5	R1:7.3
15	Open Ended experiments-Text to Speech, writing slogan related to the image	CO 6	R1: 54-58

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Effective listening skills can be used in professional and personal platforms in future.**
2	**By learning LSRW skills, students can enhance desired language skills to fulfill their needs.**
3	**Practicing presentation skills will boost confidence at work place.**
4	**The overall experiments of the laboratory will lead to be an effective communicator.**
5	**The Students will develop critical comprehensive skills to solve the career related problems in future.**

Signature of Course Coordinator **HOD**
Mr. P. Sunil Solomon, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING(Data Science)

COURSE DESCRIPTION

Course Title	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**				
Course Code	ACSB02				
Program	B.Tech				
Semester	II	CSE (DS)			
Course Type	Foundation				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. P Ravinder, Assistant Professor				

I COURSE OVERVIEW:

The course covers the basics of programming and demonstrates fundamental programming techniques, customs and terms including the most common library functions and the usage of the preprocessor. This course helps the students in gaining the knowledge to write simple C language applications, mathematical and engineering problems. This course helps to undertake future courses that assume this programming language as a background in computer programming. Topics include variables, data types, functions, control structures, pointers, strings, arrays and dynamic allocation principles. This course in reached to student by power point presentations, lecture notes, and lab involve the problem solving in mathematical and engineering areas..

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB02	I	-

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Programming Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

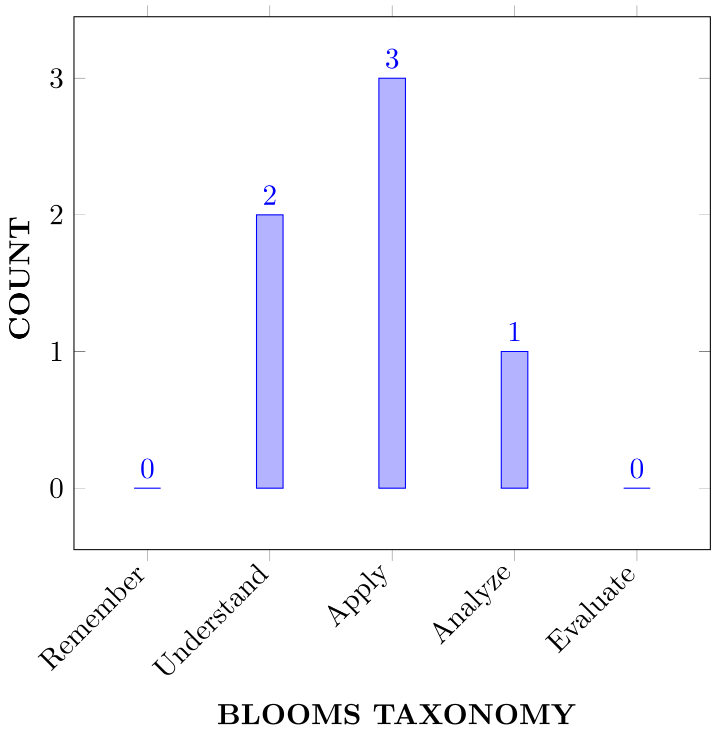
I	The hands on experience in design, develop, implementation and evaluation by using Asymptotic notation.
II	The demonstration knowledge of basic abstract data types (ADT) and associated algorithms for organizing programs into modules using criteria that are based on the data structures of the program.
III	The practical implementation and usage of non linear data structures for solving problems of different domain.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing.
V	The graph traversals algorithms to solve real-world challenges such as finding shortest paths on huge maps and assembling genomes from millions of pieces

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** problem solving steps in terms of algorithms, pseudocode and flowcharts for Mathematical and Engineering problems. .	Understand
CO 2	**Make use** the concept of operators, precedence of operators, conditional statements and looping statements to solve real time applications.	Apply
CO 3	**Demonstrate** the concept of pointers, arrays and perform pointer arithmetic, and use the pre-processor.m.	Understand
CO 4	**Analyze** the complexity of problems, modularize the problems into small modules and then convert them into programs.	Apply
CO 5	**Implement** the programs with concept of file handling functions and pointer with real time applications of C.	Apply
CO 6	**Explore** the concepts of searching and sorting methods with real time applications using c	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Viva-voce/Laboratory Practices
PO 2	**Problem analysis:**Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Viva-voce/Laboratory Practices
PO 3	**Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Viva-voce/Laboratory Practices
PO 5	**Modern Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2	Viva-voce/Laboratory Practices

PO 10	**Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Viva-voce/Laboratory Practices
PO 12	**Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Viva-voce/Laboratory Practices

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	**Professional Skills:** Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation .	2	Viva-voce Laboratory Practices
PSO 2	on improving software reliability, network security or information retrieval systems.	2	Viva-voce Laboratory Practices
PSO 3	use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	2	Viva-voce Laboratory Practices

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	Understand (knowledge) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science**	3
	PO 5	Understand the (given **knowledge**) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3

CO 2	PO 1	Understand (knowledge)the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science.**	3
	PO 5	Understand the (**knowledge**) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2
CO 3	PO 1	Understand (**knowledge**) the basic concept of algorithm analysis which provides theoretical estimates for the resources needed by any algorithm for a given computational problem. These estimates provide an insight into reasonable directions of search for efficient algorithms by applying the principles of **mathematics and science.**	3
	PO 5	Understand the (knowledge) appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3
CO 4	PO 1	Describe (knowledge) the use sorting techniques as a basic building block in algorithm design and problem solving **using principles of mathematics, science, and engineering fundamentals.**	3
	PO 5	Understand the **knowledge** appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	2
	PO 10	Apply (knowledge) concept of dimensional analysis and similarity parameters for predicting physical parameters (understanding) for the fluid flow analysis used in designing prototypes devices (apply) solving design problems by applying the **communicating effectively with engineering community.**	3
CO 5	PO 1	Outline the importance of searching algorithms to retrieve an element from any data structure where it is stored by **understanding and applying the fundamentals of mathematics, science and engineering.**	3
	PO 10	Understand the use of searching techniques that retrieve information stored within some data structure by **communicating effectively with engineering community**.	2
CO 6	PO 1	Outline the importance of searching algorithms to retrieve an element from any data structure where it is stored by **understanding and applying the fundamentals of mathematics, science and engineering**	2

	PO 10	Understand the use of searching techniques that retrieve information stored within some data structure by **communicating effectively with engineering communit.**	3

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				
	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	4	2	
CO 2	3	4	5	2	
CO 3	3	3	4	2	3
CO 4	3	3	3	2	2
CO 5	2	4	5	4	2
CO 6	3	5	3	3	2

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	PO 1, ,PO 2, PO 3, PSO 1	SEE Exams	PO 1,PO 3, PO 5, PSO 1	Seminars	-
Laboratory Practices	PO 1,PO 2, PO 3, PO 5,PO 10, PSO 1	Student Viva	PO 1, PO 5	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**OPERATORS AND EVALUATION OF EXPRESSIONS**

	a. Write a C program to check whether a number is even or odd using ternary operator. b. Write a C program to perform the addition of two numbers without using + operator. c. Write a C program to evaluate the arithmetic expression ((a + b / c * d - e) * (f - g)). Read the values a, b, c, d, e, f, g from the standard input device. d. Write a C program to find the sum of individual digits of a 3 digit number. e. Write a C program to read the values of x and y and print the results of the following expressions in one line: i. (x + y) / (x - y) ii. (x + y)(x - y)
WEEK II	**CONTROL STRUCTURES**
	a. Write a C program to find the sum of individual digits of a positive integer. b. A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1.Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence. c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user. d. A character is entered through keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if- else and switch case. The following table shows the range of ASCII values for various characters. Characters ASCII values A – Z 65 – 90 a – z 97 – 122 0 – 9 48 – 57 Special symbols 0 – 47, 58 – 64, 91 – 96, 123 – 127 If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Write a C program to determine how much profit or loss incurred in percentage.
WEEK III	**CONTROL STRUCTURES**
	a. Write a C program to find the roots of a quadratic equation. d. Write a C program to check whether a given 3 digit number is Armstrong number or not. e. Write a C program to print the numbers in triangular form 1 1 2 1 2 3
WEEK IV	**ARRAYS**
	a. Write a C program to find the second largest integer in a list of integers. b. Write a C program to perform the following: i. Addition of two matrices ii. Multiplication of two matrices c. Write a C program to count and display positive, negative, odd and even numbers in an array. d. Write a C program to merge two sorted arrays into another array in a sorted order. e. Write a C program to find the frequency of a particular number in a list of integer.
WEEK V	**STRINGS**

	a. Write a C program that uses functions to perform the following operations: i. To insert a sub string into a given main string from a given position. ii. To delete n characters from a given position in a given string. b. Write a C program to determine if the given string is a palindrome or not. c. Write a C program to find a string within a sentence and replace it with another string. d. Write a C program that reads a line of text and counts all occurrence of a particular word. e. Write a C program that displays the position or index in the string S where the string T begins, or 1 if S doesn't contain T. .
WEEK VI	**FUNCTIONS**
	a. Write C programs that use both recursive and non-recursive functions i. To find the factorial of a given integer. ii. To find the greatest common divisor of two given integers. b. Write C programs that use both recursive and non-recursive functions i. To print Fibonacci series. ii. To solve towers of Hanoi problem. c. Write a C program to print the transpose of a given matrix using function. d. Write a C program that uses a function to reverse a given string. .
WEEK VII	**POINTERS**
	a. Write a C program to concatenate two strings using pointers. b. Write a C program to find the length of string using pointers. c. Write a C program to compare two strings using pointers. d. Write a C program to copy a string from source to destination using pointers. e. Write a C program to reverse a string using pointers. .
WEEK VIII	**STRUCTURES AND UNIONS**
	a. Write a C program that uses functions to perform the following operations: i. Reading a complex number ii. Writing a complex number iii. Addition and subtraction of two complex numbers iv. Multiplication of two complex numbers. Note: represent complex number using a structure. b. Write a C program to compute the monthly pay of 100 employees using each employee's name, basic pay. Print the employees name and gross salary. c. Create a Book structure containing book id, title, author name and price. Write a C program to pass a structure as a function argument and print the book details. d. Create a union containing 6 strings: name, home address, hostel address, city, state and zip. Write a C program to display your present address. e. Write a C program to define a structure named DOB, which contains name, day, month and year. Using the concept of nested structures display your name and date of birth. .
WEEK IX	**ADDITIONAL PROGRAMS**

	a. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x2+x3+... +xn . For example: if n is 3 and x is 5, then the program computes1+5+25+125. Print x, n, the sum. Perform error checking. For example, the formula does not make sense for negative exponents if n is less than 0. Have your program print an error message if n¡0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too. b. 2s complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the2 s complement of a binary number. c. Write a C program to convert a Roman numeral to its decimal equivalent. E.g. Roman number CD is equivalent to 400. .
WEEK X	**PREPROCESSOR DIRECTIVES**
	a. Define a macro with one parameter to compute the volume of a sphere. Write a C program using this macro to compute the volume for spheres of radius 5, 10 and 15 meters. b. Define a macro that receives an array and the number of elements in the array as arguments. Write a C program for using this macro to print the elements of the array. c. Write symbolic constants for the binary arithmetic operators +, -, *, and /. Write a C program to illustrate the use of these symbolic constants.
WEEK XI	**FILES**
	a. Write a C program to display the contents of a file. b. Write a C program to copy the contents of one file to another. c. Write a C program to reverse the first n characters in a file, where n is given by the user. d. Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are put in the third file. e. Write a C program to count the no. of characters present in the file
WEEK XII	**COMMAND LINE ARGUMENTS**
	a. Write a C program to read arguments at the command line and display it. b. Write a C program to read two numbers at the command line and perform arithmetic operations on it. c. Write a C program to read a file name at the command line and display its contents.

TEXTBOOKS

1. Sutton, G.P., et al., —Rocket Propulsion Elements, John Wiley Sons Inc., New York, 1993

2. Martin J.L Turner , Rocket Space Craft Propulsion, Springers oraxis publishing, 2001

REFERENCE BOOKS:

1. Mathur, M., and Sharma, R.P., —Gas Turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi 1998

2. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, J.W., Freeman & Co. Ltd., London, 1982.

3. Parker, E.R., Materials for Missiles and Spacecraft, McGraw-Hill Book Co. Inc., 1982.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Calibration of Venturimeter and Orifice meter.	CO 1	R1: 1.2
2	Determination of pipe flow losses in rectangular and circular pipes.	CO 2	R2: 3.5
3	Verification of Bernoulli's theorem	CO 3	R1: 3.4
4	Determination of Reynolds Number of fluid flow	CO 4	R1: 2.2
5	Determine the reaction forces produced by the change in momentum.	CO 5	R1: 2.4
6	Determine the efficiencyand draw theperformance curves ofcentrifugal pump.	CO 6	R3: 4.5
7	Determine the efficiencyand draw theperformance curves of reciprocating pump.	CO 6	R3: 4.6
8	Determine the performance characteristics of pelton wheel under constant head.	CO 6	R2: 5.1
9	Determine the performance characteristics of Francis turbine.	CO 6	R2: 5.2
10	Determine the rate of flow through weir.	CO 7	R1: 7.1
11	Determine the rate of flow through Nothches.	CO 7	R1:7.2
12	Determine the rate of flow through a Orifice meter	CO 7	R1:7.3

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Demonstration of twin vortex formation and calculation of vortex size for different geometries.
2	**Open channel:** Demonstration of streamline at different angle of attack and calculation of separation point for different Reynolds number.
3	**Capillary action:** By modeling capillary action using two cups of water and a paper towel, you'll gain a better understanding of the importance of this process in trees.
4	**Buoyancy** Calculation of meta center and displacement volume for various geometries and materials.
5	**Flow through pipes:** Encourage students to design and analyze flow through pipes using ANSYS

Signature of Course Coordinator **HOD,CSE(DS)**
Mr. P Ravinder, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DS)
COURSE DESCRIPTION

Course Title	**PHYSICS LABORATORY**				
Course Code	AHSC05				
Program	B.Tech				
Semester	I	AE			
Course Type	FOUNDATION				
Regulation	IARE - UG 22				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. P. Usha, Assistant Professor				

I COURSE OVERVIEW:

This lab course provides hands on experience in a number of experimental techniques and developscompetenceintheinstrumentationtypicallyusedinphysics.This also develops student's expertise in applying physical concepts to practical problem and in learning about experimental techniques with advanced equipments. This laboratory includes experiments involving electromagnetism and optoelectronics.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	Basic principles of physics	1.5

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Physics laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing Further Experiments

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day-to-day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the principal from the panel of experts recommended by Chairman, BOS.
The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

A. Experiment Based

Objective	**Analysis**	**Design**	**Result and Conclusion**	**Viva**	**Total**
2	2	2	2	2	10

B. Programming Based

Purpose	**Algorithm**	**Program**	**Conclusion**	**Viva**	**Total**
-	-	-	-	-	-

VI COURSE OBJECTIVES:

The students will try to learn:

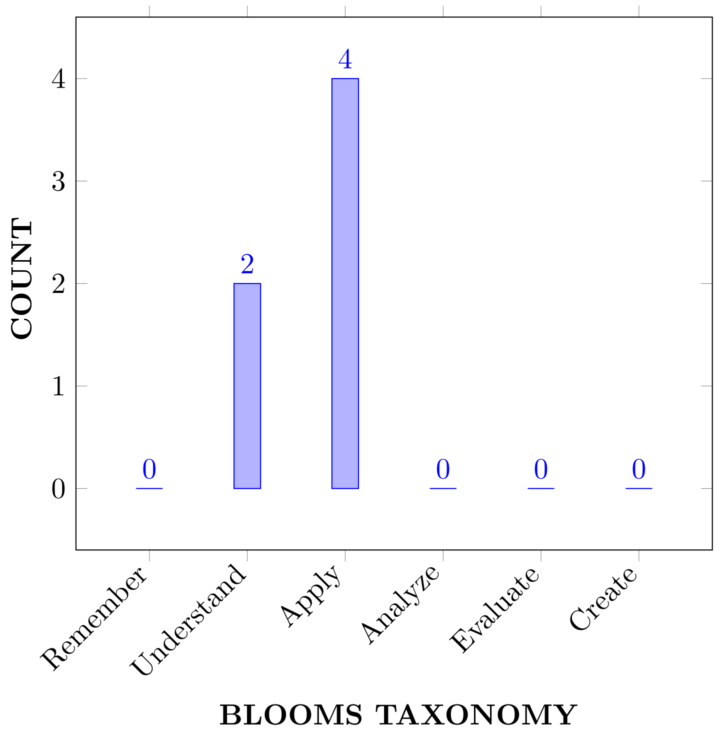
I	To familiarize with the lab facilities, equipment, standard operating procedures.
II	About the different kinds of functional electric and magnetic materials which paves a way for them to use in various technical and engineering applications.
III	The analytical techniques and graphical analysis to study the experimental data for optoelectronic devices.
IV	The applications of variation in the intensity of light due to natural phenomena like interference and diffraction.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Identify** the type of semiconductor using the principle of Hall Effect and also determine the energy gap of a semiconductor diode.	Apply
CO 2	**Illustrate** principle, working and application of wave propagation and compare results with theoretical harmonics and overtones.	Understand
CO 3	**Investigate** the energy losses associated with a given Ferro magnetic material and also magnetic field induction produced at various points along the axis of current carrying coil.	Apply
CO 4	**Examine** launching of light through optical fiber from the concept of light gathering capacity of numerical aperture.	Understand
CO 5	**Make use of** the phenomena of interference and diffraction for obtaining values of various parameters like radius of curvature of convex lens, wavelength of laser light and width of single slit.	Apply
CO 6	**Investigate** V-I/L-I characteristics of various optoelectronic devices like Light Emitting Diode, Photodiode to understand their basic principle of functioning as well as to infer the value of Planck's constant.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Laboratory experiments, internal and external lab examinations.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Laboratory experiments, internal and external lab examinations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Laboratory experiments, internal and external lab examinations.

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	-	Worksheets

3 = High; 2 = Medium; 1 = Low

XI JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	**Justification for mapping (Students will be able to)**	No. of Key Competencies
CO 1	PO 1	Identify basic principle of Hall effect and make use of mathematical expression for Hall coefficient to deduce the type of semiconductor.	2
	PO 2	Understand the given problem statement of identification of type of semiconductor and formulate Hall coefficient from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 1	Determine the energy gap of a semiconductor diode by making use of graphical analysis of current versus temperature curve.	2

CO 2	PO 1	Recall the theory of propagation of longitudinal and transverse waves and make use of number of loops formation in string to determine frequency of an electronically maintained tuning fork.	2
	PO 2	Understand the given problem statement of stationary wave propagation and formulate harmonics and overtones of fundamental frequency from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
CO 3	PO 1	Explain the variation of magnetic field at various points along the axis of current carrying coil and make use of mathematical expression of Tangent's law using Stewart Gee's apparatus.	2
	PO 2	Understand the given problem statement of current loop and formulate magnetic field induction at various points along the axis of current loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 1	Investigate the energy losses associated with a given ferromagnetic material and make use of graphical representation of hysteresis loop exhibited by magnetic material.	2
	PO 2	Understand the given problem statement of energy losses associated with a given ferromagnetic material and formulate hysteresis loop from experimental collection of information and data in reaching substantial conclusions by the interpretation of results.	4
	PO 4	Apply simulation tool to get hysteresis curve of a ferromagnetic material and understand energy losses associated with material.	1
	PSO 3	Make use of modern simulation tool to get information about energy losses associated with a ferromagnetic material.	1
CO 4	PO 1	Interpret launching of light through optical fiber and make use of mathematical expression for analyzing light gathering capacity through numerical aperture.	2
	PO 4	Make use of optical fiber trainer kit and understand conversion of electrical to light energy..	1
CO 5	PO 1	Explain the concept of interference in Newton's rings and make use of it to determine the radius of curvature of convex lens.	2
	PO 4	Make use of microscope to get Newton's rings and understand the phenomenon of interference in reflected light.	1
	PO 1	Recollect the phenomena of diffraction from N-slits and make use of it for the determination of wavelength of a given laser.	1

	PO 1	Understand the phenomenon of single slit diffraction and make use of it to determine the slit width by using laser light as monochromatic source.	1
CO 6	PO 1	Explain the V-I characteristics of light emitting diode and infer the value of planck's constant by plotting temperature versus current curve.	2
	PO 1	Understand the phenomenon of recombination of electron-hole pair and determine the value of threshold voltage of a given LED.	2
	PO 1	Illustrate the variation of photo current with light intensity in a photo diode.	1

XII MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES			PSO'S
	PO 1	PO 2	PO 4	PSO 3
CO 1	3	2	-	-
CO 2	3	2	1	-
CO 3	3	-	-	1
CO 4	3	2	1	-
CO 5	3	-	1	-
CO 6	3	2	1	-

3 = High; 2 = Medium; 1 = Low

XIII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIV ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XV SYLLABUS:

WEEK 1	**HALL EFFECT (LORENTZ FORCE)**
	Relate the phenomenon of voltage difference across an electrical conduvtivity that is transverse to the electric current and determine the charge carrier density and Hall coefficient of a given sample.
WEEK 2	**MELDE'S EXPERIMENT**
	Determination of frequency of a given tuning fork in longitudinal mode and transverse mode of propagation.
WEEK 3	**STEWART GEE'S APPARATUS**
	Study the Magnetic field along the axis of current carrying coil – Stewart and Gee's method.
WEEK 4	**B-H CURVE WITH CRO**
	Evaluate the energy loss per unit volume of a given magnetic material per cycle by tracing the Hysteresis loop (B-H curve), and observing the hysteresis loss of ferro magnetic materials.
WEEK 5	**ENERGY GAP OF A SEMICONDUCTOR DIODE**
	Determination of energy gap of a given semiconductor diode by measuring the variation of current as a function of temperature.
WEEK 6	**PHOTO DIODE**
	Studying the V-I characteristics of Photo Diode in reverse bias for different intesities of incident light.
WEEK 7	**OPTICAL FIBER**
	Evaluation of numerical aperture and acceptance angle of a given optical fiber.
WEEK 8	**WAVELENGTH OF LASER LIGHT**
	Make use of diffraction grating to measure wavelength of given laser light.
WEEK 9	**PLANCK'S CONSTANT**
	Determination of Planck's constant by measuring threshold voltage of given LED.
WEEK 10	**LIGHT EMITTING DIODE**
	Studying V-I Characteristics of LED in forward bias for different LEDs and measure the threshold voltage and forward resistance.
WEEK 11	**NEWTONS RINGS**
	Determination of radius of curvature of a given plano - convex lens by using the phenomenon of interference in thin films by reflected light.
WEEK 12	**SINGLE SLIT DIFFRACTION**
	Study the intensity distribution due to diffraction from single slit and to determine the slit width (d).

TEXTBOOKS

1. CL Arora, "Practical Physics", S Chand and Co.,New Delhi, 3rd Edition,2012.

2. Vijay Kumar, Dr. T. Radha krishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.

3. Dr. Rizwana, "Engineering Physics Manual", Spectrum Techno Press, 2018

REFERENCE BOOKS:

1. 1 CF Coombs,"Basic Electronic Instrument Handbook", McGraw - HillBookCo.,1972.
2. 2 CH Bernardand CD Epp, John Wiley and Sons, " Laboratory Experiments in College Physics" Inc.,NewYork,1995.

ODL THROUGH IARE AKANSHA PORTAL:

https://akanksha.iare.ac.in/index?route=course/details&course_id=1108

XVI COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Determination of charge carrier density.	CO 1	T1:13.5
2	Determination of frequency of a given tuning fork.	CO 2	T1:13.5
3	Determination of Magnetic field along the axis of current carrying coil – Stewart and Gee's method.	CO 3, CO 4	TT1:14.7
4	Determination of the energy loss per unit volume of a given magnetic material per cycle by tracing the Hysteresis loop.	CO 3	T1:15.7
5	Determination of energy gap of a semiconductor diode.	CO 1	T1:16.8
6	Studying V-I Characteristics of Photo Diode.	CO 6	T1:16.9
7	Evaluation of numerical aperture of a given optical fiber.	CO 4	T1:17.9
8	Determination of wavelength of a given laser light using diffraction grating.	CO 5	T1:18.10
9	Determination of Plank's constant using LED.	CO 6	T1:19.10
10	Studying V-I characteristics of LED	CO 6	T1:19.9
11	Determination of radius of curvature of a given Plano-convex lens.	CO 5	T1:23.10
12	Determination of width of a given single slit.	CO 5	T1:23.10

XVII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	**Design Oriented Experiments**
1	To determine the wavelength of different colored light using white light source by Newton's ring method
2	To study the bending losses and transmission losses of an optical Fiber
3	To observe the dispersion of prism by using spectrometer.
4	Study the characteristics of Laser diode.
5	To illustrate the interference pattern produced from the air wedge.
6	To determine the voltage current characteristics of solar cell

Signature of Course Coordinator **HOD,DS**
Ms. P. Usha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE ENGINEERING
COURSE DESCRIPTION

<table>
<tr><td>Department</td><td colspan="5">DATA SCIENCE</td></tr>
<tr><td>Course Title</td><td colspan="5">COMPUTER ORGANIZATION AND ARCHITECTURE</td></tr>
<tr><td>Course Code</td><td colspan="5">ACSC07</td></tr>
<tr><td>Program</td><td colspan="5">B.Tech</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4">CSE(DS)</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Regulation</td><td colspan="5">UG-20</td></tr>
<tr><td rowspan="3">Course Structure</td><td colspan="3">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Lecture</td><td>Tutorials</td><td>Credits</td><td>Laboratory</td><td>Credits</td></tr>
<tr><td>3</td><td>1</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td>Course Coordinator</td><td colspan="5">Mr D.SREENIVASULU, Assistant Professor</td></tr>
</table>

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

This course introduces the principles of basic computer organization, CPU organization, and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, register transfer languages, arithmetic, logic and shift micro-operations, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O organization of computer, parallel processing and inter process communication and synchronization.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Organization and Architecture	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

<table>
<tr><td>✓</td><td>Power Point Presentations</td><td>✓</td><td>Chalk & Talk</td><td>X</td><td>Assignments</td><td>x</td><td>MOOC</td></tr>
<tr><td>✓</td><td>Open Ended Experiments</td><td>✓</td><td>Seminars</td><td>x</td><td>Mini Project</td><td>✓</td><td>Videos</td></tr>
<tr><td>x</td><td colspan="7">Others</td></tr>
</table>

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
60 %	Understand
20 %	Apply
10 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

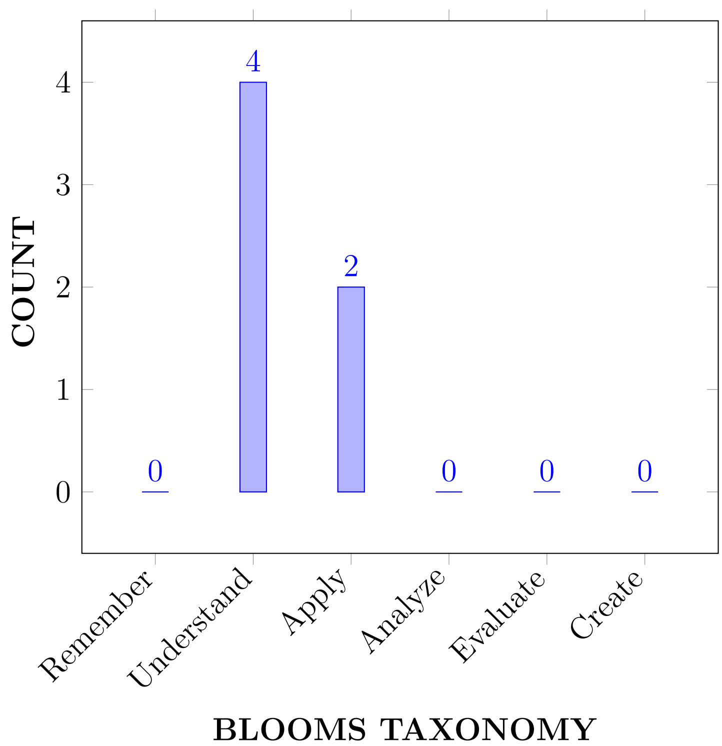
VI COURSE OBJECTIVES:
The students will try to learn:

I	Understand the organization and architecture of computer systems and electronic computers.
II	Study the assembly language program execution, instruction format and instruction cycle.
III	Design a simple computer using hardwired and micro-programmed control methods.
IV	Study the basic components of computer systems besides the computer arithmetic .
V	Understand input-output organization, memory organization and management, and pipelining.

VII COURSE OUTCOMES:
After successful completion of the course, students should be able to:

CO 1	**Illustrate** interaction of components in a computer system with functional units and levels of programming languages.	Understand
CO 2	**Demonstrate** the implementation of micro-operations with the help of register transfer language and electronic circuits.	Understand
CO 3	**Identify** appropriate addressing modes for specifying the location of an operand.	Apply
CO 4	**Make use of** number system for data representation and binary arithmetic in digital computers.	Apply
CO 5	**Interpret** the design of hardwired and micro-programmed control unit for execution of micro programs.	Understand
CO 6	**Summarize** the concepts of pipelining and interprocess communication for advanced processor design.	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE / CIE / AAT
PO 4	**Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	SEE / CIE / AAT
PO 5	**Modern tool usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineeringactivities with an understanding of the limitations.	3	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	SEE / CIE / AAT
PO 12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	CIE/Quiz/ AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	CIE/Quiz/ AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	CIE/Quiz /AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	✓	-	-	-	-	-	-	-	-		✓	✓	-
CO 2	✓	-	-	-	-	-	-	-	-	-	-	-	✓	✓	-
CO 3	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	✓	-	✓	-	-	-	-	-	✓	-	✓	✓	-	-
CO 5	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 6	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Explain the various functional units of Computer with computer science principles.	1
	PO 2	Explore the types of programming languages for problem identification and to formulate computer science and Engineering Problems.	2
	PO 3	Evaluate the instruction set architecture based on the cost drivers, integration, manage design process and understand customer needs..	4
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems..	1
CO 2	PO1	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4

	PSO 2	Focus on improving software reliability, network security or information retrieval systems..	3
CO 3	PO 1	Select appropriate addressing mode for finding effective address of operand using mathematical and computer science principles	2
	PO 2	Choose appropriate addressing mode for information and data collected from various sources memory locations or registers and perform microoperations and validation the results for interpretation	1
	PO 3	Classify the addressing modes in terms of defining various problems and understanding appropriate codes of practice.	3
	PO 4	Utilize Instruction set architecture of processors for designing assembly language programs through laboratory skills and technical literature.	2
	PO 10	Make use of variety of addressing modes to fetch operands for the development of assembly language program with clarity and semantics or grammar of the assembly language.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
CO 4	PO 1	Explain the concept of data representation by applying mathematical and computer science principles.	3
	PO 2	Understand the data representation and computer arithmetic for understanding of appropriate codes to formulate, solve problem, document and interpretation of results.	6
	PO 3	Identify the appropriate representation of data suitable for customer needs, investigation of a problem, identify and manage architecture design process.	4
	PO 4	Communicate effectively in orally and written by comprehend and write effective reports and design documentation with the engineering community by having major focus on clarity on content, Grammar/Punctuation, appropriate References, good Speaking style and depth in subject matter.	2
	PO 10	Recognize the need for advanced concepts in binary arithmetic and algorithms for developing applications through continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
CO 5	PO 1	Design control unit by considering various issues and types risk assessment and analysis activity to identify and analyze root causes using computer science principles.	1

	PO 2	Design and develop hardwired and micro programmed control units with knowledge and uncertainty of commercial engineering process and management.	2
	PO 3	Design a control memory of system by investigating and defining various problems, understanding user needs.	3
	PO 4	Utilize micro instructions for designing assembly language programs through laboratory skills, technical literature, technical uncertainty and quality issues.	3
	PO 5	Experiment the design of control unit with Computer software or simulation packages.	2
	PO 10	Recognize the need for advanced concepts of control memory design and micro instructions based on micro architecture for developing applications through continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	4
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	1
CO 6	PO 1	Understand the concept of pipelining to improve performance of the system by applying mathematical principles and computer science methodologies.	2
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation advanced micro architectures with the engineering community by having major focus on clarity on content, Grammar/Punctuation, good Speaking style	2
	PO 12	Recognize the need for advanced concepts for developing applications through continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	4
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	4	-	-	-	-	-	-	-	-	-	1	1	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	1	2	-
CO 3	2	2	1	3	-	-	-	-	-	2	-	2	1	-	-
CO 4	3	6	-	4	-	-	-	-	-	2	-	3	1	-	-
CO 5	1	2	3	3	-	-	-	-	-	2	-	4	1	-	1
CO 6	2	-	-	-	-	-	-	-	-	2	-	4	1	-	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.4	20	40	-	-	-	-	-	-	-	-	-	16.6	50	-
CO 2	66.6	-	-	-	-	-	-	-	-	-	-	-	16.6	100	-
CO 3	66.6	20	10	27.3	-	-	-	-	-	20	-	16.6	16.6	-	-
CO 4	100.0	60	-	36.4	-	-	-	-	-	20	-	25	16.6	-	-
CO 5	33.4	20	30	27.3	-	-	-	-	-	20	-	33.4	16.6	-	50
CO 6	66.6	-	-	-	-	-	-	-	-	20	-	33.4	66.7	-	50

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $< C \leq 40\%$ – Low/ Slight
2 - 40 % $< C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	2	-	-	-	-	-	-	-	-		1	-	3
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	3
CO 3	3	1	1	1	-	-	-	-	-	1	-	1	1	-	-
CO 4	3	3	-	1	-	-	-	-	-	1	-	1	3	-	-
CO 5	1	1	1	1	-	-	-	-	-	1	-	1	1	-	3
CO 6	3	-	-	-	-	-	-	-	-	1	-	1	1	-	3
TOTAL	14	6	4	3	-	-	-	-	-	4	-	4	8	-	12
AVERAGE	2.3	1.5	2.6	1	-	-	-	-	-	1	-	1	1.33	-	3

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Seminars	✓	Student Viva	-	Certification	-
Laboratory Practices	-	Student viva	-	Mini projects	-
Term Paper	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO COMPUTER ORGANIZATION**
	Basic computer organization, CPU organization, memory subsystem organization and interfacing, input or output subsystem organization and interfacing, a simple computer levels of programming languages, assembly language instructions, instruction set architecture design, a simple instruction set. .
MODULE II	**ORGANIZATION OF A COMPUTER**
	Register transfer: Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro-operations, shift micro-operations; Control unit: Control memory, address sequencing, micro program example, and design of control unit.
MODULE III	**CPU AND COMPUTER ARITHMETIC**
	CPU design: Instruction cycle, data representation, memory reference instructions, input-output, and interrupt, addressing modes, data transfer and manipulation, program control. Computer arithmetic: Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit.
MODULE IV	**INPUT-OUTPUT ORGANIZATION AND MEMORY ORGANIZATION**
	Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory; Input or output organization: Input or output Interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.
MODULE V	**MULTIPROCESSORS**
	Pipeline: Parallel processing, pipelining-arithmetic pipeline, instruction pipeline; Multiprocessors: Characteristics of multiprocessors, inter connection structures, inter processor arbitration, inter processor communication and synchronization.

TEXTBOOKS

1. M. Morris Mano, “Computer Systems Architecture”, Pearson, 3 rd Edition, 2015.
2. John D. Carpinelli, “Computer Systems Organization and Architecture”, Pearson, 1 st Edition, 2001.
3. Patterson, Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Morgan Kaufmann, 5 th Edition, 2013.

REFERENCE BOOKS:

1. John. P. Hayes, "Computer System Architecture", McGraw-Hill, 3 rd Edition, 1998.
2. Carl Hamacher, Zvonko G Vranesic, Safwat G Zaky, "Computer Organization", McGraw-Hill, 5 th Edition, 2002.
3. William Stallings, "Computer Organization and Architecture", Pearson Edition, 8 th Edition, 2010

WEB REFERENCES:

1. http://www.web.stanford.edu/class/cs103x

COURSE WEB PAGE:

1. https://lms.iare.ac.in/index?route=course/details & course_id=528

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
1-2	Outline the basic computer organization	CO1	T1: 4.1-4.2,T1: 4.1
2-3	Understand the CPU organization, memory subsystem organization and interfacing	CO 1	T1: 4.3-4.4
4-5	Analyze the input or output subsystem organization and interfacing	CO 1,CO6	T1: 3.1-3.2
5-6	Understand a simple computer levels of programming languages	CO 1	T2: 2.5-2.6,
7-8	Explain assembly language instructions	CO 2, CO 3	T1:1.5, 1.4.2,1.4.3
9	Determine the simple instruction set architecture	CO 2	T2: 7.4
10-11	Understand the register transfer language, register transfer.	CO 2	T2: 5.6-5.7
12	Analyze bus and memory transfers	CO 2	T1: 6.7-6.8
13-15	Explain the arithmetic micro-operations, logic micro-operations, shift micro-operations	CO 2	T2: 8.5-8.7
16	Understand the control memory	CO 5	T2: 8.6
17-18	Explain the instruction cycle	CO 2	T2: 10.1-10.5
19-20	Outline the data representation, memory reference instructions	CO 3	T2: 12.1
20-21	Analyze input-output, and interrupt, addressing modes	CO 3	T2: 11.2

22	Discuss the data transfer and manipulation, program control	CO 3	T2: 11.3-11.4
23-25	Determine the Addition and subtraction, floating point arithmetic operations, decimal arithmetic unit	CO 4	T2: 11.5
26	Need of Input or output organization	CO5	R1: .3.1
27-29	Discuss the Input or output Interface	CO5	R1: 3.3-9.5
30-31	Understand the asynchronous data transfer, modes of transfer	CO5	T2: 9.4
32-33	Analyze the priority interrupt, direct memory access	CO5	T2:13.1
34	Understand the memory organization	CO5	T2:13.2
35-36	Discuss Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory	CO 5	T2: 13.3
37-38	Understand the Pipeline: Parallel processing, Instruction pipeline	CO6	T2: 13.
39	Characteristics of multiprocessors	CO6	T2: 13.1
40	Inter connection structures	CO6	T2: 13.2
41	Inter processor arbitration	CO 3,CO6	T2: 13.3
42	Inter processor communication and synchronization	CO 6	T2: 13.4
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on BCD conversions	CO1	T2:2.1
2	Problems on BCD conversions	CO1	T2:2.3
3	Problems on Addition and substraction	CO3	T2:2.3.1
4	Problems on Multiplication	CO3	T2:7.2,7.3
5	Problems on Booths multiplication	CO3	T2:10.3.1
6	Problems on Booths Algorithm	CO3	T2:13.3.2, 13.4.1
7	Problems on Division	CO3	T2:17.1.1, 17.1.3
8	Problems on Data presentation	CO3	T2:18.3.4, 18.3.4.1
9	Problems on Data presentation	CO3	T2:22.12, 19.1.2
10	Problems on Data presentation	CO3	T2:18.4, 18.4.3
11	Problems on floating point arithmetic operations	CO3	T2:19.2, 18.4.4
12	Problems on Decimal arithmatic unit	CO3	T2:23.1.1, 23.1.3
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Define register transfer language,fixed point number,instruction format,data Processing instruction,data Processing instruction	CO 1	T2:18.3.4, 18.3.4.1
2	Define miscellaneous Instructions, addressing mode,micro operation.	CO 2	T2:22.12, 19.1.2
3	Define arithmetic micro operations,arithmetic micro operations,logical shift operation	CO 3	T2:18.4, 18.4.3

4	Define data bus,metropolitan area network,network topology,star topology,bus tropology	CO4, CO 5	T2:19.2, 18.4.4
5	define vecto,pipeline cycle time, arithmetic pipeline,optimal number of pipeline stages	CO 6	T2:23.1.1, 23.1.3
DISCUSSION ON QUESTION BANK			
1	Illustrate the input and output operations with a neat diagram.	CO 1	T2:18.3.4, 18.3.4.1
2	List the various instruction formats and illustrate with an example.	CO 2	T2:22.12, 19.1.2
3	Identify micro programexample and build a computer hardware configuration	CO3,CO4	T2:18.4, 18.4.3
4	Illustrate the belowaddressing modes withexamples a. Implied Modeb. Immediate Mode c. Autoincrement and Auto,decrement Mode d. Direct and Indirect Address Mode.	CO5	T2:19.2, 18.4.4
5	Define parallel processing and explain the flynn's classification of computer with suitable diagram	CO 6	T2:23.1.1, 23.1.3

Course Coordinator **HOD,CSE (DS)**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING(DS)**				
Course Title	**DATA STRUCTURES**				
Course Code	ACSC08				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	UG.20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr B.Dilip Chakravarthy, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming

II COURSE OVERVIEW:

The course covers some of the general-purpose data structures and algorithms, and software development. Topics covered include managing complexity, analysis, static data structures, dynamic data structures and hashing mechanisms. The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter in real life. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	whiteboard		Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	**Blooms Taxonomy Level**
0%	Remember
30%	Understand
60%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table.

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

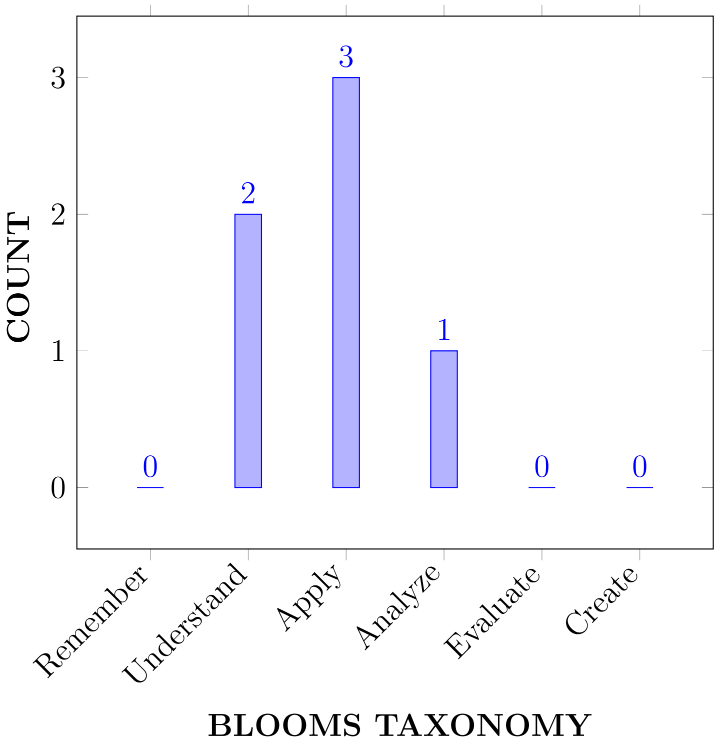
I	To provide students with skills needed to understand and analyze performance trade-offs of different algorithms / implementations and asymptotic analysis of their running time and memory usage.
II	To provide knowledge of basic abstract data types (ADT) and associated algorithms: stacks, queues, lists, tree, graphs, hashing and sorting, selection and searching.
III	The fundamentals of how to store, retrieve, and process data efficiently
IV	To provide practice by specifying and implementing these data structures and algorithms in Python.
V	Understand essential for future programming and software engineering courses.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Interpret** the complexity of algorithm using the asymptotic notations.	Understand
CO 2	**Select** appropriate searching and sorting technique for a given problem.	Apply
CO 3	**Construct** programs on performing operations on linear and nonlinear data structures for organization of a data	Apply
CO 4	**Make use of** linear data structures and nonlinear data structures solving real time applications.	Apply
CO 5	**Describe** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance.	Understand
CO 6	**Compare** various types of data structures ; in terms of implementation, operations and performance.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Outcomes	
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIA/SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIA/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	CIA/SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIA/SEE

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIA/SEE/Open ended Experiments
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	Tech Talk/Concept Videos/Open ended Experiments
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	Tech Talk/Concept Videos/Open ended Experiments

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	CIA/ SEE/ Tech Talk/ Concept Videos
PSO 2	**Focus on** Focus on improving software reliability, network security or information retrieval systems.	2	CIA/ SEE/ Tech Talk/ Concept Videos
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2	CIA/ SEE/ Tech Talk/ Concept Videos

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 5	✓	-	✓	-	✓	-	-	-	-	✓	-	-	✓	✓	✓
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO1	PO 1	**Understand** (knowledge) the concept of conventional digital communication system and (understand) various types of pulse analog modulation techniques for signals analysis by applying the principles of **mathematics, science,** and **engineering fundamentals**.	3
	PO 2	**Problem Analysis** on different types of algorithms to analyze space and time complexities.	4
	PO 3	**Design the Solutions** for finding space and time complexities of a complex algorithm and representing it by asymptotic notations	2
	PO 10	**Subject matter and speaking style** assessed in explanation of various algorithms, algorithm complexity.	2
	PSO1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 2	PO 1	**Make use** of broad knowledge of searching and sorting techniques for an efficient search from a data structure and optimize the efficiency of other algorithms by applying the knowledge of mathematics, science, Engineering fundamentals.	1
	PO 2	**Problem Analysis** on different types of search sort algorithms to analyze space and time complexities.	5

	PO 3	**Design/Development of Solutions** using appropriate searching and sorting techniques for designing a solution for complex Engineering problems.	2
	PO 5	**Implementation of** different sorting and searching techniques for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of searching and sorting along with efficiency of searching and sorting techniques in terms of space and time complexity	2
	PO 12	**Keeping current in CSE and advanced engineering concepts** of various searching , sorting and respective time and space complexity by tech talk, concept videos and open ended experiments.	3
	PSO1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
	PSO2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 3	PO 1	**Make use of** linear and nonlinear data structures to organize the data in a particular way so to use them in the most effective way by applying the basic knowledge of mathematics, science, engineering fundamentals	2
	PO 2	**Problem analysis:** Organizing the given data in particular way by performing the operations on linear and nonlinear data structures to use the data in the most effective way.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue by Designing solutions for complex Engineering.	5
	PO 4	**Conduct Investigations** Conduct Investigations of Complex Problems: Ability to apply operations on linear and nonlinear data structures in order to organize the given data in a particular way	4
	PO 5	**Implementation of** Implementation of different operations on linear and nonlinear data structures for given problem with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks and queues	2
	PO 12	**Keeping current in** CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks and queues by tech talk, concept videos and open-ended experiments	3

	PSO1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5
	PSO2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 4	PO 1	**Make use of** linear and nonlinear data structures for solving real time applications by applying the basic knowledge of mathematics, science, engineering fundamentals	3
	PO 2	**Problem analysis:**Solving real time applications by performing the operations on linear or nonlinear data structures.	7
	PO 3	**Recognize the** need of linear and nonlinear data structures such as linked list, array, stack and queue for Designing real time applications.	2
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4
	PO 5	**Implementation of** different operations on linear and nonlinear data structures for solving real time applications with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs	2
	PO 12	**Keeping current** in CSE and advanced engineering concepts of linear and nonlinear data structures like linked lists, stacks, queues, trees and graphs by tech talk, concept videos and open-ended experiments for solving real time applications.	3
	PSO1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5
	PSO3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 5	PO 1	**Understand** the knowledge of hashing techniques and collision resolution methods and implementing for specified problem domain using knowledge of mathematics, science and engineering fundamentals	1
	PO 3	**Design the Solution** for efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	2

	PO 5	**Implementation of** hashing techniques and collision resolution methods for efficiently accessing data with respect to performance with the help of computer software	1
	PO 10	**Subject matter and speaking style** assessed in explanation of Hashing, Collision techniques	2
	PSO1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
	PSO2	**F**ocus on improving software reliability, network security or information retrieval systems.	
	PSO3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 6	PO 1	**Understand** various types of data structures in terms of implementations and choose appropriate data structure for specified problem domain using knowledge of mathematics, science and engineering fundamentals	3
	PO 2	**Problem Analysis:** Recognize the importance of suitable data structures in checking the efficiency of algorithms used for complex engineering problems.	7
	PO 3	**Design the Solution** complex problems or efficiently accessing data with respect to performance by using hashing techniques and collision resolution methods	5
	PO 4	**Conduct Investigations of Complex Problems:** Ability to apply operations on linear or nonlinear data structures in order to solve real time applications.	4
	PO 5	**Understand** the Implementation of various types of data structures with the help of computer software	1
	PO 10	**Subject matter and speaking** style assessed in explanation of Implementation of various types of data structures.	2
	PO 12	**Keeping current in CSE** and advanced engineering concepts of Implementation of various types of data structures by tech talk, concept videos and open ended experiments	3
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	1
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	1	4	2	-	-	-	-	-	-	2	-	-	3	-	1
CO 2	1	5	2	-	1	-	-	-	-	2	-	3	4	2	1
CO 3	2	7	5	4	1	-	-	-	-	2	-	3	5	2	1
CO 4	3	7	2	4	1	-	-	-	-	2	-	3	5	1	1
CO 5	1	-	2	-	1	-	-	-	-	2	-	-	4	1	1
CO 6	3	7	5	4	1	-	-	-	-	2	-	3	5	1	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	2	2	2
CO 1	33.3	40	20	-	-	-	-	-	-	40	-	-	50	-	50
CO 2	33.3	50	20	-	100	-	-	-	-	40	-	25	66.6	100	50
CO 3	66.6	70	50	36.3	100	-	-	-	-	40	-	25	83.3	100	50
CO 4	100	70	20	36.3	100	-	-	-	-	40	-	-	66.6	50	50
CO 5	33.3	-	20	-	100	-	-	-	-	40	-	-	66.6	50	50
CO 6	100	70	50	36.3	100	-	-	-	-	40	-	25	83.3	50	50

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - $0 \leq C \leq 5\%$ – No correlation
1 - $5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE	PROGRAM OUTCOMES												PSO'S		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	1	-	-	-	-	-	-	1	-	-	2	-	2
CO 2	1	2	1	-	3	-	-	-	-	1	-	1	3	3	2
CO 3	3	3	2	1	3	-	-	-	-	1	-	1	3	3	2
CO 4	3	3	1	1	3	-	-	-	-	1	-	1	3	2	2
CO 5	1	-	1	-	3	-	-	-	-	1	-	-	3	2	2
CO 6	3	3	2	1	3	-	-	-	-	1	-	1	3	2	2
TOTAL	**12**	**12**	**8**	**3**	**15**	**-**	**-**	**-**	**-**	**6**	**-**	**4**	**17**	**12**	**12**
AVERAGE	**2.0**	**2.4**	**1.3**	**1.0**	**3.0**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2.8**	**2.4**	**2.0**

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Assignments	✓
Seminars	-	Student Viva	-	Certification	-
Laboratory Practices	-	5 Minutes Video	-	Open Ended Experiments	-
Term Paper	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✓	Assessment of Activities/model		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING**
	Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Algorithms Specification ,Recursive algorithms ,Data Abstraction, Performance analysis-time complexity and space complexity, Asymptotic Notation-Big O ,Omega and Theta notations. Introduction to Linear and Non Linear data structures, Searching techniques: Linear search, Binary search; Sorting techniques: Bubble, Selection, Insertion, Quick and Merge Sort and comparison of sorting algorithms
MODULE II	**LINEAR DATA STRUCTURES**
	Stacks: Stack ADT, definition and operations, Implementations of stacks using array, applications of stacks, Arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Arrays, applications of linear queue, circular queue and double ended queue (deque).
MODULE III	**LINKED LISTS**
	Linked lists: Introduction, singly linked list, representation of a linked list in memory, operations on a single linked list; Applications of linked lists: Polynomial representation and sparse matrix manipulation. Types of linked lists: Circular linked lists, doubly linked lists; Linked list representation and operations of Stack, linked list representation and operations of queue
MODULE IV	**NON LINEAR DATA STRUCTURES**
	Trees: Basic concept, binary tree, binary tree representation, array and linked representations, binary tree traversal, binary tree variants, application of trees; Graphs: Basic concept, graph terminology, Graph representations-Adjacency matrix, Adjacency lists, graph implementation, Graph traversals-BFS,DFS, Application of graphs, Minimum spanning trees-Prims and Kruskal algorithms
MODULE V	**BINARY TREES AND HASHING**
	Binary search trees: Binary search trees, properties and operations; Balanced search trees: AVL trees; Introduction to M-Way search trees, B trees; Hashing and collision: Introduction, hash tables, hash functions, collisions, applications of hashing.

TEXTBOOKS

1. Rance D. Necaise, —Data Structures and Algorithms using Python, Wiley Student Edition.
2. Benjamin Baka, David Julian, —Python Data Structures and Algorithms, Packt Publishers, 2017.

REFERENCE BOOKS:

1. S. Lipschutz, —Data Structures , Tata McGraw Hill Education, 1st Edition, 2008.
2. D. Samanta, —Classic Data Structures, PHI Learning, 2nd Edition, 2004.

WEB REFERENCES:

1. http://www.tutorialspoint.com/data-structures-algorithms
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.studytonight.com/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms

COURSE WEB PAGE:

1. https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	https://www.iare.ac.in/?q=courses/computer-science-and-engineering-autonomous/datastructures
CONTENT DELIVERY (THEORY)			
1	Basic concepts: Introduction to Data Structures	CO 3	T1:1.1.3 R2 : 1.2
2	Classification of data structures	CO 3	T1:1.1.3 R2 : 1.4
3	Operations on data Structures	CO 3	T1:1.2
4	Recursive algorithm, Performance Analysis	CO 1	T1:1.2 T1:5.1
5	Searching techniques: Linear search and binary search	CO 2, CO 6	T1:5.1
6	Searching techniques: Fibonacci search and comparison	CO 2, CO 6	T1:5.1
8	Sorting techniques: Bubble sort, selection sort and companding	CO 2 CO 6	R1:14.5

9	Sorting techniques: Insertion sort, Quick sort	CO 2, CO 6,	T1:5.2 R2 : 10.2
10	Merge sort ,comparison of sorting algorithms	CO 4, CO 6	T1:5.2 R2 : 10.2
13	Stacks: Primitive operations, implementation of stacks using Arrays	CO 3, CO 4	T1:7.1
14	Applications of stacks arithmetic expression conversion and evaluation	CO 4, CO 6	T1:7.2
16	Queues: Primitive operations; Implementation of queues using Array	CO 3, CO 4	T1:8.1
17	Applications of linear queue, circular queue	CO 3, CO 4	T1:8.4
18	Double ended queue (deque)l	CO 3, CO 4	R2 : 5.4
19	Linked lists: Introduction, singly linked list, representation of a linked list in memory	CO 3, CO 4	T1:9.1
20	Operations on a single linked list :creation, insertion and deletion	CO 3, CO 4	T1:9.2
21	Applications of linked lists	CO 4,	T1:9.3
22	Operations on a double linked lists :creation, insertion and deletion	CO 3, CO 4	T1:9.4
23	Operations on a double linked lists : deletion ,traversal.	CO 3, CO 4	T1:9.4
24	single linked list :polynomial expression	CO 3, CO 4	T1:9.3
25	single linked list :Sparse matrix manipulation.	CO 3, CO 4	T1:9.3
26	Operations on a Circular linked lists: creation, insertion and deletion	CO 3, CO 4	T1:9
30	Operations on a Circular linked lists: deletion, traversal	CO 3, CO 4	T1:9
31	Linked list representation and operations of Stack	CO 3, CO 4	T1:9.7
32	Linked list representation and operations of queue	CO 3, CO 4	T1:9.8
37	Trees: Basic concept, Tree terminology	CO 3	T1:13.1

CONTENT DELIVERY (THEORY)			
38	Binary tree :Binary Tree properties	CO 3, CO 4	T1:13.1
39	Binary tree representation using array	CO 3, CO 4	T1:13.2
40	Binary tree representation using linked list	CO 3, CO 4	T1:13.2
41	Binary tree traversal, binary tree variants	CO 3, CO 4	T1:13.2
42	Application of trees	CO 4	T1:13.2.3
44	Graphs: Basic concept, graph terminology	CO 3	R2 : 8.2
45	Types of graphs, Representation of graph	CO 3	R2 : 8.2
46	Graph traversals :DFS and BFS, Application of graphs	CO 3	T2:6.2
48	Minimum Spanning Trees-Prims and Kruskal algorithms	CO 4	T1:6.1 T2:5.6
50	Binary search trees, properties	CO 3	T1:13.2.3
51	Binary search trees operations	CO 3	T1:13.2.3
52	AVL trees	CO 3	T1:14.3
53	M- Way search trees, B trees	CO 3	T1:14.3
54	Hashing, Collision	CO 5	R2 : 6.4
7	Problems on linear search, binary search and Fibonacci search.	CO 2	T1:5.1
11	Problems on bubble sort, selection and insertion sort	CO 3, CO 4	T1:5.2 R2 : 10.2
12	Problems on quick and merge sort	CO 3, CO 4	T1:5.2 R2 : 10.2
15	Problems on Arithmetic expression conversion and evaluation	CO 3, CO 4	T1:7.2
27	Problems on single linked list to add, delete element	CO 3, CO 4	T1:9.8
28	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.8
33	Problems on circular linked list to add, delete element	CO 3, CO 4	T1:9.4
34	Problems on double linked list to add, delete element	CO 3, CO 4	T1:9.3
35	Problems on stack using linked list	CO 3, CO 4	T1:9.7
36	Problems on queue using linked list	CO 3, CO 4	T1:9.8
43	Problems on Binary tree :creation ,insertion and deletion of a node	CO 3, CO 4	T1:13.2
47	Problems on Graph Traversal: DFS and BFS	CO 3, CO 4	T2:6.2

49	Problems on MST: Prim's and Kruskal's	CO 3, CO 4	T1:6.1 T2:5.6
55	Problems on Binary search tree	CO 4	T1:14.3
56	Problems oh hashing	CO 5	R2 : 6.4
DISCUSSION ON DEFINITION AND TERMINOLOGY			
57	Definitions on Data Structures, searching and sorting	CO 1,CO2,CO 3	T1:1 R1:14
58	Definitions on Linear Data Structures	CO 3	T1:7,.T1:8
59	Definitions on Linked Lists	CO 3	T1:9
60	Definitions on Non Linear data Structures	CO 3	T1:7.5
61	Definitions on Binary Trees and Hashing	CO 3 CO 5	T1:14
DISCUSSION ON QUESTION BANK			
62	Module I	CO 1, CO2,CO6	T1:1 R1:14
63	Module II	CO 3,CO 4,CO 6	T1:9
64	Module III	CO 3,CO 4,CO 6	T1:2.5
65	Module IV	CO 3,CO 4,CO 6	T1: 4.1
66	Module V	CO 3,CO 5,CO 6	T1: 5.1

Course Coordinator **HOD,CSE(DS)**
Mr B Dilip Chakravarthy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	**OPERATING SYSTEMS**				
Course Code	ACSC12				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. S Aswani, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC04	II	Programming for Problem Solving using C
B.Tech	ACSC07	III	Computer Organization and Architecture

II COURSE OVERVIEW:

This course emphasizes on basic knowledge of various types of operating systems, effective resource utilization by using systems and applications software. It is designed to provide in-depth critique on the problems of resource management, scheduling, concurrency, synchronization, memory management, file management, protection and security of used system. Learned knowledge will be implemented in design and development of hybrid operating systems, command control systems, and in real time environments.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Operating Systems	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
45 %	Understand
18 %	Apply
27 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

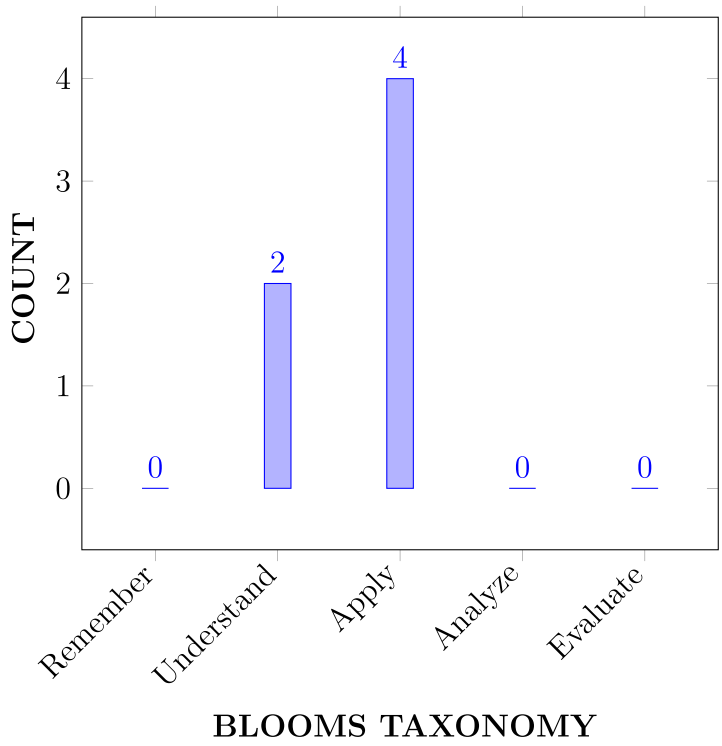
I	The principles of operating systems, services and functionalities with its evolution.
II	The structures, functions and components of modern operating systems
III	The conventional hardware at different OS abstraction levels.
IV	The essential skills to examine issues and methods employed in design of operating systems with identification of various functionalities.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** different architectures used in design of modern operating systems.	Understand
CO 2	**Solve** problems related to process scheduling, synchronization and deadlock handling in uni and multi-processing systems.	Apply
CO 3	**Choose** memory allocation algorithms for effective utilization of resources.	Apply
CO 4	**Select** various page replacement algorithms applied for allocation of frames.	Apply
CO 5	**Make use of** different file allocation and disk scheduling algorithms applied for efficient utilization of storage.	Apply
CO 6	**Outline** mechanisms used in protection of resources in real time environment	Understand

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	SEE/AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	SEE/AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	SEE/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 2	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	✓	-
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the structure and evolution of operating system by understanding fundamentals of Computer engineering specialization and mathematical and scientific principles.	3
	PO 10	Communicate effectively on evolution of operating systems including deep subject knowledge.	1
	PO 12	By understanding different operating system architectures, one can personally continue understanding of different operating systems developed by the companies to stay up with new technology and for personal development.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	2
CO 2	PO 1	Understand the concept of Process, process scheduling, issues and their solutions related to process synchronization by using mathematical principles, fundamental of Computer engineering specialization and scientific principles.	3
	PO 2	Identify synchronization problem and understand the problem statement of classical synchronization problems collect the data needed for solving the problem then analyze different models of solutions for classical synchronization problems by semaphores and monitors and interpret the solutions	6
	PO 3	Define the process synchronization problem, understand the user needs then identify the resources required next manage the design process using banker's algorithm and evaluate outcomes.	4
	PO 4	By having the knowledge of characteristics of process and understanding the context in classical synchronization problems and the solutions provided using the technical constructs like semaphores and monitors with their working strategies, these can be applied for understanding of other synchronization problems.	5
	PO 10	Communicate effectively on process communication using process communication techniques and explaining each technique.	2
	PO 12	By understanding process management, one can personally continue understanding internal functioning of operating systems developed by the companies to stay up with new technology and for personal development.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
CO 3	PO 1	Describe the need and various techniques for memory management by understanding the limits of contiguous memory allocation through applying mathematical principles, fundamental of Computer engineering specialization and scientific principles	3
	PO 2	Identify problem of memory management and understand the problem statement of contiguous memory management then analyze different models of non-contiguous memory management.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Define the problem related to contiguous memory management, understand the user needs then identify the memory requirements of each process next manage the design process by using non-contiguous memory management techniques and evaluate outcomes.	4
	PO 10	Communicate effectively on memory management techniques with clarity on contiguous and varied strategies and explaining each technique with appropriate terminology.	2
'	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 4	PO 1	Understand the concept of virtual memory and various algorithms for effective usage of memory by applying the knowledge of computer engineering fundamentals, mathematical and scientific principles.	3
	PO 2	Identify the need for page replacement, understand the problem statement of allocation of pages to frames, then collect the data related to available pages and frames then analyze various models for solving problem based on the given sequence of pages and interpret their results accordingly.	6
	PO 3	Define the problem of mapping of large virtual memory to the existing physical memory, understand the user needs then manage the design process using page replacement algorithms and evaluate outcomes by identifying the number of page faults incurred.	4
	PO 4	By understanding characteristics of process, understanding the context in virtual memory management using demand paging and segmentation, this knowledge can be applied for virtualizing engineering process.	4
	PO 10	Communicate on utilization of main memory using pictorial representation of demand paging and segmentation and explaining them in detail.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 5	PO 1	Understand the concept of file system and analyze various file allocation methods by using the knowledge of computer engineering fundamentals, mathematical and scientific principles.	3
	PO 2	Identify the need for disk scheduling, understand the problem statement of disk scheduling, then collect the data related to location of data to be accessed in the disk structure then analyze different scheduling algorithm models used for solving problems related to finding total head movements and interpret their results.	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 3	Define the problem of file allocation to disk block, understand the user needs then identify the free disk space available next manage the design process by using appropriate file allocation methods.	4
	PO 10	Communicate on effective utilization of mass storage structures clearly using pictorial representation of disk structure.	2
	PO 12	By understanding mass storage structure, one can personally continue understanding of different storage devices developed by the companies to stay up with new technology.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 6	PO 1	Explain the importance of protection of objects and the protection provided for them by using domain concept in terms of access matrix implementation by applying knowledge of computer science fundamentals.	1
	PO 10	Communicate on protection of computer system components using protection strategies in detail.	1
	PO 12	By understanding the concept of protection, one can study and analyze various protection mechanisms developed recently for personal development.	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	2	1	-	2
CO 2	3	6	4	5	-	-	-	-	-	2	-	2	4	2	-
CO 3	3	3	4	-	-	-	-	-	-	2	-	-	4	-	-
CO 4	3	6	4	4	-	-	-	-	-	2	-	-	4	-	-
CO 5	3	6	4	-	-	-	-	-	-	2	-	2	4	-	-
CO 6	1	-	-	-	-	-	-	-	-	1	-	2	1	1	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	20	-	25	17		100
CO 2	100	60	40	45	-	-	-	-	-	40	-	25	67	100	-
CO 3	100	30	40	-	-	-	-	-	-	40	-	-	67	-	-
CO 4	100	60	40	36	-	-	-	-	-	40	-	-	67	-	-
CO 5	100	60	40	-	-	-	-	-	-	40	-	25	67	-	-
CO 6	33	-	-	-	-	-	-	-	-	20	-	25	17	50	100

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -5 $< C \leq 40\%$ – Low/ Slight
2 - 40 % $< C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	1	1	-	3
CO 2	3	3	2	2	-	-	-	-	-	2	-	1	3	3	-
CO 3	3	1	2	-	-	-	-	-	-	2	-	-	3	-	-
CO 4	3	3	2	2	-	-	-	-	-	2	-	-	3	-	-
CO 5	3	3	2	-	-	-	-	-	-	2	-	1	3	-	-
CO 6	1	-	-	-	-	-	-	-	-	1	-	1	1	2	3
TOTAL	16	10	8	4	-	-	-	-	-	10	-	4	14	5	6
AVERAGE	2.7	2.5	2	2	-	-	-	-	-	1.7	-	1	2.3	2.5	3

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Operating systems objectives and functions: Computer system architecture, operating systems structure, operating systems operations; Evolution of operating systems: Simple batch, multi programmed, time shared, personal computer, parallel distributed systems, real time systems, special purpose systems, operating system services, user operating systems interface; Systems calls: Types of systems calls, system programs, protection and security, operating system design and implementation, operating systems structure, virtual machines.
MODULE II	**PROCESS AND CPU SCHEDULING, PROCESS COORDINATION**
	Process concepts: The process, process state, process control block, threads; Process scheduling: Scheduling queues, schedulers, context switch, preemptive scheduling, dispatcher, scheduling criteria, scheduling algorithms, multiple processor scheduling; Real time scheduling; Thread scheduling; Case studies Linux windows; Process synchronization, the critical section problem; Peterson‘s solution, synchronization hardware, semaphores and classic problems of synchronization, monitors.
MODULE III	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**
	Logical and physical address space: Swapping, contiguous memory allocation, paging, structure of page table. Segmentation: Segmentation with paging, virtual memory, demand paging; Performance of demand paging: Page replacement, page replacement algorithms, allocation of frames, thrashing
MODULE IV	**FILE SYSTEM INTERFACE, MASS-STORAGE STRUCTURE**
	The concept of a file, access methods, directory structure, file system mounting, file sharing, protection, file system structure, file system implementation, allocation methods, free space management, directory implementation, efficiency and performance; Overview of mass storage structure: Disk structure, disk attachment, disk scheduling, disk management, swap space management; Dynamic memory allocation: Basic concepts; Library functions.

MODULE V	**DEADLOCKS, PROTECTION**
	System model: Deadlock characterization, methods of handling deadlocks, deadlock prevention, dead lock avoidance, dead lock detection and recovery form deadlock system protection, goals of protection, principles of protection, domain of protection, access matrix, implementation of access matrix, access control, revocation of access rights, capability based systems, language based protection.

TEXTBOOKS

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, —Operating System Principles‖, Wiley Student Edition, 8th Edition, 2010.
2. . William Stallings, —Operating System- Internals and Design Principles‖, Pearson Education, 6th Edition, 2002.

REFERENCE BOOKS:

1. Andrew S Tanenbaum, —Modern Operating Systems‖, PHI, 3rd Edition, 2007.
2. D. M. Dhamdhere, —Operating Systems a Concept based Approach, Tata McGraw-Hill, 2nd Edition, 2006.

WEB REFERENCES:

1. www.smartzworld.com/notes/operatingsystems
2. www.scoopworld.in
3. www.sxecw.edu.in
4. www.technofest2u.blogspot.com

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	Computer system architecture, operating systems structure	CO 1	T1:1.1-1.4
3	operating systems operations	CO 1	T1:1.5
4	Evolution of operating systems: Simple batch, multi programmed, time shared, personal computer	CO 1	T2:2.2
5	parallel distributed systems, real time systems, special purpose systems,	CO 1	T2:2.2
6	operating system services, user operating systems interface	CO 1	T2:2.1-2.2

7	Systems calls: Types of systems calls, system programs	CO 1	T2:2.3-2.5
8	protection and security, operating system design and implementation	CO 1	T1:2.6
9	operating systems structure, virtual machines.	CO 1	T1:2.7-2.8
10	Process concepts: The process, process state	CO 2	T1:3.1-3.2
11	process control block, threads;	CO 2	T1:3.2-3.4
12	Process scheduling: Scheduling queues, schedulers, context switch	CO 2	T1:5.2
13	preemptive scheduling, dispatcher, scheduling criteria	CO 2	T1:5.3
14	scheduling algorithms	CO 2	T1:5.3
15	multiple processor scheduling	CO 2	T1:5.3
17	Real time scheduling; Thread scheduling;	CO 2	T1:5.4-5.5
18	Case studies Linux windows	CO 2	T1:5.6, 21.4
19	Process synchronization, the critical section problem	CO 2	T1:6.1
20	Peterson‘s solution	CO 2	T1:6.2-6.3
21	synchronization hardware	CO 2	T1:6.4
22	semaphores	CO 2	T1:6.5
23	classic problems of synchronization, monitors.	CO 2	T1:6.6-6.7
24	Logical and physical address space: Swapping, contiguous memory allocation	CO 3	T1:8.1
26	paging, structure of page table	CO 3	T1:8.2
27	Segmentation: Segmentation with paging	CO 3	T1:8.3
29	virtual memory, demand paging	CO 3	T1:8.4-8.5
30	Performance of demand paging	CO 3	T1:8.6
31	Page replacement, page replacement algorithms,	CO 4	T1:8.6
33	allocation of frames	CO 4	T1:9.5
34	Thrashing	CO 4	T1:9.6
35	The concept of a file, access methods	CO 4	T1:10.1-10.2
36	directory structure	CO 4	T1:10.3
37	file system mounting	CO 4	T1:10.5
38	file sharing, protection	CO 4	T1:10.6
39	file system structure	CO 4	T1:10.6
40	file system implementation	CO 4	T1:11.3
41	allocation methods	CO 4	T1:11.4
43	free space management	CO 4	T1:11.5
44	directory implementation, efficiency and performance	CO 4	T1:11.6

45	Overview of mass storage structure: Disk structure, disk attachment	CO 5	T1:12.1-12.3
46	disk scheduling, disk management, swap space management	CO 5	T1:12.4-12.6
48	Dynamic memory allocation: Basic concepts; Library functions.	CO 5	T1:12.7-12.8
49	System model: Deadlock characterization, methods of handling deadlocks	CO 2	T1:7.1-7.2
50	deadlock prevention	CO 2	T1:8.1
51	deadlock avoidance	CO 2	T1:8.2
52	dead lock detection and recovery form deadlock system protection	CO 2	T1:8.3
55	goals of protection, principles of protection, domain of protection	CO 6	T2:27.8
56	access matrix, implementation of access matrix, access control, revocation of access rights	CO 6	T2:27.9
57	capability based systems, language based protection	CO 6	T1:8.2-8.3
PROBLEM SOLVING/ CASE STUDIES			
16	Problems on CPU scheduling algorithms	CO 2	T1:5.3-5.3
25	Problems on contiguous memory allocation	CO 3	T1:8.1-8.3
28	Problems on paging and segmentation	CO 3	T1:8.4-8.6 T1:9.1-9.2
32	Problems on page replacement algorithms	CO 4	T1:9.4-9.6
42	Problems on file allocation methods	CO 5	T1:11.3-11.6
47	Problems on disk scheduling	CO 5	T1:12.1-12.6
53	Problems on deadlock avoidance	CO 2	T1:8.1-8.3
54	Problems on recovery from deadlocks	CO 2	T1:8.1-8.3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
58	Definitions on operating systems fundamentals	CO 1	T1:1.2
59	Definitions on process, CPU scheduling and process coordination	CO 2	T1:1.5
60	Definitions on memory management and virtual memory	CO 3, CO 4	T1:8,9
61	Definitions on file system interface and mass storage structure	CO 5	T1:10,11
62	Definitions on deadlocks and protection	CO 2, CO 6	T1:9.1

DISCUSSION OF QUESTION BANK			
1	Introduction	CO 1	T1:1.2
2	Process and CPU Scheduling, Process Coordination	CO 2	T1:1.5
3	Memory Management and Virtual Memory	CO 3,4	T1:8,9
4	File System Interface, Mass Storage Structure	CO 5	T1:10,11
5	Deadlocks, Protection	CO 2,6	T1: 9.1

Signature of Course Coordinator **HOD, CSE (DS)**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CSE (DATA SCIENCE)**				
Course Title	**PRINCIPLES OF DATA SCIENCE**				
Course Code	ACDC01				
Program	B.Tech				
Semester	III Semester				
Course Type	Foundation				
Regulation	UG - 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	1	2
Course Coordinator	Dr.M.Lakshmi Prasad, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC08	II	Probability and Statistics

II COURSE OVERVIEW:

The Course is designed in various levels of data and use of R for statistical programming and visualization of data .It includes the basics of mathematics, probability and statistical methods and data communication. The techniques are used in Distribution and data analysis in non- parametric statistics.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Principles of Data Science	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
40%	Understand
35%	Apply
15%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

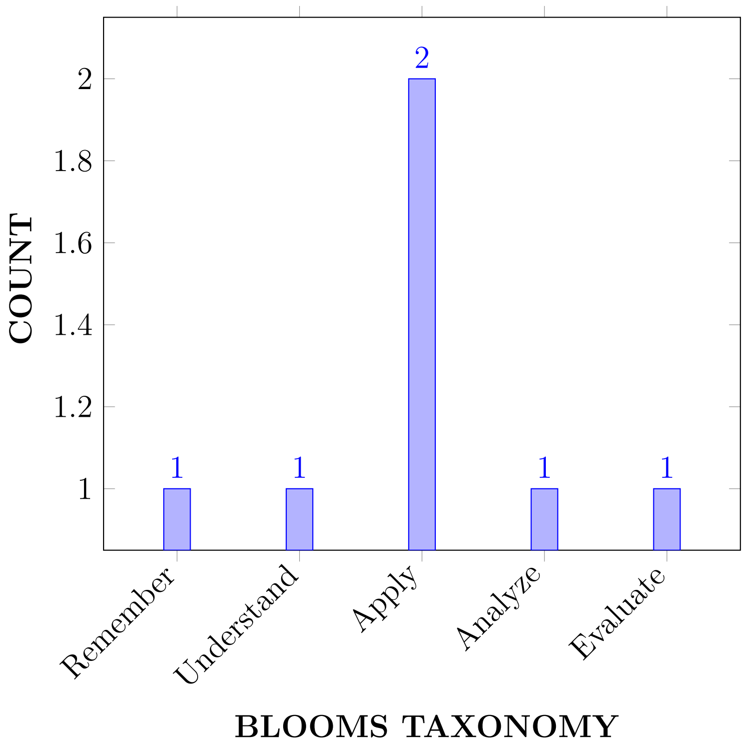
I	The different flavors of data for data analysis.
II	The R Language for understanding and visualization of data using statistical methods.
III	The mathematical tools in data science for statistical methods.
IV	The data communication for data visualization.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recognize** the different levels of data science concepts for visualization of data.	Remember
CO 2	**Describe** the R programming for the advanced data structure to store efficient data.	Remember
CO 3	**Apply** the advanced data structure for efficient data storage.	Apply
CO 4	**Analyse** the basics of probability and statistics models for data exploration.	Analyse
CO 5	**Make Use of** Hypothesis testing for statistical analytics for destroying target based on the mission requirements.	Understand
CO 6	**Present** the effective and ineffective visualizations for data communication.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/Quiz/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/Quiz/AAT
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	CIE/Quiz/AAT
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	1	CIE/Quiz/AAT
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	CIE/Quiz/AAT

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	CIE/Quiz/AAT
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	CIE/Quiz/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	3	CIE/Quiz/AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	CIE/Quiz/AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	✓	-	-	-	-	-	-	-	-	-	✓	✓
CO 2	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓	✓	✓
CO 4	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓	-	✓
CO 5	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓	✓	-
CO 6	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Explain the different levels of data in data by using** mathematical and data science related fundamentals and engineering specializations for complex problems	3
	PO 4	**Identify different levels of data science concepts for interpretation of data, and synthesis of the information to provide valid conclusions**	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 2	PO 1	Exhibit the R programming basics by using **mathematical and data science related methodologies .**	3
	PO 2	Explain the control statements in R programming by using **statement and system definition , formulation and abstraction , validation ,experimental ,design and solution development**	2
	PO 3	Understand R programming to evaluate the **design solutions for complex engineering problems and design system components.**	3
	PO 4	**Identify R Programmig concepts for interpretation of data, and synthesis of the information to provide valid conclusions**	3
	PO 5	Make use of R Progrmming to **modern engineering including prediction and modelling to complex engineering activities**	2
	PO 6	Apply R Progrmming to **the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice**	1
	PO 7	Understand the impact of R Progrmming **in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**	2
	PO 9	Understand the impact of R Progrmming **Functions effectively as an individual, and as a member or leader in diverse teams.**	1
	PO 10	Communicate effectively on complex engineering activities using R Progrmming **to comprehend and write effective reports and design documentation, make effective presentations.**	3

	PO 11	Apply R Programming knowledge . **to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**	1
	PO 12	Reconnize the need of R Programming knowledge . **to engage in independent and life-long learning in the broadest context of technological change.**	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	3
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3
CO 3	PO 1	Exhibit the R programming data structures by using **mathematical and data science related methodologies .**	3
	PO 2	Make use of R programming data structures **for experimental ,design and solution development**	3
	PO 3	Exhibit the R programming data structures to evaluate the **design solutions for complex engineering problems and design system components.**	3
	PO 4	**Exhibit the R programming data structures for synthesis of the information to provide valid conclusions**	3
	PO 5	Use R programming data structures **to modern engineering including prediction and modelling to complex engineering activities**	3
	PO 6	Exhibit the R programming data structures **from the contextual knowledge to assess societal, health, safety and cultural issues and the consequent responsibilities relevant to the professional engineering practice**	2
	PO 7	Understand the impact of R Progrmming data structures **in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**	2
	PO 9	Make use of R Progrmming data strutures **functions effectively as an individual, and as a member or leader in diverse teams.**	1
	PO 11	Apply R Programming data structures knowledge . **to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**	1
	PO 12	Recognize the need of R Programming data structures **to engage in independent and life-long learning in the broadest context of technological change.**	2
	PSO 1	Apply R programming data structures to **different areas of data science related algorithms ,system software ,machine learning and networking**	3

	PSO 3	**Use moden R programming data structures tools and techniques** to analyse large data sets for visualization and interpretation.	3
CO 4	PO 1	Apply the Bayes theorem to find solutions of **complex problems .**	2
	PO 2	Explain the basics of probability by understanding the **formulation and abstraction ,validation ,solution development implementation ,interpretation of results .**	2
	PO 3	Exhibit basics of probability to evaluate the **design solutions for complex engineering problems and design system components.**	3
	PO 4	Design the Bayes theorem and random variables by applying **to define a problem and identify constraints ,creativity to establish innovative solutions ,manage the design process and evaluate outcomes management techniques and engineering activities**	3
	PO 5	Appply basics of probability **to modern engineering including prediction and modelling to complex engineering activities**	2
	PO 6	Appply basics of probability **to assess societal, health, safety and cultural issues and the consequent responsibilities relevant to the professional engineering practice**	2
	PO 7	Understand the basics of probability **in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**	2
	PO 9	Make use of the basics of probability **effectively as an individual, and as a member or leader in diverse teams for data exploration.**	2
	PO 11	Use the knowledge of probability **to manage projects and in multidisciplinary environments.**	2
	PO 12	Recongize the basics of probability **to engage in independent and life-long learning in the broadest context of technological change.**	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 5	PO 1	Describe obtaining data directly from the source by applying **design solutions for complex engineering problems and design system components or processes that meet the specified needs**	2

	PO 2	Explain the basics of statistics by understanding the **formulation and abstraction ,validation ,solution development implementation ,interpretation,validation ,solution development or implementation of results .**	2
	PO 3	Exhibit basics of statistics to evaluate the **design solutions for complex engineering problems and design system components.**	3
	PO 4	Communicate the hypothesis testing methodologies **to conduct investigations on research based knowledge ,analysis and interpretation of data and synthesis the information to provide valid conclusions**	2
	PO 6	Appply basics of statistics **to assess societal, health, safety and cultural issues and the consequent responsibilities relevant to the professional engineering practice**	2
	PO 7	Understand the basics of statistics **in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development**	2
	PO 9	Make use of the basics of statistics **effectively as an individual, and as a member or leader in diverse teams for data exploration.**	2
	PO 11	Use the knowledge of statistics **to manage projects and in multidisciplinary environments.**	2
	PO 12	Recognize the basics of statistics **to engage in independent and life-long learning in the broadest context of technological change.**	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	1
CO 6	PO 1	Understand the data communication techniques effective and ineffective visualizations by applying **the knowledge of mathematics ,science ,engineering fundamentals**	3
	PO 2	Understand the data communication techniques **for formulation and abstraction ,validation ,solution development implementation ,interpretation, data collection ,validation ,solution development or implementation of results .**	3
	PO 3	Exhibit data communication techniques **for complex engineering problems and design system components.**	2
	PO 4	Extend the scatter plots in mathematical diagram using Cartesian coordinates of two variables in **desigining of experiments analysis and interpretation of data ,and synthesis of information to provide valid conclusions**	3

	PO 5	Make use of Box Plots for graphically depicting groups of numerical data through their quartiles by applying to **appropriate techniques ,resources and modern engineering and It tools including prediction and modelling to complex engineering activities**	2
	PO 6	Use data communication techniques **to assess societal, health, safety and cultural issues and the consequent responsibilities relevant to the professional engineering practice**	3
	PO 9	Make use of data communication techniques **effectively as an individual, and as a member or leader in diverse teams for data exploration.**	3
	PO 10	Exhibhit data communication techniques **to comprehend and write effective reports and design documentation, make effective presentations.**	3
	PO 11	Use the data communication techniques **to manage projects and in multidisciplinary environments.**	3
	PO 12	Recongize the basics data communication techniques **to engage in independent and life-long learning in the broadest context of technological change.**	2
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems. .	3
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	5	3	12	5	12	12	6	2	2
CO 1	3	-	-	2	-	-	-	-	-	-	-	-	-	2	2
CO 2	3	3	3	2	1	2	2	-	3	2	2	2	3	2	2
CO 3	3	3	3	2	2	2	2	-	2	2	2	2	3	2	2
CO 4	2	3	3	2	2	2	2	-	2	2	2	2	3	-	2
CO 5	2	3	3	2	2	2	2	-	2	2	2	2	3	2	-
CO 6	3	3	2	2	2	2	2	-	2	2	2	2	3	2	2

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	1	5	5	3	12	5	12	12	6	2	2
CO 1	100	-	-	2	-	-	-	-	-	-	-	-	-	100	67
CO 2	100	30	30	18	100	40	40	-	25	2	2	2	50	100	67
CO 3	100	30	20	18	20	40	40	-	17	17	17	2	50	100	67
CO 4	67	30	20	18	20	40	40	-	17	17	17	2	50	-	67
CO 5	67	30	20	18	20	40	40	-	17	17	17	2	50	100	-
CO 6	100	30	20	18	20	40	40	-	17	17	17	2	50	100	67

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq$ 5% – No correlation

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	2	-	-	-	-	-	-	-	-	-	2	2
CO 2	3	3	3	2	1	2	2	-	3	2	2	2	3	2	2
CO 3	3	3	3	2	2	2	2	-	2	2	2	2	3	2	2
CO 4	2	3	3	2	2	2	2	-	2	2	2	2	3	-	2
CO 5	2	3	3	2	2	2	2	-	2	2	2	2	3	2	-
CO 6	3	3	2	2	2	2	2	-	2	2	2	2	3	2	2
TOTAL	16	15	14	12	9	10	10	-	11	10	10	10	15	10	10
AVERAGE	3	2.5	2.5	2	1.5	2	2	-	2	2	2	2	2.5	2	2

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	✓	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**Flavors of Data**
	Structured versus unstructured data,Quantitative and Qualitative data ,The four levels of data : Nominal level, ordinary level and Ratio level,The five steps of Data Science :Ask an interesting question,Obtain the data,Explore the data, model the data,communicate and visualize the results,Explore the data .
MODULE II	**Introduction to R Programming**
	How to run R, R sessions and functions , Basic Math, Variables , Data types , Vectors , Conclusion , Advanced Data Structures , Data Frames ,Lists ,Matrixes, Array Classes, R programming Structures, Control Statements Loops –Looping over Non vector Sets , If-else ,Arithmetic and Boolean Operators and Values ,Default Values for Argument ,Return values ,Functions are objects, Recursion
MODULE III	**Basic Mathematics and Probability for Data Science**
	Mathematics : Vectors and matrices , Arithmetic symbols ,Graphs, Logarithms /Exponents, Set theory ,Linear algebra. Probability :Basic definitions ,Probability ,Bayesian Versus Frequentist ,Compound events ,Conditional Probability ,The rules of probability ,Collectively exhaustive events ,Bayes theorem, Random Variables .
MODULE IV	**Statistics for Data Science**
	Statistics: Obtaining data , Sampling data ,Measuring Statistics , The Empirical rule, Point estimates ,Sampling distributions ,Confidence intervals ,Hypothesis tests
MODULE V	**Communicating Data**
	Identifying effective and ineffective visualizations :Scatter plots ,Line graphs , Bar charts ,Histograms ,Box plots ,Graphs and Statistics lie:Corelation versus ,causation , Simpson's paradox ,verbal communication , The why/ how/what strategy of presenting

TEXTBOOKS

1. Sinam Ozdemir ,"Principles of Data Science ", Packt.
2. Norman Matlaoff," The Art of R programming ", Cengege Learning..

REFERENCE BOOKS:

1. Cathy O'Neil and Rachel Schutt, "Doing Data Science , Straight talk from the Frontline ", O'Reily 2014
2. G.Jay Kerns ,"Introduction to probability and Statistics Using R ", First edition
3. Nina Zurnel , John Mount ,"Practical Data Science with R ", Manning Publications ,1st Edition 2014

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/108/111108157/

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
1-2	Structured and Unstructured data , Quantitative and Qualitative data	CO 1	T1: 2.3-2.4
3-4	The four levels of data Nominal level, ordinary level, Ratio level	CO 1	T1: 2.6
5-6	The five steps of Data Science Ask an interesting question Obtain the data ,Explore the data , model the data	CO 1	T1: 3.2
7	Visualize the results , Explore the data CO 2 T1:3.10	CO 1	T1: 3.3
8	How to run R, R sessions and functions, Basic Math, Variables , Data types	CO 2	T2: 1.1
9-10	Vectors , Conclusion	CO 3	T2: 2.1
10-11	Advanced Data Structures- Data Frames,	CO 3	T2: 5.1
12-13	Lists ,Matrixes , Array , Classes,	CO 3	T2: 3.1-4.1
14-15	R programming Structures-Control Statements , Loops –Looping over Non vector Sets	CO 2	T2: 7.1-7.4
16-17	If-else ,Arithmetic and Boolean Operators and Values , Default Values for Argument, Return values Functions are objects, Recursion	CO 2	T2: 7.1-7.9
18	Mathematics : Vectors and matrices, Arithmetic symbols	CO 3	T1: 4.1
19	Graphs, Logarithms /Exponents, Set theory , Linear algebra	CO 4	T1: 4.1
20	Bayesian Versus Frequentist,.	CO 4	T1: 5.3
21	Compound events	CO 4	T1: 5.4
22-23	Conditional Probability ,The rules of probability	CO 4	T1: 5.5-5.6

24-25	Collectively exhaustive events	CO 4	T2: 6.1
26-27	Bayes theorem, Random Variables,	CO 4	T2: 6.2-6.3
28	Statistics: Obtaining data , Sampling data,	CO 5	T2: 7.2-7.3
29-30	Measuring Statistics.	CO 5	T1: 7.4
31-32	The Empirical rule, Point estimates	CO 5	T1: 7.5
33-34	Sampling distributions ,Confidence intervals	CO 5	T1: 8.2
35-36	Hypothesis Tests	CO 5	T1:8.3
37-38	Scatter plots ,Line graphs , Bar charts	CO 6	T1: 9.2
39-40	Histograms ,Box plots	CO 6	T1: 9.2
41-42	Graphs and Statistics lie: Correlation versus Causation	CO 6	T1: 9.3
43-44	Verbal communication	CO 6	T1:9.4
45-46	Simpson's paradox	CO 6	T1:9.4
47	The why/ how/what strategy of presenting	CO6	T1:9.5
PROBLEM SOLVING/ CASE STUDIES			
1	Vectors	CO 2	T2:2.1
2	Matrices	CO 2	T2:3.1
3	Arrays	CO 2	T2:3.1
4	Lists-1	CO 2	T2:4.1
5	Lists -2	CO 2	T2:4.1
6	Data Frames	CO 2	T2:5.1
7	Factors	CO 2	T2:6.1
8	Tables	CO 2	T2:6.1
9	R Programming Decision Structures	CO 3	T2:7.1
10	R Programming Loop Structures	CO 3	T2:7.1
11	R Functions	CO 3	T2:7.5
12	R Functions-1	CO 3	T2:7.6
13	R Recursion	CO 3	T2:7.9
14	R Strings-1	CO 3	T2:11.1
15	R Strings-2	CO 3	T2:11.3
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Flavors of Data	CO 1	T1:2.1-3.3
2	Introduction to R Programming	CO 2,3	T2:1.1-7.9
3	Basic Mathematics and Probability for Data science	CO 4	T1:4.1-6.2
4	Statistics for Data science	CO 5	T1:7.1-8.4
5	Communicating Data	CO 6	T1:9.1-9.5

DISCUSSION OF QUESTION BANK			
1	Flavors of Data	CO 1	T1:2.1-3.3
2	Introduction to R Programming	CO 2,3	T2:1.1-7.9
3	Basic Mathematics and Probability for Data science	CO 4	T1:4.1-6.2
4	Statistics for Data science	CO 5	T1:7.1-8.4
5	Communicating Data	CO 6	T1:9.1-9.5

Signature of Course Coordinator **HOD,CSE(DS)**
Dr.M.Lakshmi Prasad, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (Data Science**				
Course Title	**PROGRAMMING WITH OBJECTS**				
Course Code	AITC02				
Program	B.Tech				
Semester	III				
Course Type	Core				
Regulation	UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	0	3	-	-
Course Coordinator	Ms Anusha R, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	I	Programming for Problem Solving

II COURSE OVERVIEW:

This course presents the principles of object oriented programming using the Java language, one of the most increasingly preferred languages for programming today. This course uses Net beans IDE to afford a more interactive experience. This course helps to develop different applications in various domains like GUI Applications, BigData, Web-based Applications,etc..

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Programming With Objects	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIE examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	**Blooms Taxonomy Level**
10	Remember
60	Understand
30	Apply
0	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

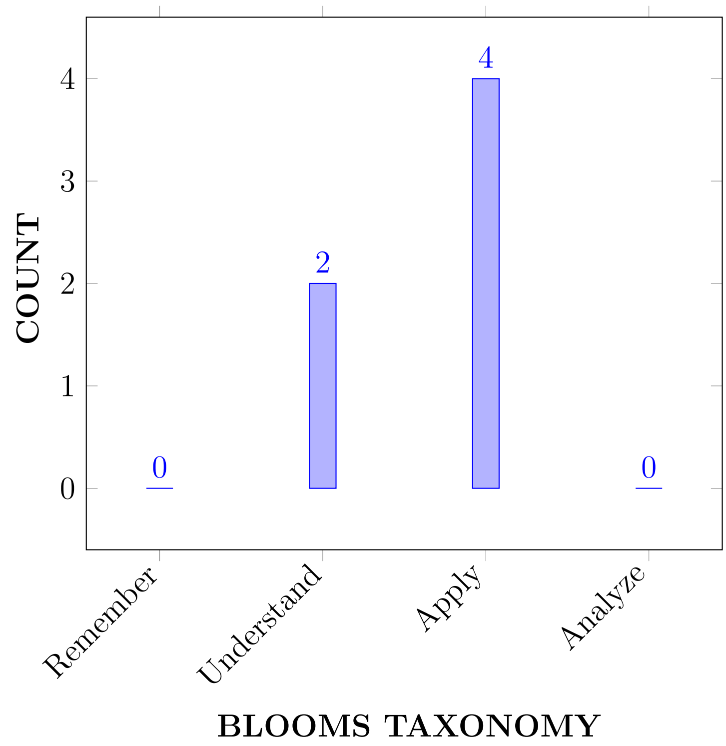
I	The basic concepts and principles of object oriented programming.
II	The object oriented features to develop the robust applications and database connectivity.
III	The Graphical User Interface (GUI) with multithreading concepts to develop real world applications on different platforms.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Summarize** the concepts of object oriented programming that helps in complex problems solving.	Understand
CO 2	**Interpret** the classes and objects with abstraction and access control in representing real world entities.	Understand
CO 3	**Apply** different types of inheritance and polymorphism for achieving reusability.	Apply
CO 4	**Make use of** the multithreading concepts in inter process communication.	Apply
CO 5	**Make use of** JDBC concepts for connecting with Database.	Apply
CO 6	**Develop** GUI based applications using AWT, Swing and Applets	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE /Quiz/CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	SEE /Quiz/ CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	SEE /Quiz/ CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	SEE /Quiz/ CIE / AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3	SEE /Quiz/ CIE / AAT
PO 10	**Communication:**Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions..	1	Discussion onInnovations /Presentation
PO 12	**Life-LongLearning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.	1	Short term courses

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	Quiz
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1	Quiz

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	✓	-	-	✓	✓	-	-	-	-	✓	-	✓	-	-	-
CO 3	✓	✓	-	✓	✓	-	-	-	-	✓	-	✓	✓	-	-
CO 4	✓	✓	-	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓
CO 5	✓	✓	-	✓	✓	-	-	-	-	✓	-	✓	✓	-	-
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Summarize** the concepts of object oriented programming that helps in complex problems solving by using **fundamentals of Computer engineering specialization and scientific principles.**	2
	PO 10	**Summarize** the concepts of object oriented programming that helps in complex problems solving by communicating effectively in Oral or writing	2
CO 2	PO 1	**Interpret** the concept of class and objects with access control to represent real world entities by understanding **fundamentals of Computer engineering specialization and scientific principles.**	2

	PO 4	**Interpret** the concept of class and objects in **by which engineering knowledge can be applied, analyze key engineering processes, use computer software in order to solve engineering problems**	4
	PO 5	**Interpret** the concept of class and objects in **modelling complex Engineering activities by using Computer software**	1
	PO 10	**Interpret** the concept of class and objects by **communicating effectively in Oral or writing**	2
	PO 12	**Interpret** the concept of class and objects for lifelong learning by **keeping current in CSE, for professional certification, to begin work on advanced concepts of engineering of CSE**	3
CO 3	PO 1	**Apply** different types of inheritance and polymorphism to achieve reusability by understanding **fundamentals of Computer engineering, specialization and scientific principles.**	2
	PO 2	**Apply** different types of inheritance and polymorphism to achieve reusability by **Identifying complex Engineering problems, system definition, Experimental design, Solution development, Interpretation of results in Engineering sciences**	5
	PO 4	**Apply** different types of inheritance and polymorphism to achieve reusability **by which engineering knowledge can be applied, analyze key engineering processes, use computer software in order to solve engineering problems**	4
	PO 5	**Apply** different types of inheritance and polymorphism to achieve reusability in **modelling complex Engineering activities by using Computer software**	1
	PO 10	**Apply** different types of inheritance and polymorphism in achieving reusability in **communicating effectively in Oral or writing**	2
	PO 12	**Apply** different types of inheritance and polymorphism to achieve reusability by **keeping current in CSE, for professional certification, to begin work on advanced concepts of engineering of CSE**	3
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 4	PO 1	**Make use of** the multithreading concepts in inter process communication by understanding **fundamentals of Computer engineering specialization and scientific principles.**	2

	PO 2	**Make use of** the multithreading in inter process communication by **Identifying complex Engineering problems, system definition, Experimental design, Solution development, Interpretation of results in Engineering sciences**	5
	PO 4	**Make use of** the multithreading in inter process communication **by which engineering knowledge can be applied, analyze key engineering processes, use computer software in order to solve engineering problems**	4
	PO 5	**Make use of** the multithreading concepts for **modelling complex Engineering activities by using Computer software**	1
	PO 10	**Make use of** the multithreading concepts in **communicating effectively in Oral or writing**	2
	PO 12	**Make use of** the multithreading concepts in **keeping current in CSE, for professional certification, to begin work on advanced concepts of engineering of CSE**	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 5	PO 1	**Make use of** JDBC concepts in understanding **fundamentals of Computer engineering specialization and scientific principles.**	2
	PO 2	**Make use of** JDBC concepts in **Identifying complex Engineering problems, system definition, Experimental design, Solution development, Interpretation of results in Engineering sciences**	5
	PO 4	**Make use of** JDBC concepts **by which engineering knowledge can be applied, analyze key engineering processes, use computer software in order to solve engineering problems**	4
	PO 5	**Make use of** JDBC concepts for **modelling complex Engineering activities by using Computer software**	1
	PO 10	**Make use of** JDBC concepts for in **communicating effectively in Oral or writing**	2
	PO 12	**Make use of** JDBC concepts in **keeping current in CSE, for professional certification, to begin work on advanced concepts of engineering of CSE**	3

	PSO 1	suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 6	PO 1	**Develop** GUI based applications using AWT, Swing and Applets by understanding **fundamentals of Computer engineering specialization and scientific principles.**	2
	PO 2	**Develop** GUI based applications using AWT, Swing and Applets by **Identifying complex Engineering problems, system definition, Experimental design, Solution development, Interpretation of results in Engineering sciences**	5
	PO 3	**Develop** GUI based applications by using **Knowledge and understanding of commercial and economic context of engineering processes, to establish innovative solutions**	2
	PO 4	**Develop** GUI based applications in **by which engineering knowledge can be applied, analyze key engineering processes, use computer software in order to solve engineering problems**	4
	PO 5	**Develop** GUI based applications **modelling complex Engineering activities by using Computer software**	1
	PO 10	**Develop** GUI based applications for **communicating effectively in Oral or writing**	2
	PO 12	**Develop** GUI based applications in **keeping current in CSE, for professional certification, to begin work on advanced concepts of engineering of CSE**	3
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
	PSO 3	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	2	-	-	4	1	-	-	-	-	2	-	3	-	-	-
CO 3	2	5	-	4	1	-	-	-	-	2	-	3	4	-	-
CO 4	2	5	-	4	1	-	-	-	-	2	-	3	4	-	1

CO 5	2	5	-	4	1	-	-	-	-	2	-	3	4	-	-
CO 6	2	5	2	4	1	-	-	-	-	2	-	3	4	-	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	3	10	10	11	1	5	3	3	12	5	12	12	6	2	2
CO 1	67	-	-	-	-	-	-	-	-	40	-	-	-	-	-
CO 2	67	-	-	36	100	-	-	-	-	40	-	25	-	-	-
CO 3	67	50	-	36	100	-	-	-	-	40	-	25	67	-	-
CO 4	67	50	-	36	100	-	-	-	-	40	-	25	67	-	50
CO 5	67	50	-	36	100	-	-	-	-	40	-	25	67	-	-
CO 6	67	50	20	36	100	-	-	-	-	40	-	25	67	-	50

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, **0** being **no correlation**, **1** being the **low correlation**, **2** being **medium correlation** and **3** being **high correlation**.

0 - $0 \leq$ C$\leq$ 5% – No correlation
1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	1	3	-	-	-	-	-	-	1	-	-	-
CO 3	3	2	-	1	3	-	-	-	-	-	-	1	3	-	-
CO 4	3	2	-	1	3	-	-	-	-	-	-	1	3	-	2
CO 5	3	2	-	1	3	-	-	-	-	-	-	1	3	-	-
CO 6	3	2	1	1	3	-	-	-	-	3	-	1	3	-	2
TOTAL	**18**	**8**	**1**	**5**	**15**	**-**	**-**	**-**	**-**	**3**	**-**	**5**	**12**	**-**	**4**
AVERAGE	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**3**	**-**	**2**

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	AAT	✓
Seminars	-	Student Viva	-	Certification	-
Laboratory Practices	-	5 Minutes Video	PO 4	Open Ended Experiments	-
Term Paper	-	-	-	-	-

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Activities,modelling and experimental tools in Engineering by Experts		

XVIII SYLLABUS:

MODULE I	**OOP CONCEPTS AND JAVA PROGRAMMING**
	OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object oriented programming paradigm; Java programming: History of java, comments data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow statements, jump statements, simple java stand alone programs, arrays, console input and output, formatting output, constructors, methods, parameter passing, static fields and methods, access control, this reference, overloading methods and constructors, recursion, garbage collection, exploring string class.
MODULE II	**INHERITANCE, INTERFACES AND PACKAGES**
	Inheritance: Inheritance hierarchies, superand subclasses, member access rules, super key word, preventing inheritance: final classes and methods, the object class and its methods; Polymorphism: Dynamic binding, method overriding, abstract classes and methods; Interface: Interfaces vs Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface; Packages: Defining, creating and accessing a package, understanding CLASSPATH, importing packages.
MODULE III	**EXCEPTION HANDLING AND MULTITHREADING**
	Exception Handling: Benefits of exception handling, the classification of exceptions, exception hierarchy, checked and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception subclasses. Multithreading: Differences between multiple processes and multiplethreads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication.
MODULE IV	**FILES, AND CONNECTING TO DATABASE**
	Files: Streams, byte streams, character stream, text input/output, binary input/output, random access file operations, file management using file class; Connecting to Database: Connecting to a database, querying a database and processing the results, updating data with JDBC.
MODULE V	**GUI PROGRAMMING AND APPLETS**

	GUI programming with Java: The AWT class hierarchy, introduction to swing, swing Vs AWT, hierarchy for swing components, containers, JFrame, JApplet, JDialog, JPanel; Overview of some swing components: JButton, JLabel, JTextField, JTextArea, simple applications; Layout management: Layout manager types: Border, grid and flow; Applets: Inheritance hierarchy for applets, differences between applets andapplications,life cycle of an applet,passing parameters to applets.

TEXT BOOKS

1. Herbert Schildt, Dale Skrien, "Java Fundamentals– A Comprehensive Introduction", McGraw- Hill, 1^{st}Edition, 2013.

2. Herbert Schildt, "Java the Complete Reference", McGraw Hill, Osborne,8^{th}Edition, 2011.

3. T.Budd, "Understanding Object-Oriented Programming with Java", Pearson Education, Updated Edition(NewJava2Coverage), 1999.

REFERENCE BOOKS:

1. P.J.Deitel, H.M.Deitel, "Java: How to Program", Prentice Hall, 6^{th}Edition, 2005.

2. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, CRCPress, 2007.

3. Bruce Eckel, "Thinking in Java", Prentice Hall,4^{th} Edition, 2006.

4. Sachin Malhotra, Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2^{nd} Edition, 2014.

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education(OBE): Course Objectives, Course Outcomes(CO), Program Outcomes(PO) and CO-PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
2	OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism	CO 1	T1:3-7
3	procedural and object oriented programming paradigm; Java programming: History of java,	CO 1	T1:3-7
4	OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism	CO 1	T1:9-13
5	Java programming: History of java, Comments, data types, variables, constants, scope and life time ofvariables,operators, operator hierarchy	CO 1	T1:17-39
6	Expressions, type conversion and casting,		T1-5.14 to 5.15
7	enumerated types, control flow statements, jump statements	CO 1	T1:73-151
8	Simple java stand-alone programs, arrays.	CO 2	T1-5.16 to 5.16
10	Console input and output, formatting output, constructors, and methods.	CO2	T1:73-151
11	Parameter passing, static fields and methods	CO 2	T1:73-151
12	Access control, this reference, example	CO 2	T1:73-151
13	Overloading methods and constructors	CO 3	T1:155-178
14	Recursion, garbage collection	CO 3	T1:155-178
15	Exploring string class.	CO 3	T1:155-178
16	Overloading methods and constructors-Access Control-Static members	CO 3	T1:156-188
17	Inheritance: Inheritance hierarchies, super and subclasses, member access rules,	CO 3	T1:189
18	super keyword, preventing inheritance: final classes and methods the object class and its methods;	CO 3	T1:190-216
19	Polymorphism: Dynamic binding, method overriding	CO3	T1:190-216
20	abstract classes and methods;	CO3	T1:223-232
21	Interfaces vs Abstract classes, defining an interface, implement interfaces,	CO3	T1:223-232

22	accessing implementations through interface references, extending interface;	CO 3	T1:223-232
23	Packages: Defining, creating and accessing a package, understanding CLASSPATH, importing packages.	CO 3	T1:235–246
29	Exception Handling: Benefits of exception handling, the classification of exceptions, exception hierarchy, checked and unchecked exceptions	CO 4	T1:249-263
24	usage of try, catch, throw, throws and finally	CO4	T1:265–267
25	re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes	CO 4	T1:273–275
26	Multithreading: Differences between multiple processes and multiple threads, thread states, creating threads,	CO 4	T1:276-296
27	interrupting threads, thread priorities, synchronizing threads, inter thread communication.	CO 4,CO 5	T1:11.12 R2:7.1,7.2.3
28	Files: Streams, byte streams, character stream,	CO4	T1:11.10 R2:7.6
29	text input/output, binary input/output,	CO 4	T1:11.10 R2:7.6
30	random access file operations, file management using file class	CO 5	T1:627-636
31	Connecting to Database: Connecting to a database,	CO 5	T1:627-636
32	querying a database and processing the results, updating data with JDBC.	CO 5	T1:627-636
33	GUI programming with Java: The AWT class hierarchy, introduction to swing,	CO6	T1:627-636
34	swing Vs AWT, hierarchy for swing components,	CO6	T1:627-636
35	JFrame, JApplet,	CO 6	R2:9.4
36	JDialog, JPanel;	CO6	R2:9.4
37	Overview of some swing components: JButton,	CO6	R2:9.4
38	JLabel,	CO 6	T1:735-748
39	JTextField	CO 6	T1:735-748
40	, JTextArea	CO 6	T1:735-748
41	simple applications;	CO 6	T1:735-748
42	Layout manager types: Border	CO 6	T1:735-748
43	grid layout,Flow layout	CO 6	T1:735-748
44	Applets: Inheritance hierarchy for applets,differences between applets and applications,	CO 6	T1:735-748
45	life cycle of an applet, passing parameters to applets	CO 6	T1:735-748
PROBLEM SOLVING/ CASE STUDIES			
1	Describe the primitive data types supported in java and write a java program to print first 100 Fibonacci numbers	CO 1	T1:73-151

2	Write a do-while loop that asks the user to enter two numbers. The numbers should be added and the sum displayed. The loop should ask the user whether he or she wishes to perform the operation again. If so, the loop should repeat; otherwise it should terminate	CO1	T1:73-151
3	Write a program in Java which enters five numbers in an array using command line arguments and print sum and average of the numbers.	CO2	T1:73-151
4	Write a java program to create an abstract class named shape that contains two integers and an empty method named printarea(). Provide three classes named rectangle, triangle and circle such that each one of the classes extends the classshape. Each one of the classes contains only the method printarea () that prints the area of the given shape	CO 3	T1:189-246
5	Write a java program to handle the abnormal termination caused by an arithmetic expression having Division by zero	CO 4	T1:249-296
6	Write a java program for the following scenario, Animal and Dog both classes have a common property color. If we print color property, it will print the color of current class by default. To access the parent property, we need to use super key word.	CO 3	T1:627-636
7	Write a program to copy the content of one text file into another. The program accepts the name of the source file and the destination file from comm. And line. For example, to copy a file called FIRST.TXT to a file called SECOND.TXT.	CO 5	T1:627-636
8	Write a program that creates with reads. Fist thread prints the numbers from 1 to 100 and the other thread prints the numbers from 100 to 1	CO4	T1:249-296
9	Write a java program to handle abnormal termination caused be the following expression Int a[5]; // array size is5 a[6]=20/0;	CO 4	T1:249-296
10	Write a java program to handle abnormal termination caused by the expression	CO 4	T1:249-296
11	Write a Java program to merge two files and display the merged file content	CO 5	T1:11.12 R2:7.1,7.2.3
12	Write a java to implement method overloading and constructor overloading	CO 3	T1:156-188
13	Develop an applet that receives an integer in one text field and computes its factorial value and returns it in another text field, when the button named —compute‖ is clicked.	CO 3	T1:156-188

14	Write java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the Arithmetic operations. Add a text field to display the result. Handle any possible exception like divided by zero.	CO 6	T1:735-748
15	Describe events for handling a button click? Write a program for handling a button clicks?	CO 6	T1:735-748
DISCUSSION ON DEFINITION AND TERMINOLOGY			
1	Procedural language and OOP's	CO 1	T1:3-150
2	Inheritance, interfaces and packages	CO 3	T1:189-246
3	Differentiate between multiprocessing and multithreading, methods of thread class.	CO 4	T1:249-296
4	The steps to connect to the database in java	CO 5	T1:735-748
5	Applet, swings and AWT components	CO 6	R2:9.4
DISCUSSION ON QUESTION BANK			
1	Oop Concepts And Java Programming	CO 1 CO 2 CO3	T1:3-150
2	Inheritance, Interfaces And Packages	CO 3	T1:189-246
3	Exception Handling And Multithreading	CO 4, CO6	T1:249-296
4	Files,And Connecting To Database	CO 5	T1-13.1 to 13.3
5	Gui Programming And Applets	CO 6	T1:735-748

Course Coordinator **HOD, CSE(DS)**

Mrs. Anusha R, Assistant Professorr

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE)

COURSE DESCRIPTION

Course Title	**DATA STRUCTURES LABORATORY**				
Course Code	ACSC10				
Program	B.Tech				
Semester	III	CSIT			
Course Type	Core				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mrs.D.Kavitha,Assistant Professor,CSIT				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC02	I	Python Programming Laboratory
B.Tech	ACSC08	III	Data Structures

II COURSE OVERVIEW:

A data structure is a particular way of organizing data in a computer so that it can be used effectively. It covers the design and analysis of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications. A Data Structure is a particular way of storing and organizing data in a computer so that it can be stored, retrieved, or updated efficiently. Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by an address. This course is essential for image viewer software, in this images are linked with each other so, images uses a linked list to view the previous and the next images using the previous and next buttons. Web pages can be accessed using the previous and the next URL links which are linked using linked list. The music players also use the same technique to switch between music. To keep the track of turns in a multi player game, a circular linked list is used.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Structures Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	-	Purpose
20 %	-	Algorithm
20 %	-	Programme
20 %	-	Conclusion
20 %	-	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

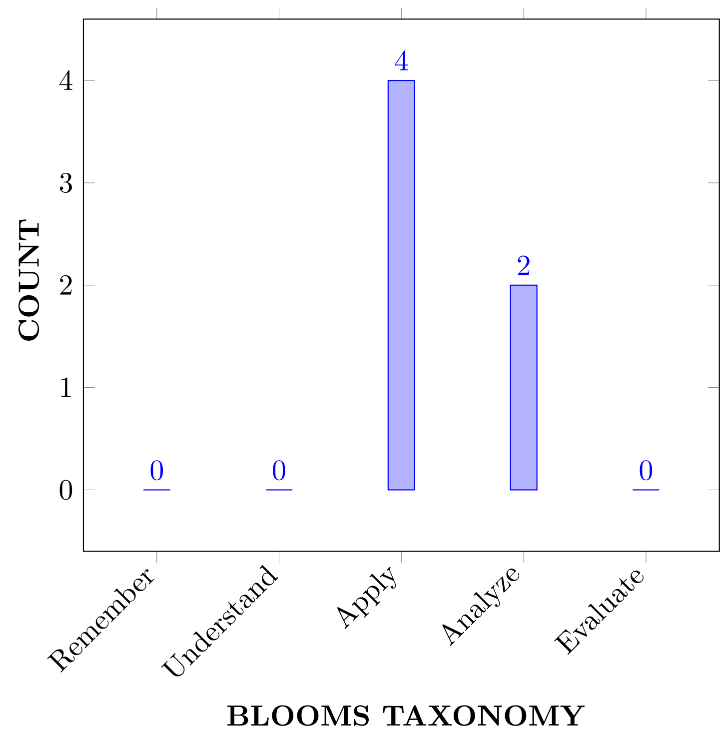
I	The hands on experience in design, develop, implementation and evaluation by using Asymptotic notation.
II	The demonstration knowledge of basic abstract data types (ADT) and associated algorithms for organizing programs into modules using criteria that are based on the data structures of the program .
III	The practical implementation and usage of non linear data structures for solving problems of different domains.
IV	The knowledge of more sophisticated data structures to solve problems involving balanced binary search trees, AVL Trees, B-trees and B+ trees, hashing
V	The graph traversals algorithms to solve real-world challenges such as finding shortest paths on huge maps and assembling genomes from millions of pieces.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Examine** different searching techniques for efficient retrieval of an element from any form of stored data structure.	Analyze
CO 2	**Select** appropriate Sorting technique to specify the way to arrange data in a particular order for optimize search time.	Apply
CO 3	**Make use of** stacks and queues representation and operations to model real time applications.	Apply
CO 4	**utilize** linked lists to implement stacks,queues and graph data structures.	Apply
CO 5	**Analyze** tree data structure for optimize search time.	Analyze
CO 6	**Apply** graph data structures to real life problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	LAB PROGRAMS / / CIA/SEE
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences	3	LAB PROGRAMS / / CIA/SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	LAB PROGRAMS / / CIA/SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	2	LAB PROGRAMS / / CIA/SEE
PO 5	**Modern Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	LAB PROGRAMS / / CIA/SEE
PO 10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	3	LAB PROGRAMS / / CIA/SEE

PO 12	**Life - Long Learning:**Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2	LAB PROGRAMS / / CIA/SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	LAB PROGRAMS / / CIA/SEE
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	LAB PROGRAMS / / CIA/SEE
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	2	LAB PROGRAMS / / CIA/SEE

3 = High; 2 = Medium; 1 = Low

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	**Program Outcomes/ No. of Key Competencies Matched**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	2	3	-	-	-	-	2	-	2	2	1	1
CO 2	1	2	2	2	3	-	-	-	-	2	-	2	1	1	1
CO 3	1	2	2	1	3	-	-	-	-	2	-	2	2	2	1
CO 4	1	2	1	1	3	-	-	-	-	2	-	2	2	1	1
CO 5	1	1	2	1	3	-	-	-	-	2	-	2	2	1	1
CO 6	1	1	2	3	3	-	-	-	-	2	-	2	2	1	1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**SEARCHING TECHNIQUES**
	Write Python programs for implementing the following searching techniques. a. Linear search. b. Binary search. c. Fibonacci search.
WEEK II	**SORTING TECHNIQUES**
	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort. b. Insertion sort. c. Selection sort
WEEK III	**SORTING TECHNIQUES**
	Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Quick sort. b. Merge sort.
WEEK IV	**IMPLEMENTATION OF STACK AND QUEUE**
	Write Python programs to a. Design and implementation Stack and its operations using Arrays. b. Design and implementation Queue and its operations using Arrays
WEEK V	**APPLICATIONS OF STACK**
	Write Python programs for the following: a. Uses Stack operations to convert infix expression into postfix expression. b. Uses Stack operations for evaluating the postfix expression.
WEEK VI	**IMPLEMENTATION OF SINGLE LINKED LIST**
	Write Python programs for the following: a. Uses functions to perform the following operations on single linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal b. To store a polynomial expression in memory using linked list.
WEEK VII	**IMPLEMENTATION OF CIRCULAR SINGLE LINKED LIST**
	Write Python programs for the following: Uses functions to perform the following operations on Circular linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal
WEEK VIII	**IMPLEMENTATION OF DOUBLE LINKED LIST**
	Write Python programs for the following: Uses functions to perform the following operations on double linked list. (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.
WEEK IX	**IMPLEMENTATION OF STACK USING LINKED LIST**
	Write Python programs to implement stack using linked list.
WEEK X	**IMPLEMENTATION OF QUEUE USING LINKED LIST**
	Write Python programs to implement queue using linked list.
WEEK XI	**GRAPH TRAVERSAL TECHNIQUES**
	Write Python programs to implement the following graph traversal algorithms: a. Depth first search. b.Breadth first search.

WEEK XII	**IMPLEMENTATION OF BINARY SEARCH TREE**
	Write a Python program that uses functions to perform the following: a. Create a binary search tree. b.Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.

TEXTBOOKS

1. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley Student Edition.
2. Benjamin Baka, David Julian, "Python Data Structures and Algorithms", Packt Publishers, 2017.

REFERENCE BOOKS:

1. Michael H Goldwasser, David Letscher, —Object Oriented Programming in Python‖, Prentice Hall, 1 st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, —Let us Python‖, BPB publication, 1st Edition, 2019.
3. Ashok Kamthane, Amit Kamthane, —Programming and Problem Solving with Python‖, McGraw Hill Education (India) Private Limited, 2018.
4. Taneja Sheetal, Kumar Naveen, —Python Programming – A modular approach‖, Pearson, 2017.
5. R Nageswara Rao, —Core Python Programming‖, Dreamtech Press, 2017 Edition.

WEB REFERENCES:

1. https://realpython.com/python3-object-oriented-programming
2. https://python.swaroopch.com/oop.html
3. https://python-textbok.readthedocs.io/en/1.0/Object-Oriented-Programming.html
4. https://www.programiz.com/python-programming/
5. . https://www.geeksforgeeks.org/python-programming-language

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Searching Techniques	CO 1	T1
2	Sorting Techniques.	CO 2	T1
3	Sorting Techniques	CO 2	T1,T2
4	Implementation of Stack and Queue	CO 3	T1,T2
5	Applications of Stack.	CO 3	T1, W1
6	Implementation of Single Linked List	CO 4	T1,W2
7	Implementation of Circular Single Linked List.	CO 4	T1,W3

8	Implementation of Double Linked List	CO 4	T2,W3
9	Implementation of Stack Using Linked List.	CO 3,CO 4	T2,W2
10	Implementation of Queue Using Linked List	CO 3,CO 4	T2,W5
11	Graph Traversal Techniques.	CO 6	T2,W2
12	Implementation of Binary Search Tree	CO 5	T1,W5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Design a Data Structure SpecialStack that supports all the stack operations like push(), pop(), isEmpty(), isFull() and an additional operation getMin() which should return minimum element from the SpecialStack. All these operations of SpecialStack must be O(1). To implement SpecialStack, you should only use standard Stack data structure and no other data structure like arrays, list, . etc.
2	**Open channel:** In class, we studied binary search trees that do not allow us to insert duplicate elements. However, sometimes we do need to store duplicates. For example, a database of student marks might contain one record for every mark by every student; so if you've taken two courses, there will be two records with the same key (your student number) and different data (your two marks). To accomplish this, we might use a data structure called a "BST with duplicates", or BSTD
3	**Capillary action:** The variable tos in the Stack class is the index of the array element that would be filled the next time push() is called. Modify the code so that tos is the index of the top element actually in use. In other words, tos is to be the index of the top array element occupied by a value that has been "pushed" onto the stack. Write your changes on the code above. Don't forget to fix the comments. You do not need to add preconditions as in part-a.
4	**Buoyancy** Given an adjacency matrix representation of a graph, describe with pseudo code an algorithm that finds a single path, if one exists, between any two different vertices.
5	**Flow through pipes:** There is a garage where the access road can accommodate any number of trucks at one time. The garage is building such a way that only the last truck entered can be moved out. Each of the trucks is identified by a positive integer (a truck-id). Write a program to handle truck moves, allowing for the following commands: a) On-road (truck-id); b) Enter-garage (truck- id); c) Exit-garage (truck-id); d) Show-trucks (garage or road); If an attempt is made to get out a truck which is not the closest to the garage entry, the error message Truck x not near garage door

Signature of Course Coordinator **HOD,CSE(DS)**
Mrs.D.Kavitha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE)
COURSE DESCRIPTION

Course Title	**Data Science Laboratory**				
Course Code	ACDC02				
Program	B.Tech				
Semester	III	CSE(DS)			
Course Type	FOUNDATION				
Regulation	IARE - UG 20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	1	-	-	1	2
Course Coordinator	Ms. Priyanka Gupta, Assistsant Professor				

I COURSE OVERVIEW:

This course is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from many structural and unstructured data. Data science is related to data mining, machine learning and big data.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	No prerequisite required

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Science Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Demo Video	✓	Lab Worksheets	✓	Viva Questions	X	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	The graphs and charts with the help of statistics in R Programming.
II	The given data with different distribution functions.
III	The relevance and importance of the theory in solving practical problems in the real world.

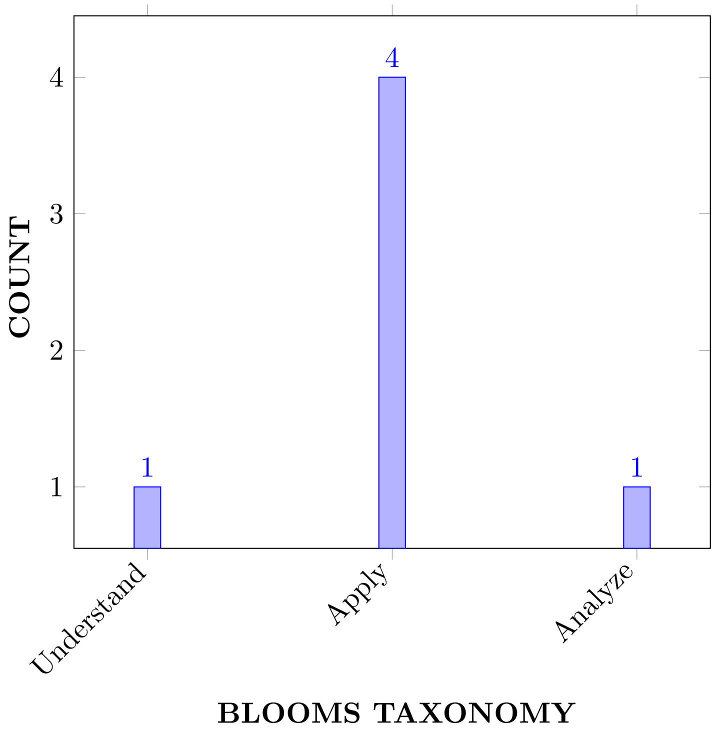
VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** the basic data types and functions of R Programming for describing data.	Understand
CO 2	**Illustrate** the shape and distribution of data with visualization methods in R for describing relationships.	Apply
CO 3	**Calculate** various hypothesis tests, display and probability distributions of data for obtaining the probability statistics.	Apply
CO 4	**Present** various data analysis, data visulization functions on population dataset inferring the data insights for Exploratory Data Analysis.	Apply

CO 5	**Discover** different types of Hypothesis testing for statistical analytic.	Apply
CO 6	**Analyze** the statistical inference with basic and advanced modeling methods for to estimate the uncertainty or sample to sample variation.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations

Program Outcomes	
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / SEE/ Lab Exercises
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE / SEE/ Lab Exercises
PO 5	**Modern tool usage:** UCreate, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	CIE / SEE/ Lab Exercises

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	Lab Exercises
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	Lab Exercises
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

XI JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Demonstrate the data types of R Programming by understating their importance and applicability (apply) in. **solving (complex) engineering problems by applying the principles of Mathematics and Engineering.**	3
	PO 2	Demonstrate the data types of R Programming **with provided information and data in reaching substantiated conclusions by the interpretation of results.** .	3
	PO 5	Demonstrate the data types of R Programming **for solving problems with the help of built in function in R programming Tool.** .	3
	PSO 3	Use real time data to implement machine learning basics with R programming **using basic packages and functions for describing data.** .	3
CO 2	PO 1	Illustrate the distribution of data by using built in functions of R programming for visualizing the shape and distribution of data **by applying principles of Mathematics, Science and Engineering.**	3
	PO 2	Illustrate the distribution of data by using built in functions of R programming **for visualizing the shape and distribution of data in solving analysis problems.** .	2
	PO 5	Illustrate the distribution of data by using built in functions of R programming **for visualizing the shape and distribution of data with the help of built in function in R programming Tool.** .	3
	PSO 3	Use real time data to implement machine learning basics with R programming **by visualizing the data and its relationships.** .	3

CO 3	PO 1	Explain the probability distributions of data and applicability in solving (complex) data centric engineering problems **by applying the principles of Mathematics, Science and Engineering.** .	3
	PO 2	Explain the probability distributions of data and applicability in solving (complex) data centric engineering problems **from the provided information and substantiate with the interpretation of variations in the results.** .	3
	PSO 3	Implement machine learning basics with R programming **by exploring probability distribution to solve complex problems.** .	3
CO 4	PO 1	Conclude the insights of data using exploratory data analysis **by applying the principles of Mathematics, Science and Engineering.**.	3
	PO 5	Define Hive commands for reading, writing and managing large datasets in hdfs **Find the statistical conclusions and visualizations of the.**.	2
	PSO 3	Implement machine learning tasks with R programming **by exploring statistical analysis and data visualization for generating predictions.** .	3
CO 5	PO 1	Apply the hypothesis testing on probabilistic problems **by understanding the appropriate parametric assumptions and limitations based on mathematical fundamentals..**.	3
	PO 3	Understand the given problem statement and formulate (complex) engineering system **for deriving chances of occurrences od different states of outcomes with the interpretation of variations in the results..**.	2
	PO 5	Make use of packages and functions **for creating conclusions of various testing on hypothesis.**.	3
	PSO 3	Understand the hypothesis by performing various tests to interpret the sampling **from distributions to visualize the data to analyze the complexity.**.	3
CO 6	PO 1	Apply the knowledge of **statistics fundamentals** like a **Mathematics and statistics functions and inferences**.	3
	PO 3	Apply regression, generalized linear models, advanced modeling methods on the **model for fit measures** reaching **good fit**.	3
	PSO 3	Use packages and function in R tool **for applying different modeling techniques on the statistical inference**.	3

XII MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 5	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	3	-	-	3
CO 2	3	2	-	3	-	-	3
CO 3	3	3	-	-	-	-	3
CO 4	3	-	-	2	-	-	3
CO 5	3	2	3	-	-	-	3
CO 6	3	-	3	-	-	-	3

XIII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIV ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XV SYLLABUS:

WEEK 1	**INTRODUCTION TO COMPUTING**

	Problem Statement: (a) Installation of R (b) There is a vector, matrices and lists. Perform the basics, sub-setting and use functions in R Programming language. **Solution expected:** 1. There is a vector having the following properties: (a) There is a number 23 stored using an assignment operator. (b) A vector with elements 1,2,3,4,5,6,7,8,9,10. (Using c() or seq() function and also use mean(), var(), sd() and summary() system-defined functions.) 2. There is a matrix having the following properties: (a) A 2-D matrix with 4 rows and 2 columns having elements 1,2,3,4,5,6,7,8 filled column to column. (b) Transpose of the matrix. (c) The (3,4) element extracted of the matrix. (d) Extracted first row of the matrix. 3. There is a list having the following properties: (a) A list with elements 'Server', 'Network Device', 1,2,3,4. (b) The first element 'Server' extracted from the list.
WEEK 2	**GETTING USED TO R: DESCRIBING DATA**

	Problem Statement: There is an R-inbuilt mtcars dataset having the observations and variables in the form of rows and columns. mpg cyl disp hp drat wt qsec vs am gear carb Mazda RX4 21.0 6 160.0 110 3.90 2.620 16.46 0 1 4 4 Mazda RX4 Wag 21.0 6 160.0 110 3.90 2.875 17.02 0 1 4 4 Datsun 710 22.8 4 108.0 93 3.85 2.320 18.61 1 1 4 1 Hornet 4 Drive 21.4 6 258.0 110 3.08 3.215 19.44 1 0 3 1 Hornet Sportabout 18.7 8 360.0 175 3.15 3.440 17.02 0 0 3 2 ... ... Lincoln Continental 10.4 8 460.0 215 3.00 5.424 17.82 0 0 3 4 Chrysler Imperial 14.7 8 440.0 230 3.23 5.345 17.42 0 0 3 4 Fiat 128 32.4 4 78.7 66 4.08 2.200 19.47 1 1 4 1 Honda Civic 30.4 4 75.7 52 4.93 1.615 18.52 1 1 4 2 Toyota Corolla 33.9 4 71.1 65 4.22 1.835 19.90 1 1 4 1 ... ... Lotus Europa 30.4 4 95.1 113 3.77 1.513 16.90 1 1 5 2 Ford Pantera L 15.8 8 351.0 264 4.22 3.170 14.50 0 1 5 4 Ferrari Dino 19.7 6 145.0 175 3.62 2.770 15.50 0 1 5 6 Maserati Bora 15.0 8 301.0 335 3.54 3.570 14.60 0 1 5 8 Volvo 142E 21.4 4 121.0 109 4.11 2.780 18.60 1 1 4 2 **Solution expected:** 1. (a) List the objects, variables, and structure of the dataset. (b) Dimension and class of the object. (c) Type and length of data. (d) Print first and last 5 rows. 2. (a) Select all columns from hp to vs. (b) Select the first 3 rows. (c) Sorted rows by variables in both ascending and descending order.

<table>
<tr><td>WEEK 3</td><td>READING THE DATA: USING CONSOLE, FILES, LOCAL DISK, AND WEB</td></tr>
<tr><td></td><td>
Problem Statement
3. (a) Read the input given by the user in the terminal with the readline() and scan() function.
(b) Read data from a file data stored as a data frame.

(c) Create csv file using windows notepad by copying and pasting the following data. Save the file as input.csv using the save As All files(*.*) option in notepad.

id,name,salary,start$_{d}ate, dept$
$1, Rick, 623.3, 2012-01-01, IT$
$2, Dan, 515.2, 2013-09-23, Operations$
$3, Michelle, 611, 2014-11-15, IT$
$4, Ryan, 729, 2014-05-11, HR$
$5, Gary, 843.25, 2015-03-27, Finance$
$6, Nina, 578, 2013-05-21,$
$7, Simon, 632.8, 2013-07-30, Operations$
$8, Guru, 722.5, 2014-06-17, Finance$

$Readthedatausingtheread.csv("input.csv")command.$

$(d) Readawebfile$
$http://www.sthda.com/upload/boxplot_format.txt".$

Note: Using dplyr() package.
</td></tr>
<tr><td>WEEK 4</td><td>EXPLORATORY DATA ANALYSIS</td></tr>
<tr><td></td><td>
Problem Statement:
Find the description of the statistics and do exploratory data analysis for the following csv file dataset.(Use latest dataset)
Dataset: Forbes Richest Athletes 1990-2020 Dataset
Solution expected:
1. Show the description of the dataset. (Use str() and summary() functions)
2. Print the first five and last five rows of the data.
3. Descriptive statistics like mean, median, and measures of Dispersion like variance and standard deviation.
4. Plot the scatter plot.
5. Exclude the missing values from the dataset.

Note: Use the library tidyverse and ggplot2.
</td></tr>
</table>

WEEK 5	**PROBABILITY DISTRIBUTIONS**
	Problem Statement: Figure out the different probability distributions. **Solution expected:** a) Random number generation Distributions, the practice of simulation. b) Generate and Visualize Discrete and continuous distributions using the statistical environment. c) Demonstration of CDF and PDF uniform and normal, binomial and Poisson distributions.
WEEK 6	**BINOMIAL DISTRIBUTION**
	Problem Statement: Find out the probabilities of the following sets: 1. Suppose there are ten multiple-type questions in an English class quiz. Each question has four possible answers, and only one of them is correct. 2. Investment Advisors agree that near retirees, defined as people aged 55 to 65, should have balanced portfolios. Most advisors suggest that the near -retirees have no more 50 percent of their investments in stocks. However, during the huge decline in the stock market in 2008, 22 percent of near -retirees had 90 percent or more of their investments in stocks. Suppose you have a random sample of 10 people who have labeled as near -retirees in 2008. What is the probability that during 2008. **Solution expected:** 1. (a) Find out the probability of having exactly 4 correct answers if a student attempts all ten questions. (b) Find the probability of having four or less correct answers if a student attempts to answer every question at random. 2. (a) Zero had 90 percent or more of their investments in stocks? b) Exactly one had 90 percent or more of his investments in stocks? c) Two or fewer had 90 percent or more of their investment in stocks? d) Three or more had 90 percent or more of their investments in stocks.
WEEK 7	**CORRELATION**
	Problem Statement: The data for heights and weights of a group of persons are as follows:

Height (cm) : X	158	160	163	166	168	171	174	176
Weight (kg) : Y	60	62	64	65	67	69	71	72

Solution expected:
1. Find the correlation between two variables on scatter plots, investigate the relationship between two variables.
3. Check whether the correlation between heights and weights of a group of persons is a positive/negative/zero correlated.

WEEK 8 | **TEST OF HYPOTHESES**

Problem Statement:
There is empirical data on households and TVs.

No. of TVs	**No. of Households**	x	$P(x)$
0	1,218	0	0.012
1	32,379	1	0.319
2	37,961	2	0.374
3	19,387	3	0.191
4	7,714	4	0.076
5	2,842	5	0.028
	101,501		1.000

Solution expected:
1. Estimate the mean and variance of the probability mass function on the number of TVs in a household.
2. Find the probability at X = 3 to observe the event.

WEEK 9 | **TESTS OF HYPOTHESES**

Problem Statement:
Boys of a certain age are known to have a mean weight of 85 pounds. A complaint is made that the boys living in a municipal children's home are underfed. As one bit of evidence, a sample of 25 boys (of the same age) is weighed and found to have a mean weight of = 80.94 pounds. The population standard deviation is 11.6.

Solution expected:
(a) Investigate the tests of hypotheses about the mean when the variance is known.
(b) Find out the p-value for the sample mean.

WEEK 10 | **ESTIMATING A LINEAR RELATIONSHIP**

Problem Statement:
The following dataset is about income (in a range of 15kto75k) and happiness (rated on a scale of 1 to 10) in an imaginary sample of 500 people.

	income	happiness
1	3.862647	2.314489
2	4.979381	3.43349
3	4.923957	4.599373
4	3.214372	2.791114
5	7.196409	5.596398
6	3.729643	2.458556
7	4.674517	3.192992
8	4.498104	1.907137
9	3.121631	2.94245
10	4.639914	3.737942
11	4.63284	3.175406
12	2.773179	2.009046
13	7.119479	5.951814
14	7.466653	5.960547
15	2.117742	1.445799
16	2.559166	2.898583
17	2.354793	1.231168
18	2.388157	2.312988
19	4.75568	2.666116
20	1.994275	2.584729
21	7.310916	5.747444
22	3.528319	2.546525
23	2.428752	1.200786

Solution expected:
(a) Find out the linear relationship between income over happiness.
(b) Find out the linear regression coefficient of happiness on income.
(c) Visualize the results of linear regression.
(i) Plot the data points on a graph.
(ii) Add the linear regression line to the plotted data.
(iii) Add the equation for the regression line.
Note: The income values are divided by 10,000 to make the income data match the scale of the happiness scores (so a value of 2$represents$20,000, 3is30,000, etc.)

WEEK 11	**APPLY-TYPE FUNCTIONS**
	Problem Statement: Consider the FARS (Fatality Analysis Recording System) dataset available in gamclass package of R. It contains 151158 observations of 17 different features. The dataset includes every accident in which there was at least one fatality and the data is limited to vehicles where the front seat passenger seat was occupied. **Solution expected:** 1. Calculate the mean of age column using apply() function and lapply() function. 2. Use sapply() function and tapply() function. 3. Use mapply() function and by() function.
WEEK 12	**STATISTICAL FUNCTIONS IN R**
	Problem Statement: A medical chart portrayed a patient who was displaying symptoms of a migraine headache but was otherwise healthy. The experiment included a total of 122 primary care physicians affiliated with one of three major hospitals in the Texas Medical Center of Houston. The data (http://pluto.huji.ac.il/ msby/StatThink/Datasets/discriminate.csv) for the given collection of responses from 72 primary care physicians is stored in the file discriminate.csv". **Solution expected:** 1. (a) Read the content of the file into a data frame by the name patient" and present the summary of the variables. (b) Produce a table of the response i.e. patient Vs time. 2. (a) Plot histogram of the variable time". (have a look at the data before doing the analysis) (b) Plot the relation between the response and the explanatory variable. 3. (a) Apply the test and examine the presence, or lack thereof, of such effect on the variance of the response on the function var.test". (b) Validate the significance of our findings. **Note:** Two variables (the gender and the weight of the patient) were manipulated across six different versions of the medical charts. The weight of the patient, described in terms of Body Mass Index (BMI), was average (BMI = 23), overweight (BMI = 30), or obese (BMI = 36). Although three patient weight conditions were used in the study (average, overweight, and obese) only the average and overweight conditions will be analyzed. Therefore, there are two levels of patient weight (average and overweight) and one dependent variable (time spent).

TEXTBOOKS

1. Sandip Rakshit, "Statistics with R Programming", McGraw Hill Education, 2018.

2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "AN Introduction to Statistical Learning: with Applications in R", Springer Texts in Statistics, 2017.

3. Joseph Schmuller, "Statistical Analysis with R for Dummies", Wiley, 2017.

4. K G Srinivasa, G M Siddesh, Chetan Shetty, Sowmya B J, “Statistical Programming in R”, Oxford Higher Education, 2017.

REFERENCE BOOKS:

1. Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt “Probability and Statistics with R” 2nd Edition on, CRC Press, 2016.
2. P. Dalgaard. “Introductory Statistics with R” Springer, 2nd Edition, 2008.

XVI COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO’s	Reference
1	Introduction To Computing	CO 1	R1: 1
2	Getting Used To R: Describing Data	CO 1	R3: 2
3	Shape Of Data And Describing Relationships	CO 2	R1: 7
4	Probability Distributions	CO 3	R1: 8
5	Exploratory Data Analysis	CO 4	R1: 2.4
6	Testing Hypotheses	CO 5	R1: 9
7	Predicting Continuous Variables	CO 6	R1: 10
8	Correlation	CO 2	R3: 15
9	Tests Of Hypotheses	CO 5	R1: 9
10	Estimating A Linear Relationship	CO6	R1: 10
11	Apply-Type Functions	CO 1	R4:7
12	Statistical Functions In R	CO 1	R4:10

XVII EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Generalized linear model: Fit to multinomial response data from a teaching experiment using the **polr** function in R package **MASS**.
2	Analysis of a two-factor: **ANOVA** of Hunter’s CO emission data using R function **aov**.
3	Visualization: Creating a simplex-lattice design and a simplex-centroid design with the mixexp package in R
4	Model performance: Finding the constrained optimum a model fit to a mixture experiment using R.

Signature of Course Coordinator **HOD,CSE (DS)**
Ms. Priyanka Gupta, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

COURSE DESCRIPTION

Course Title	PROGRAMMING WITH OBJECTS LABORATORY				
Course Code	AITC03				
Program	B.Tech				
Semester	III				
Course Type	Laboratory				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr. N RAGHAVA RAO, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC04	II	Programming for problem solving using C
B.Tech	AITC02	III	Programming with Objects

II COURSE OVERVIEW:

The course covers object oriented programming paradigm. Topics covered include object oriented concepts such as abstraction, inheritance, and polymorphism for demonstrating real world entity representation and creation of reusable software components. The main objective of the course is to teach the students how identify and implement object oriented concepts, file handling and web page design and establishing access with databases from java programs. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Programming with Objects Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	NA	Purpose
20 %	NA	Algorithm
20 %	NA	Programme
20 %	NA	Output
20 %	NA	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
NA	NA	NA	NA	NA	NA

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

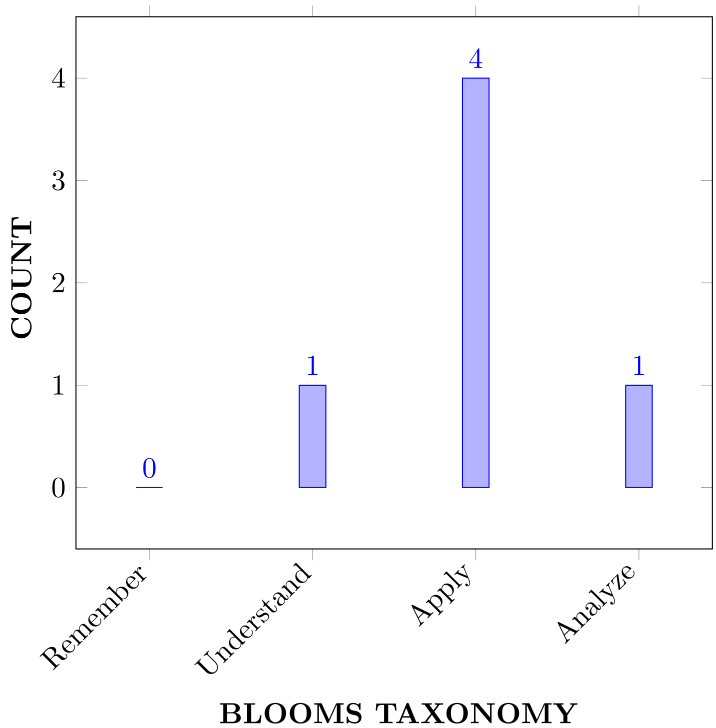
I	The object-oriented programs in java.
II	The implementation of java programs for demonstrating object oriented concepts such as abstraction, inheritance and polymorphism.
III	The demonstration of file accessing and web based user interface creation.
IV	Database connectivity in java and implement GUI applications.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** object oriented programming concepts that helps to organize complex problems solving	Understand
CO 2	**Make Use Of** the programming constructs like control Structures, arrays, parameter passing techniques and constructors to solve the real time problems.	Apply
CO 3	**Utilize** the abstraction,encapsulationand polymorphism Techniques to solve different complex problems	Apply
CO 4	**Experiment** all threading and thread synchronization problems in soft real time systems.	Apply
CO 5	**Make use of** inheritance, interfaces, packages and files to implement reusability in soft real time systems	Analyze
CO 6	**Construct** GUI based applications along with Exception handling using AWT, Swingand Applets with JDBC connectivity.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE/QUIZ

PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/SEE/QUIZ
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	2	CIE/SEE/QUIZ
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	CIE/SEE/QUIZ
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2	CIE/SEE/QUIZ

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	SEE/QUIZ
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2	SEE/QUIZ

3 = High; 2 = Medium; 1 = Low

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	**Program Outcomes/ No. of Key Competencies Matched**												**PSO'S**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	2	-	-	-	-	2	-	1	-	2	1
CO 2	3	-	-	-	1	-	-	-	-	2	-	1	-	1	1
CO 3	3	-	2	-	2	-	-	-	-	2	-	1	-	-	-
CO 4	3	-	2	-	2	-	-	-	-	2	-	1	-	-	-
CO 5	3	-	2	-	2	-	-	-	-	2	-	1	-	1	1
CO 6	3	-	2	-	2	-	-	-	-	2	-	1	-	1	1

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**Basic Programs**
	Problem statement: Use the basic Java Programming Knowledge and implement java program to find the real solutions of quadratic equation and to display fibonacci series. **Solution Expected:** a) Try debug step by step with small program of about 10 to 15 lines which contains at least one if else condition and a for loop. b) Java program that prints all real solutions to the quadratic equation ax2 +bx+c=0. Read in a, b, c and use the quadratic formula. c) The Fibonacci sequence is defined by the following rule. The first two values in the sequence are 1 and every subsequent value is the sum of the two values preceding it. Java program that uses both recursive and non recursive functions.
WEEK II	**Matrices, Overloading, Overriding**
	Problem statement: Using the method overloading and overwriting concepts in Object Oriented Programming, Implement the Java program that describe the use of method overloading and overwriting concepts. **Solution Expected:** a) Java program to multiply two given matrices. b) Java program to implement method overloading and constructors overloading. c) Java program to implement method overriding.

WEEK III	**Palindrome, Abstract Class**
	Problem statement: Implement the java programs to check the string palindrome property, sorting of strings and find the area of different shapes like rectangle,traingle,circle for a given two given integers. **Solution Expected:** a) Java program to check whether a given string is palindrome. b) Java program for sorting a given list of names in ascending order. c)Java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
WEEK IV	**Interface**
	Problem statement: Create the user interface to perform the division of two numbers given in text fields and display the result when the user click on Divide button. It should display error messages according to the exceptions. **Solution Expected:** a)Java program that creates a user interface to perform integer division. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 and Num2 were not integers, the program would throw a Number Format Exception. If Num2 were zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box. b)Java program that creates a user interface to perform integer addition. The user enters two numbers in the text fields, Num1 and Num2. The addition of Num1 and Num2 is displayed in the Result field when the Addition button is clicked.
WEEK V	**Multithreading**
	Problem statement: Using the multi-thread concept in java, Implement the program to find the square and cube of given number and solve the producer consumer problem. **Solution Expected:** a) Java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number. b) java program that correct implements of producer consumer program.

WEEK VI	**Files**
	Problem statement: Get the filename from the user console and display the file properties like existence of file, readability ,writability,type of file,length of file,no of characters,no of lines and no of words in the text file. **Solution Expected:** a) Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes. b) Java program that displays the number of characters, lines and words in a text file. c) Java program that reads a file and displays the file on the screen with line number before each line.
WEEK VII	**Files**
	Problem statement: Consider the text file with some database where elements are separated by commas. Display the content in GridLayout format and implement the database manipulation operations. **Solution Expected:** a) Suppose that table named table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas. Write a java program to display the table using labels in gridlayout. b) Java program that connects to a database using JDBC and does add, delete, modify and retrieve operations.
WEEK VIII	**Java Program with Database**
	Problem statement: Consider the text file containing names and phone numbers of students organized as records. Retrieve the name of student for a given Phone number. **Solution Expected:** a) Java program that loads names and phone numbers from a text file where the data is organized as one line per record and each field in a record are separated by a tab (/t). It takes a name or phone number as input and prints the corresponding other value from the hash table. Hint: Use hashtables. b) Program with database instead of a text file.
WEEK IX	**Files**
	Problem statement: Implement a Java Program which converts the content of text into the database and print the meta data of a given table **Solution Expected:** a) Java program that takes tab separated data (one record per line) from a text file and insert them into a database. b) Java program that prints the metadata of a given table.

WEEK X	**Traffic Light**
	Problem statement: Develop a traffic signal controller, which can be sensitive to changing traffic management policy, and aim to achieve a wide range of transport and environmental objectives in addition to minimisation of vehicle delays and stops in JAVA **Solution Expected:** a)Java program that simulates a traffic light. The program lets the user select one of two lights: Red, Yellow with radio buttons. On selecting a button an appropriate message with —STOP‖ or —READY should appear above the buttons in selected color. Initially, there is no message shown. b)Java program that simulates a traffic light. The program lets the user select one of one light: Green with radio buttons. On selecting a button an appropriate message with GO should appear above the buttons in selected color. Initially, there is no message shown.
WEEK XI	**Mouse Events**
	Problem statement: Implement all mouse events and key events using Object Programming language Java. **Solution Expected:** a) Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired. Use adapter classes. b) Java program to demonstrate the key event handlers.
WEEK XII	**Calculator**
	Problem statement: Consider the Grid Layout design Process in java to design a simple calculator with digits and simple airthmatic operators. **Solution Expected:** a) A java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +,-,*, percentage operations. b) Add a text field to display the result. Handle any possible exception like divided by zero..
WEEK XIII	**Applet**
	Problem statement: Consider the Applet design Techniques in Java to implement java program to develop an applet that displays a simple message and for displaying the factorial value of a given input. **Solution Expected:** a) Applet that displays a simple message. b) Applet that receives an integer in one text field and computes its factorial value and returns it in another text field, when the button named —compute‖ is clicked.

REFERENCE BOOKS:

1. P. J. Deitel, H. M. Deitel, —Java for Programmers‖, Pearson Education, PHI, 4th Edition, 2007.

2. P. Radha Krishna, —Object Oriented Programming through Java‖, Universities Press, 2nd Edition, 2007

3. Bruce Eckel, —Thinking in Java‖, Pearson Education, 4th Edition, 2006.

4. Sachin Malhotra, Saurabh Chaudhary, —Programming in Java‖, Oxford University Press, 5th Edition, 2010.

WEB REFERENCES:

1. www.niecdelhi.ac.in
2. https://www.linkedin.com/in/achin-jain-85061412

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Basic Programs	CO 1,CO 2	Ref 1,Ref 2
2	Matrices, Overloading, Overriding	CO 1,CO 2	Ref 1,Ref 2
3	Palindrome, Abstract Class	CO 3	Ref 1.Ref 2
4	Interface	CO 3, CO 5	Ref 1.Ref 2
5	Multithreading	CO 4	Ref 1.Ref 2
6	Files	CO 5	Ref 2, Ref 3
7	Files	CO 5	Ref 3, Ref 4
8	Java Program with Database	CO 6	Ref 1.Ref 2
9	Files	CO 5	Ref 1.Ref 2
10	Traffic Light	CO 6	Ref 3, Ref 4
11	Mouse Events	CO 5 ,CO 6	Ref 3, Ref 4
12	Calculator	CO 5,CO 6	Ref 3, Ref 4
13	Applet	CO 6	Ref 3, Ref 4

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design a class to represent a Student details include the Student ID, Name of the Student, Branch, year, location and college. Assign initial values using constructor. Calculate average of marks of 6 subjects and calculate attendance percentage
2	Develop with suitable hierarchy, classes for Point, Shape, Rectangle, Square, Circle, Ellipse, Triangle, Polygon, etc. Design a simple test application to demonstrate dynamic polymorphism
3	Write a program that creates three threads. First thread displays “Good Morning” every one second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.
4	Write an Applet that computes the payment of a loan on the amount of the loan, the interest rate and the number of months. It takes one parameter from the browser. Monthly; if true, the interest rate is per month, otherwise the interest rate is annual.
5	Write a java programs to find factorial of a number. user is allowed to enter a number into the text field whose factorial is to be determined. On pressing the button the value of the text field is firstly converted into integer and then processed to find its factorial. The result will get display in another text field.(Hint: use swings).

Signature of Course Coordinator **HOD,DS**
Mr. N Raghava Rao

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**CSE (DATA SCIENCE)**				
Course Title	**DATA MANAGEMENT AND REPRESENATATION**				
Course Code	ACDC03				
Program	B.Tech				
Semester	IV Semester				
Course Type	Professional				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr. M Lakshmi Prasad, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACDC02	III	Principles of Data science

II COURSE OVERVIEW:

The course emphasis on the data management and representataion. It is the fundamental course and is interdisciplinary in nature for all engineering applications. The students will understand principles of data management, different kinds of data, missing data, data representation in the form of tables and graphs.This course provides adequate knowledge to mange differnt kinds of data and visulaize data in different forms.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Fluid Dynamics	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
%	Remember
%	Understand
%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

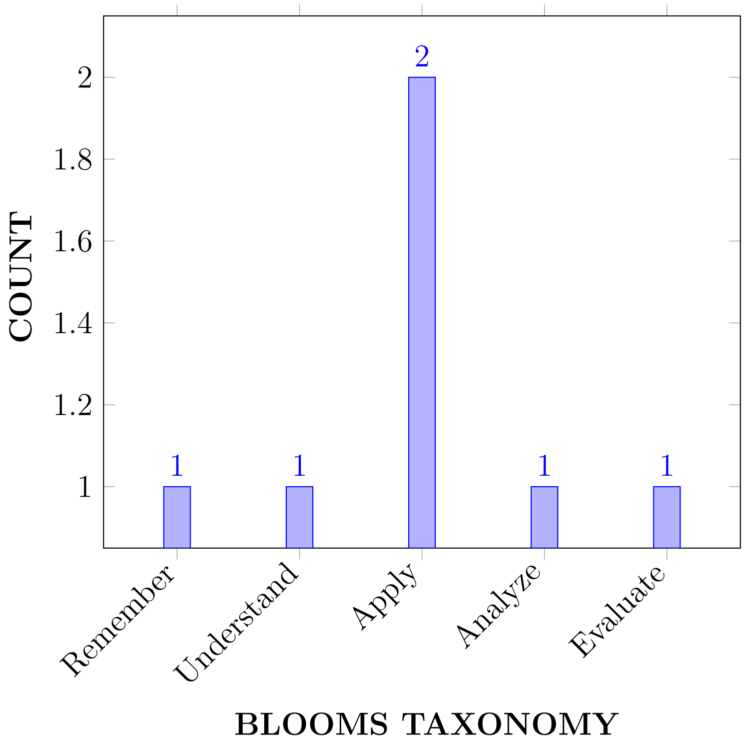
I	Summarize the fundamental knowledge on data management for data science.
II	To provide knowledge on forms of data, Datasets, Missing data and data presentation.
III	Able to document and transfer the results and effectively communicate the findings using visualization techniques.
IV	To interpret and communicate data and results.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the basic concepts of data and principles of data management.	Remember
CO 2	**Illustrate** secondary, primary and administrative data sources.	Understand
CO 3	**Identify** the reasons of missing data and various forms of data set.	Apply
CO 4	**Examine** different styles of tables and graphs for presenting the data.	Analyze
CO 5	**Determine** the principles like clarity, precision and efficiency of data presentation.	Evaluate
CO 6	**Build** different data visualizations using tables and graphics.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE/Quiz/AAT
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	CIE/Quiz/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE/Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	CIE/Quiz/AAT
PO 11	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, and Web design, Artificial Intelligence, Machine Learning and Networking.	3	CIE/Quiz/AAT
PSO 2	Focus on improving software reliability, network security and information retrieval systems.	2	CIE/Quiz/AAT
PSO 3	Make use of modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 2	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 3	✓	✓	-	✓	✓	-	-	-	-	✓	-	✓	✓	-	-
CO 4	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 5	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
CO 6	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the various sources,forms and principles of data management by using **mathematical principles, data science related fundamentals and engineering specializations for complex problems.**	2
	PSO 1	Explain, design and analyze different forms of data in the areas related to **System Software, Web design, Artificial Intelligence, Machine Learning and Networking.**	3
CO 2	PO 1	Illustrate different types of secondary,primary and administrative data and its uses by applying **mathematical principles and data science methodologies.**	2
	PO 2	Explain the process of exploring different types of secondary,primary and adminstrative data **by applying the formulation and abstraction, information,data collection and validation**	6

	PO 3	Identify the principles for primary and administrative data and linking datasets for various problems **by understanding customer and user needs, with cost effective and creative solutions by managing the design process, knowledge on economic context, management techniques.**	7
	PO 10	Communicate effectively on linking datasets by comprehend and write effective reports and design documentation and presentations on data exploration with the engineering community by having major focus on **clarity on content, Grammar/Punctuation and appropriate References.**	5
	PO 12	Recognize the need of the principles for primary and administrative data and linking datasetsdatasets for understanding and developing data centric applications through **continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development** in the broadest context of technological change.	5
	PSO 1	Explain the **principles for secondary primary and administrative data and linking datasets** in the areas related to **Data science, Artificial Intelligence and Machine Learning.**	4
CO 3	PO 1	Identify reasons of missing data and its types by using **mathematical principles and data science methodologies**.	2
	PO 2	Consider missing data and its types through **data collection, validation and interpretation of results.**	6
	PO 4	Use research-based knowledge and research methods for finding missing data and its types based on **technical literature and quality issues.**	3
	PO 5	Make use of missing data, reasons and its types by using **the interpretation of data , understanding of contexts in technology development ,awareness of issues ,working technical uncertainty, ability to apply analyze.**	1
	PO 10	Communicate in written and orally by comprehending and writing effective reports and design documentation and presentations on the use of missing data, reasons and its types based on **clarity on content, Grammar/Punctuation and appropriate References.**	5
	PO 12	Recognize the need for missing data, forms and patterns and addressing of missing data through **continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development** in the broadest context of technological change.	5

	PSO 1	Make use of missing data, reasons and its types to develop analytical solutions related to **Artificial Intelligence, Machine Learning and Data science.**	4
CO 4	PO 1	Develop a visualization model by make use of presenting data with the help of **mathematical and scientific principles by integrating data science knowledge.**	3
	PO 2	Consider the use of presenting data, visual images of data by including variant forms of **information and data collection, validation, experimental design and interpretation of results.**	6
	PO 3	Develop a visualization of any real time application by **investigating and defining various problems with different forms of visualization by managing the design process, knowledge on economic context, management techniques.**	7
	PO 4	Develop a visualization data model with **laboratory skills, technical literature and quality issues. Identify, classify and predict through analytical methods and techniques.**	5
	PO 5	Make use of presenting data for **developing a visualization model.**	1
	PO 10	Communicate in written form by the use of presenting data, for better visualization by having major focus on **clarity on content, and with appropriate References**.	3
	PO 12	Recognize the need for advanced concepts for presenting data for developing data visualization through **continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development** in the broadest context of technological change.	5
	PSO 1	Develop data visualization for different applications by including huge volume of data and related to **Artificial Intelligence, Machine Learning and Data science.**	4
	PSO 2	Develop data visualization applications for specific problems with a major focus on **improving presenting data and information retrieval systems.**	1
	PSO 3	**Develop applications** by using visualization tools related to **create innovative career paths, to be an entrepreneur and desire for higher studies in data science area.**	2

CO 5	PO 1	Remember principles like clarity, precision, and efficiency for data presentation by applying **mathematical and scientific principles by integrating computer science and data science knowledge.**	3
	PO 2	Identify the appropriate principles for finding a visualization model to specific problems by including of **information and data collection, validation, experimental design and interpretation of results.**	6
	PO 3	Design solutions with high efficiency by **iinvestigating and defining various problems, understanding customer and user needs and creative solutions by using principles of data management techniques.**	7
	PO 4	Develop accurate applications with high accuracy by working on **laboratory skills, technical literature and quality issues.**	8
	PO 5	Make use of principles of data presentation **for developing a visualization model.**	1
	PO 10	Communicate in written form by the use of presenting data, for better visualization by having major focus on **clarity on content and with appropriate References**.	3
	PO 12	Recognize the need for advanced concepts for presenting data for developing data visualization through **principles of data presentation in the broadest context of technological change.**	5
	PSO 1	Develop data visualization applications for specific problems by considering principles of data presentation and related to **Artificial Intelligence, Machine Learning and Data science.**	4
	PSO 2	Develop data visualization applications for specific problems with a major focus on **improving presenting data and information retrieval systems.**	1
	PSO 3	**Develop applications** by using visualization tools related to **create innovative career paths, to be an entrepreneur and desire for higher studies in data science area.**	3
CO 6	PO 1	Remember principles of data presentation by applying **mathematical and scientific principles by integrating computer science and data science knowledge.**	3
	PO 2	Identify the appropriate data presentation principles to model a specific problem by including of **information and data collection, validation, experimental design and interpretation of results.**	6

	PO 3	Design solutions with high efficiency by **iinvestigating and defining various problems, understanding customer and user needs and creative solutions by using principles of data management techniques.**	7
	PO 4	Make use of tools for tables and its examples for the appearance of data through **through laboratory skills, technical literature, technical uncertainty and quality issues.**	9
	PO 5	Develop real time **software applications** using tables for the presentation of data.	1
	PO 10	Communicate in written form by the using priciples of presenting data for better visualization by having major focus on **clarity on content and with appropriate References**.	3
	PO 12	Recognize the need of the principles for primary and administrative data and linking datasets datasetsfor understanding and developing data centric applications through **continuing education efforts with ongoing learning – stays up with industry trends/ new technology and continued personal development** in the broadest context of technological change.	5
	PSO 1	Develop different data visualization applications using tables and graphics of data presentation and related to **Artificial Intelligence, Machine Learning and Data science.**	5
	PSO 2	Develop applications using tools of tables and graphics concepts with a major focus on improving **visualization of data and information retrieval systems.**	1
	PSO 3	**Develop applications** by using tools oftables and graphics for creating **innovative data visualization of applications for higher studies.**	3

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	2	6	7	-	-	-	-	-	-	5	-	5	4	-	-
CO 3	2	6	-	4	1	-	-	-	-	5	-	5	4	-	-
CO 4	3	6	7	5	1	-	-	-	-	3	-	5	4	1	2
CO 5	3	6	7	8	1	-	-	-	-	3	-	5	4	1	3
CO 6	3	6	7	9	1	-	-	-	-	3	-	5	5	1	3

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	67	-	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 2	67	60	70	-	-	-	-	-	-	100	-	42	67	-	-
CO 3	67	60	-	37	100	-	-	-	-	100	-	42	-	-	-
CO 4	100	60	70	45	100	-	-	-	-	60	-	42	67	50	100
CO 5	100	60	70	73	100	-	-	-	-	60	-	42	67	50	67
CO 6	100	60	70	82	100	-	-	-	-	60	-	42	84	50	67

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	3	2	3	-	-	-	-	-	-	3	-	2	3	-	-
CO 3	3	3	-	2	3	-	-	-	-	3	-	2	-	-	-
CO 4	3	3	3	2	3	-	-	-	-	3	-	2	3	3	3
CO 5	3	3	3	3	3	-	-	-	-	3	-	2	3	3	3
CO 6	3	3	3	3	3	-	-	-	-	3	-	3	3	-	-
TOTAL	18	14	9	13	15	-	-	-	-	15	-	11	15	6	6
AVERAGE	3	2.3	1.5	2.2	2.5	-	-	-	-	2.5	-	1.9	2.5	1	1

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	✓	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**PRINCIPLES OF DATA MANAGEMENT**
	Data, Sources of Data, From Concepts to Variables, Forms of Data Data Management: Codebooks, Documentation, Coding, Data Cleaning and Screening, Naming Conventions, Principles of File Management
MODULE II	**SECONDARY, PRIMARY AND ADMINISTRATIVE DATA**
	Secondary Data: Types of Secondary Data, Use of Secondary Data, Sources of Secondary Data, Examples of Searching for Downloading and Importing Data, A Simple Test of the Conceptual Model. Primary and Administrative Data: Principles for Primary Data, Administrative Data and Linking Datasets.
MODULE III	**MISSING DATA**
	Working with Missing Data: Why Are Missing Data a Problem?, Reasons for Missing Data, Types of Missing Data, Forms and Patterns of Missing Data, Addressing Missing Data in the Analysis Stage
MODULE IV	**DATA PRESENTATION**
	Presenting Data, Visual Images, First Principles: Clarity, Precision, and Efficiency, Why Words Are Not Enough, Types of Tables and Graphics, Principles of Data Presentation
MODULE V	**DESIGNING TABLES AND GRAPHICS FOR DATA PRESENTATIONS**
	Tables, Examples of Tables, Graphics, Examples of Graphics.

TEXTBOOKS

1. Dr. John P. Hoffmann, “Principles of Data Management and Presentation”, First Edition.

REFERENCE BOOKS:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt.

WEB REFERENCES:

1. Not Available

COURSE WEB PAGE:

1. https://akanksha.iare.ac.in/index?route=course/details and course-id=656

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
1-3	Data, Sources of Data, From Concepts to Variables, Forms of Data.	CO 1	T1: 3.1-3.4
4-6	Codebooks, Documentation, Coding	CO 1	T1: 4.1-4.3
7-9	Data Cleaning and Screening, Naming Conventions	CO 1	T2: 4.4-4.5
10	Principles of File Management	CO 1	T1: 4.6
11-13	Types of Secondary Data, Use of Secondary Data, Sources of Secondary Data	CO 2	T1: 5.1 -5.3
14-15	Examples of Searching for Downloading and Importing Data, A Simple Test of the Conceptual Model	CO 2	T1: 5.4-5.5
16-17	Principles for Primary Data, Administrative Data and Linking Datasets.	CO 2	T1: 6.1-6.3
18-20	Why Are Missing Data a Problem?, Reasons for Missing Data.	CO 3	T1: 7.1-7.3
21-22	Types of Missing Data	CO 3	T1: 7.4
23-29	Forms and Patterns of Missing Data, Addressing Missing Data in the Analysis Stage	CO 3	T1: 7.5-7.6
30-31	Presenting Data, Visual Images	CO 4	T1: 8.1-8.2
32	First Principles: Clarity, Precision, and Efficiency, Why Words Are Not Enough	CO 5	T1: 8.3-8.4
33-35	Types of Tables and Graphics	CO 6	T1: 8.5
36	Principles of Data Presentation.	CO 6	T1: 8.6
37-38	Tables, Examples of Tables	CO 6	T1: 9.1-9.2
39-40	Graphics, Examples of Graphics	CO 6	T1: 10.1-10.2
PROBLEM SOLVING/ CASE STUDIES			
1	Introduction to SATA	CO 1	T1:4.2
2	Overview on SAS	CO 1	T1:4.2
3	Hands on Practice SPSS	CO 1	T1:4.2
4	Case study for creating a CodeBook	CO 1	R2:7.5
5	Case study on Data Cleaning and Screening	CO 1	R2:7.5
6	Overview on Types of Tables and Graphics	CO 4	T1: 8.5
7	Case study on designing tables for data presentations	CO 6	T1:9.1-9.2

8	Case study on designing graphics for data presentations	CO 6	T1: 10.1-10.2
9	Case study on designing graphics for data presentations using bar Charts	CO 6	T1: 10.1-10.2
10	Case study on designing graphics for data presentations using Histogram	CO 6	T1: 10.1-10.2
11	Case study on designing graphics for data presentations using Line Charts and Pie Charts	CO 6	T1: 10.1-10.2
12	Designing Tables and Graphics for data Presentations for an application	CO 6	T1: 10.1-10.2
13	Introduction to R Programming	CO 2	T1:Appendix
14	Basic Concepts of R	CO 2	T1:Appendix
15	Various Functions of R	CO 2	T1:Appendix
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Principles of Data Management	CO 1	T1:3.1-4.6
2	Secondary,Primary,and Adminstrative Data	CO 2	T1:5.1-5.5
3	Missing Data	CO 3	T1:6.1-7.6
4	Data Presentataion	CO 4,5	T1:8.1-8.6
5	Designing Tables and Graphics for data Presentations	CO 6	T1:9.1-10.2
DISCUSSION OF QUESTION BANK			
1	Principles of Data Management	CO 1	T1:3.1-4.6
2	Secondary,Primary,and Adminstrative Data	CO 2	T1:5.1-5.5
3	Missing Data	CO 3	T1:6.1-7.6
4	Data Presentataion	CO 4,5	T1:8.1-8.6
5	Designing Tables and Graphics for data Presentations	CO 6	T1:9.1-10.2

Signature of Course Coordinator **HOD,CSE(DS)**

Dr. M Lakshmi Prasad, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE**				
Course Title	**DATABASE MANAGEMENT SYSTEMS**				
Course Code	AITC05				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms.Akula Rajitha				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHS001	I	Computer Programming
B.Tech	AHS002	II	Data Structures

II COURSE OVERVIEW:

Database management system is intended to provide a clear understanding of fundamentals with emphasis on their applications to create and manage large data sets. It emphasizes on technical overview of database software to retrieve data from database. This includes database design principles, normalization, concurrent transaction processing, security, recovery and file organization techniques. This will provide adequate knowledge to understand future evolutions of data technologies.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Database Managment Systems	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	White Board	✓	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
33%	Remember
27%	Understand
33%	Apply
0 7%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
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	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

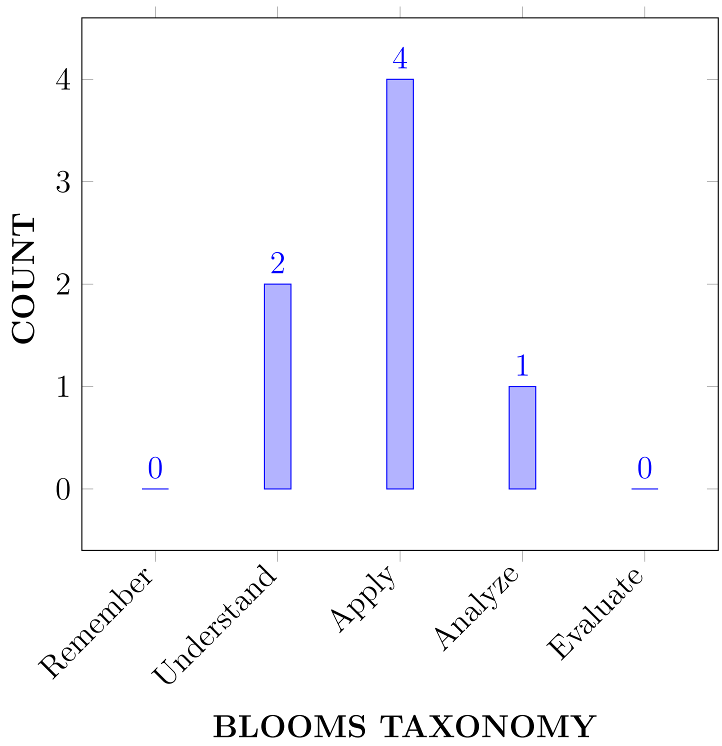
I	Efficient ways of designing database by encapsulating data requirements for business and organizational scenarios
II	Analysing and developing sophisticated queries in database language SQL for extracting information from large datasets
III	Enhancing skills in developing and managing data efficiently in related engineering problems.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** the importance of database system, RDBMS and its functionalities for voluminous data storage and management..	Understand
CO 2	**Model** the real world database systems using Entity Relationship Diagrams from the requirement specification.	Apply
CO 3	**Construct** queries in Relational Algebra, Relational Calculus and SQL to retrieve desired information.	Apply
CO 4	**Identify** appropriate normalization technique using dependencies for controlling the redundancy of data in database.	Apply
CO 5	**Demonstrate** ACID properties of Transaction processing, currency control protocols and recovery to preserve the database in a consistent state.	Understand
CO 6	**Organize** data storage and file organization techniques using tree and hash indices for effective query processing.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2.6	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2.16	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	SEE / CIE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1.5	SEE / CIE / AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	SEE / CIE / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	Quiz/AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	Quiz/AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	Quiz/AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	✓	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-		-	-	-	-	-	-		✓	✓	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-		-	-	-	-	-	-	-	-	-	
CO 7	✓	✓	-	✓	-	-	-	-	-	-	-	-		-	-
CO 8	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓
CO 9	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-
CO 10	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 1	Demonstrate basics of databases, functions of database management system and types of users to describe large sets of data with knowledge of mathematics, Science and Engineering Fundamentals.	3
	PO 2	Define the relational data model, constraints and keys to maintain integrity of data with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation	3
	PO 10	Understand and Outline fundamental concepts of databases with clarity .	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 2	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	5
	PO 3	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation.	5
	PO 4	Model the real world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation.	6
	PO 10	Develop logical model for real time applications to get clarity on requirements.	1
	PO 12	Choose appropriate techniques to model Database project using advanced concepts of CSE to meet industry trends..	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 3	PO 1	Outline the use of relational algebra, relational calculus and SQL for creation and management of database with knowledge on fundamentals of mathematics such as set theory and engineering basics.	2
	PO 2	Build queries in Relational Algebra , Relational Calculus and SQL to retrieve desired information with detail Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation and validation	5
	PO 3	Illustrate the use of Relational Algebra , Relational Calculus and SQL for database creation and querying with the help of Investigate and define a problem , Identify constraints ,find creative solution , Manage the design process and evaluate outcomes	7
	PO 4	Develop RA, RC and SQL queries for database creation and maintenance by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , appropriate codes of practice , industry standards and apply system approach to output qualitative output	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 5	Select appropriate techniques to retrieve information using modern tools such as SQL	1
	PO 10	Develop queries in SQL , RA and RC for retrieving information in real time applications with clear understanding of needs	1
	PO 12	Choose appropriate techniques to model Database project using advanced concepts of CSE to meet industry trends..	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 4	PO 1	Illustrate the definition of Functional Dependencies, Inference rules and minimal sets of FD's to maintain data integrity basic fundamentals of mathematics and engineering fundamentals.	2
	PO 2	Illustrate the definition of Functional Dependencies, Inference rules and minimal sets of FD's to maintain data integrity with the Problem statement and system definition, Problem formulation and abstraction , Information and data collection, Model translation.	7
	PO 3	Make use of normalization techniques for reducing redundancy of database to Investigate and define a problem and identify constraints ,Understand customer and user needs, for creating and Managing the design process and evaluate outcomes.	5
	PO 4	Apply normalization techniques to normalize a database by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature , Understanding of appropriate codes of practice and industry standards.	2
	PO 10	Develop efficient logical model of database using normalization for real time database applications with clear understanding of enterprise needs.	1
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems. .	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
	PO 1	Demonstrate the concepts of transaction ACID properties and recovery techniques in data manipulation with basic engineering fundamentals.	1
CO 5	PO 2	Outline concurrent transaction processing, recovery techniques in transaction failure by formulating and stating the problem with constraints using Information management and data collection .	5
	PO 3	Make use of concurrency control protocols to preserve the database in a consistent state by Investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes	3
	PO 4	Utilize concurrency control protocols to preserve the database in a consistent state by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature.	2
	PO 10	Build a database which will always in a consistent state during concurrent transaction processing with reference to security and integrity.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 6	PO 1	Describe disk storage devices, file organization to select efficient data storage with basic fundamentals of mathematics and engineering fundamentals	2
	PO 2	Apply indexing ,hashing techniques to access the records from the file effectively through problem statement and formulation with data collection and validation in designing experiment and developing effective data retrieval system	7
	PO 3	Apply indexing techniques to access the records from the file effectively by Investigate and define a problem and identify constraints ,Understand customer and user needs, Manage the design process and evaluate outcomes.	5
	PO 10	Make use of efficient data storage devices to implement effective retrieval techniques with clear understanding of data structures	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	-	5	5	6	-	-	-	-	-	1	-	2	2	2	1
CO 3	2	5	7	6	-	-	-	-	-	1	-	2	2	2	1
CO 4	2	7	5	2	-	-	-	-	-	1	-	-	3	1	1
CO 5	1	5	3	2	-	-	-	-	-	1	-	-	-	-	1
CO 6	2	7	5	-	-	-	-	-	-	1	-	-	-	1	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	30	-	-	-	-	-	-	-	20	-		-	-	-
CO 2	-	50	50	54.54	-	-	-	-	-	20	-	37.5	33.3	100	50
CO 3	66.66	50	70	54.4	100	-	-	-	-	20	-	25.5	33.3	100	50.0
CO 4	66.66	70	50	27.3	-	-	-	-	-	20	-	-	50	50	50
CO 5	33.33	50	30	27.3	-	-	-	-	-	20	-	-	-	-	50
CO 6	66.66	70	50	-	-	-	-	-	-	20	-	-	-	50	50

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 - $5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	-	-	-	-	-	-	-	-	-	-	-	3	
CO 2	-	2	2	2	-	-	-	-	-	1	-	1	1	3	2
CO 3	3	2	3	2	3	-	-	-	-	1	-	1	1	3	2
CO 4	3	3	2	1	-	-	-	-	-	1	-	-	2	2	2
CO 5	1	2	1	1	-	-	-	-	-	1	-	-	-	-	2
CO 6	3	3	2	-	-	-	-	-	-	1	-	-	-	2	2
TOTAL	13	13	10	6	3	-	-	-	-	6	-	2	4	10	8
AVERAGE	2.6	2.16	2	3	1	-	-	-	-	1	-	1	1.33	2.5	1.6

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO1, PO2, PO3, PO4	SEE Exams	PO1, PO2, PO3 ,PO4	Assignments	PO1,PO2
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO1, PO2, PO3,	Open Ended Experiments	-

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**CONCEPTUAL MODELING INTRODUCTION**
	Introduction to Data bases: Purpose of Database Systems, View of Data, Data Models, Database Languages, Database Users, Various Components of overall DBS architecture, Various Concepts of ER Model, Basics of Relational Model. .
MODULE II	**RELATIONAL APPROACH**
	Relational algebra and calculus: Relational algebra, selection and projection, set operations, renaming, joins,division, examples of algebra queries, relational calculus: Tuple relational calculus, Domain relationalcalculus, expressive power of algebra and calculus.
MODULE III	**SQL QUERY - BASICS, RDBMS - NORMALIZATION**
	SQL – Data Definition commands, Queries with various options, Mata manipulation commands, Views,Joins, views, integrity and security; Relational database design: Pitfalls of RDBD, Lossless joindecomposition, Functional dependencies , Armstrong Axioms, Normalization for relational databases 1st 2nd and 3rd normal forms, Basic definitions of MVDs and JDs, 4th and 5th normal forms Theory of games: Introduction, terminology, solution of games with saddle points and without saddle points, 2 x 2 games, dominance principle, m x 2 and 2 x n games, graphical method.
MODULE IV	**TRANSACTION MANAGEMENT**
	Transaction processing: Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability. Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols,Multiple Granularity, Multiversion Schemes, Deadlock Handling. Recovery: Failure Classification, Storage Structure ,Recovery and Atomicity, Log-Based Recovery, Shadow Paging, Recovery With Concurrent Transactions Buffer Management .

MODULE V	**DATA STORAGE AND QUERY PROCESSING**
	Data storage: Overview of Physical Storage Media, Magnetic Disks, Storage Access, File Organization, Organization of Records in Files. Indexing and Hashing: Basic Concepts: Ordered Indices, B+-Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing.Query Processing: Overview, Measures of Query Cost.

TEXTBOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill 6th Edition, 2017.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 6th Edition, 2014. 2. Raghu Ramakrishnan, "Database Management System", Tata McGraw

REFERENCE BOOKS:

1. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2007.
2. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
3. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	CD based on OBE for DBMS course		
CONTENT DELIVERY (THEORY)			
1	Introduction to Databases	CO 1	T2:1.1-1.5
2	File System vs. Database system	CO 1	T2: 1.6-1.8 T1.2.1
3	Data Models and Levels of Abstraction	CO 1	T2:1.1 - 1.5
4	Database users and Database languages, DBS architecture	CO 1	T1:1.5, 1.4.2,1.4.3
5	Basics of ER Model	CO 2	T1:2.2
6	Extended ER Model	CO 2	T1:3.1

7	Basics of Relational Model	CO 1	T1:3.1,3.2 R1:6.2-6.8
8	Logical Database design.	CO 1	T1: 3.1
9	Relational database languages	CO 3	T1:4.1
10	Basic operations of Relational algebra	CO 3	T1:4.1
11	Derived operations of Relational algebra, Extended operations of Relational algebra	CO 3	T1: 4.1
12	Queries in Relational algebra	CO 3	T1:4.1,4.2.2
13	Tuple Relational Calculus	CO 3	T1:4.3
14	Domain Relational calculus	CO 3	T1:4.3
15	Intiegrity constraints – RDB Design	CO 4	T1: 3.1
16	Pitfalls of RDBD	CO 4	T1:3.1
17	Lossless join decomposition	CO 4	T1: 9.1,19.1.3
18	Functional dependencies Armstrong Axioms	CO 4	T2: 19.4
19	Closure of set of FDs and Attribute Closure, Canonical Cover	CO 4	T2: 19.4
20	Purpose of Normalization – RDBD.	CO 4	T1: 9.1
21	1st, and 2nd normal forms.	CO 4	T1: 9.1
22	3rd and BCNF normal forms.	CO 4	T1: 9.1
23	4NF, 5NF Normal forms and Other Dependencies.	CO 4	T2: 19.8-19..9
24	Transaction Concept, Transaction State	CO 4	T2:15.1
25	Implementation of Atomicity and Durability.	CO 5	T2:15.1
26	Serial Vs. Nonserial Transactions.	CO 5	T2:15.1
27	Serializability – Conflict Serializability.	CO 5	T2: 16.1
28	View Serializability.	CO 5	T2: 16.3
29	Lock-Based Protocols.	CO 5	T2: 16.1
30	Deadlock Handling – Concurrent Transactions	CO 5	T2: 16.3
31	Implementation of locks and Multiple Granularity.	CO 5	T2: 16.1
32	Timestamp-Based and Validation-Based Protocols	CO 5	T2: 16.3
33	Transaction Recovery and LogBbased Recovery techniques	CO 5	T2:17.1
34	Recovery Algorithms – Buffer Management	CO 5	T2:17.1
35	Physical Storage Media	CO 6	T1: 8.1
36	Data Access and File Organization Techniques	CO 6	T1: 8.1
37	B+ Tree index File Organization	CO 6	T1: 8.3-8.4
38	B-Tree and Bit Index File Organization	CO 6	T1: 10 10.2
39	Static and Dynamic Hashing Techniques	CO 6	T1: 8.3-8.4
40	Query Processing : Overview	CO 6	T1: 10 10.2

PROBLEM SOLVING/ CASE STUDIES			
1	SQL – DDL Statements	CO 3	R1.5
2	SQL – DML Statements.	CO 3	R1.5.1
3	SQL – Builtn funcions	CO 3	R1.5.2
4	SQL – SELECT Statement	CO 3	R1.5.3
5	SQL - Join operation .	CO 3	R1.5.4
6	SQL – Subqueries.	CO 3	R1.5.5
7	SQl – Views	CO 3	R1.5.6
8	SQL – Stored Programs and stored Functions	CO 3	R1.5.7
9	SQL - Triggers	CO 3	R1.5.8
10	Problems on Rlational algebra and Relational Calculus	CO 3	R1.4
11	Problems on ER Model	CO 2	R1.2
12	Problems on Concurrent Transactions and Recovery	CO 5	R1.3
13	Problems on Normalization.	CO 4	R1.3
14	Problems on Functional dependencies.	CO 4	R1.3
15	Problems on B-trees and hashing	CO 6	R1.9, R1.10
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module I	CO 1, CO 2	T1.1, R1.1,2
2	Module II	CO 3	R1.4
3	Module III	CO 3,CO 4	R1.5
4	Module IV	CO 5	R1.18, 19,20
5	Module V	CO 6	R1.7, 8, 9,10
DISCUSSION ON QUESTION BANK			
1	Module I	CO 1, CO 2	T1.1, R1.1,2
2	Module II	CO 3	R1.4
3	Module III	CO 3,CO 4	R1.5
4	Module IV	CO 5	R1.18, 19,20
5	Module V	CO 6	R1.7, 8, 9,10

Signature of Course Coordinator
HOD,CSE(DS)

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Course Title	**DESIGN AND ANALYSIS OF ALGORITHMS**					
Course Code	ACSC13					
Program	B.Tech					
Semester	IV	CSE(DS)				
Course Type	Core					
Regulation	IARE - UG20					
Course Structure	Theory			Practical		
	Lecture	Tutorials	Credits	Laboratory	Credits	
	3	-	3	-	-	
Course Coordinator	Dr.S.Sreekanth, Professor					

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB01	II	Programming for problem solving
B.Tech	ACSB03	III	Data structures

II COURSE OVERVIEW:

Design and analysis of algorithms is the process of finding the computational complexity of algorithms. It helps to design and analyze the logic on how the algorithm will work before developing the actual code for a program. It focuses on introduction to algorithm, asymptotic complexity, sorting and searching using divide and conquer, greedy method, dynamic programming, backtracking, branch and bound. NP-hard and NP-complete problems. The applications of algorithm design are used for information storage, retrieval, transportation through networks, and presentation to users.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Design and Analysis of Algorithms	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
20 %	Understand
70%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

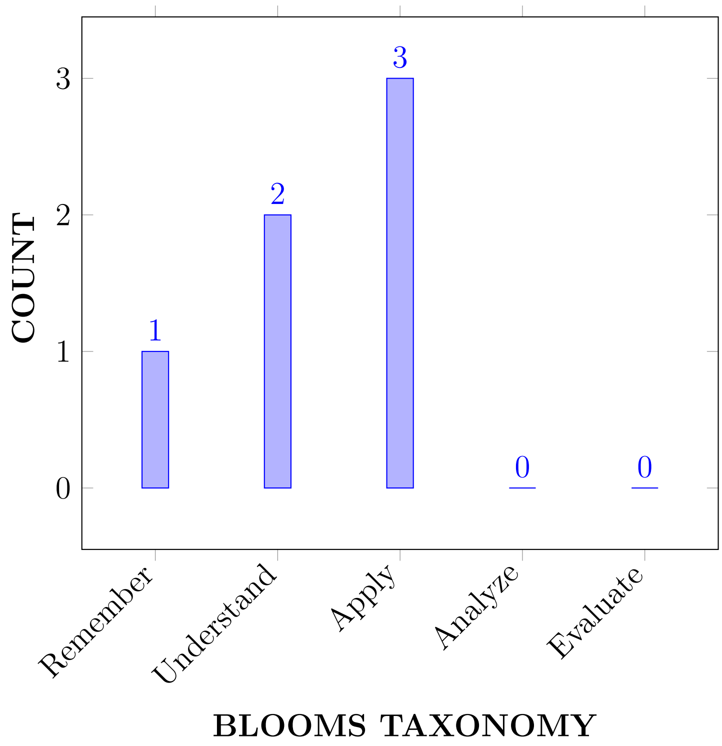
I	Mathematical approach for Analysis of Algorithms.
II	Methods and techniques for analyzing the correctness and resource requirements of algorithms.
III	Different paradigms of algorithm design including recursive algorithms, divide-and-conquer algorithms, dynamic programming, greedy algorithms, Backtracking , Branch and Bound and graph algorithms.
IV	Strategies for solving problems not solvable in polynomial time.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Find** the (worst case, randomized, amortized) running time and space complexity of given algorithms using techniques such as recurrences and properties of probability.	Remember
CO 2	**Apply** divide and conquer algorithms for solving sorting, searching and matrix multiplication.	Apply
CO 3	**Make Use of** appropriate tree traversal techniques for finding shortest path.	Understand
CO 4	**Compare** Identify suitable problem solving techniques for a given problem and finding optimized solutions using Greedy and Dynamic Programming techniques	Understand
CO 5	**Apply** greedy algorithm Utilize backtracking and branch and bound techniques to deal with traceable and in-traceable problems.	Apply
CO 6	**Apply** Describe the classes P, NP, NP-Hard, NP- complete for solving deterministic and non deterministic problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / Quiz / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	5	CIE / Quiz / AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIE / Quiz / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4	
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	4	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	3	CIE / Quiz / AAT
PSO2	Focus on improving software reliability, network security or information retrieval systems.	3	CIE / Quiz / AAT
PSO3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	✓	-	✓	✓	✓	✓
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	✓	✓
CO 3	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 4	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 5	✓	-	-	✓	-	-	-	-	-	✓	-	✓	✓	-	✓
CO 6	✓	-	-	✓	-	-	-	-	-	✓	-	✓	✓	✓	✓

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Analyze the running time and space complexity of given algorithms using techniques such as recurrences, potential functions, properties of probability by applying the **mathematical principles ,engineering principles and scientific principles**	3
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 2	PO 1	Apply divide and conquer algorithms for solving sorting, searching and matrix multiplication problems to integrate **mathematical principles, engineering Principles and Scientific Principles**	3
	PO 2	Understand the given problem and develop the solution for solving sorting, searching and matrix multiplication problems and **Interpretation of results.**	4
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 3	PO 1	Utilize appropriate tree traversal techniques for solving graph problems to integrate**mathematical principles and computer science methodologies**	2
	PO 2	Understand the given traversal techniques to develop the solution for graph problems and **interpretation of results.**	6
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
CO 4	PO 1	Finding the solution of complex **engineering problems and extend the efficiencies of same problem using different algorithms in engineering disciplines.**	2
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	4
CO 5	PO 1	Choose (Pick) greedy algorithms for finding solutions of minimization and maximization problems to support study of their own **engineering discipline and methodologies.**	3
	PO 2	Understand the given problem and develop the solution using greedy methods in reaching substantiated conclusions from the provided **information and interpret of results.**	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
CO 6	PO 1	Apply the knowledge of dynamic programing algorithms for calculating optimized solution of complex Engineering problems by understanding **mathematical principles and computer science methodologies**	3
	PO 2	Understand the given **problem** and **choose appropriate technique** of dynamic programing algorithms for solving the given problem from the provided **Information and data** in reaching substantiated conclusions by the **interpretation of results.**	6
	PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2
	PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	2
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	2	-	2	3	2	1
CO 2	3	5	-	-	-	-	-	-	-	2	-	2	2	2	1
CO 3	3	5	-	-	-	-	-	-		2	-	2	2	-	-
CO 4	3	6	6	-	-	-	-	-	-	2	-	2	2	-	-
CO 5	2	-	-	2	-	-	-	-	-	2	-	2	2	-	1
CO 6	3	-	-	-	5	-	-	-	-	2	-	2	2	2	1

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	-	-	-	-	-	-	-	50	-	25	50	50	25
CO 2	100	50	-	-	-	-	-	-	-	50	-	25	50	50	25
CO 3	100	50	-	-	-	-	-	-	-	50	-	25	25	-	-
CO 4	100	60	60	-	-	-	-	-	-	50	-	25	50	-	-
CO 5	66.7	-	-	46.6	-	-	-	-	-	50	-	25	50	-	25
CO 6	100	-	-	45	-	-	-	-	-	50	-	25	50	50	25

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq$ 5% – No correlation

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	2	-	1	2	2	1
CO 2	3	2	-	-	-	-	-	-	-	2	-	1	2	2	1
CO 3	3	2	-	-	-	-	-	-	-	2	-	1	1	-	-
CO 4	3	3	3	-	-	-	-	-	-	2	-	1	2	-	-
CO 5	3	-	-	2	-	-	-	-	-	2	-	1	2	-	1
CO 6	3	-	-	2	-	-	-	-	-	2	-	1	2	2	1
TOTAL	18	7	3	4	-	-	-	-	-	12	-	6	11	6	4
AVERAGE	3.0	2.33	3	2	-	-	-	-	-	2.0	-	1.0	1.66	2	1

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Algorithm: Pseudo code for expressing algorithms; Performance analysis: Space complexity, time complexity; Asymptotic notations: Big O notation, omega notation, theta notation and little o notation, amortized complexity; Divide and Conquer: General method, binary search, quick sort, merge sort, Strassen's matrix multiplication.
MODULE II	**SEARCHING AND TRAVERSAL TECHNIQUES**
	Disjoint set operations, union and find algorithms; Efficient non recursive binary tree traversal algorithms, spanning trees; Graph traversals: Breadth first search, depth first search, connected components, bi-connected components.
MODULE III	**GREEDY METHOD AND DYNAMIC PROGRAMMING**
	Greedy method: The general method, job sequencing with deadlines, knapsack problem, minimum cost spanning trees, single source shortest paths. Dynamic programming: The general method, matrix chain multiplication optimal binary search trees, 0/1 knapsack problem, single source shortest paths, all pairs shortest paths problem, the travelling salesperson problem.
MODULE IV	**BACKTRACKING AND BRANCH AND BOUND**
	Backtracking: The general method, the 8 queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles; Branch and bound: The general method, 0/1 knapsack problem, least cost branch and bound solution, first in first out branch and bound solution, travelling salesperson problem.
MODULE V	**NP-HARD AND NP-COMPLETE PROBLEM**
	Basic concepts: Non-deterministic algorithms, the classes NP - Hard and NP, NP Hard problems, clique decision problem, chromatic number decision problem, Cook's theorem.

TEXTBOOKS

1. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekharan, —Fundamentals of Computer Algorithms, Universities Press, 2nd Edition, 2015.

2. Tom White, —Hadoop: The Definitive Guide, O'Reilly, 3rd Edition, 2012.

3. Alfred V. Aho, John E. Hopcroft, Jeffrey D, —The Design And Analysis Of Computer Algorithms, Pearson India, 1st Edition, 2013.

REFERENCE BOOKS:

1. Levitin A, —Introduction to the Design and Analysis of Algorithms‖, Pearson Education, 3rd Edition, 2012.

2. Goodrich, M. T. R Tamassia, —Algorithm Design Foundations Analysis and Internet Examples‖, John Wileyn and Sons, 1st Edition, 2001.

3. Base Sara Allen Vangelder, —Computer Algorithms Introduction to Design and Analysis‖, Pearson, 3rd Edition, 1999

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	Discussion on mapping COs with POs. (OBE)		
CONTENT DELIVERY (THEORY)			
2	Describe Pseudo code for expressing algorithms.	CO 1	T1:1.1,1.2
3	Summarize the concept of Space complexity, time complexity.	CO 1	T1: 1.2.7, 1.2.8
4-6	Describe Big O notation, omega notation, theta notation, little o notation and amortized complexity.	CO 1	T1:1.2.9, 1.2.11, 1.3
7-10	Use the concept of Divide and Conquer such as general method, binary search and quick sort.	CO 2	T1:1.5, 1.4.2,1.4.3
11-13	Describe the concept of merge sort, Strassen's matrix multiplication.	CO 2	T1:1.4.3, 1.4.4, 2.3.1, 2.3.2,2.3.6, 2.3.7,2.3.8
14-15	Determine disjoint set operations, union and find algorithms.	CO 3	R2:4.3 T1:2.4.1, 2.4.2,2.4.3, 4.1
16-17	Understand efficient non recursive binary tree traversal algorithms.	CO 3	T1:3.1,3.2 R1:6.2-6.8
18	Describe the concept of spanning trees with suitable examples.	CO 3	R1: 7.1-7.6
19-21	Use breadth first search and depth first search graph traversals.	CO 3	R2:8.1
22-23	Describe connected components, biconnected components.	CO 3	R2:8.2, 8.3
24-27	Understand general method of greedy method, job sequencing with deadlines, knapsack problem.	CO 4	R2: 9.1-9.3
28-29	Analyze the concept of minimum cost spanning trees, single source shortest paths.	CO 4	R2: 9.8, 9.9, 10.1, 10.2
30	Describe general method of dynamic programming, matrix chain multiplication.	CO4	T2:5.5, 5.9, 5.10
31-32	Understand optimal binary search trees, 0/1 knapsack problem, single source shortest paths.	CO 5	R2:10.4, 10.6,10.7
33-34	Define all pairs shortest paths problem, the travelling salesperson problem.	CO 5	T1:5.8-5.9
35	Discuss the concept of Backtracking, the 8 queen's problem.	CO 5	T1:7.1-7.2

36	Understand sum of subsets problem, graph coloring.	CO 5	T1:7.3-7.4
37	Summarize the concept of Hamiltonian cycles, Branch and bound.	CO 5	T1:7.5,8.1.1
38	Discuss 0/1 knapsack problem, least cost branch and bound solution.	CO 5	T1:8.2.1
39	Apply the concept of first in first out branch and bound solution, travelling salesperson problem.	CO 5	T1:8.2.2, 8.3
40	Knowledge about basic concepts of NP Hard and NP Complete, Non-deterministic algorithms.	CO 6	T1:11.1
41	Apply Working with the classes NP - Hard and NP.	CO 6	T1:11.1
42	Understand NP Hard problems, clique decision problem.	CO 6	T1:11.3
43	Implement chromatic number decision problem.	CO 6	T1:11.3
44	Cook's theorem in np hard and np complete problems.	CO 6	T1:1.1,1.2
PROBLEM SOLVING/ CASE STUDIES			
45	Discuss problems onSpace complexity, time complexity.	CO 1	T1: 1.2.7,
46	Discuss the concept of Divide and Conquer such as general method, binary search and quick sort.	CO 2	T1:1.5, 1.4.2,1.4.3
47	Describe the concept of merge sort, Strassen's matrix multiplication.	CO 2	T1:1.4.3, 1.4.4, 2.3.1, 2.3.2,2.3.6, 2.3.7,2.3.8
48	Understand efficient non recursive binary tree traversal algorithms.	CO 3	T1:3.1,3.2 R1:6.2-6.8
49	Describe the concept of spanning trees with suitable examples.	CO 3	R1: 7.1-7.6
50	Analyze the concept of minimum cost spanning trees, single source shortest paths.	CO 4	R2: 9.8, 9.9, 10.1, 10.2
51	Describe general method of dynamic programming, matrix chain multiplication.	CO4	T2:5.5, 5.9, 5.10
52	Define all pairs shortest paths problem, the travelling salesperson problem.	CO 5	T1:5.8-5.9
53	Discuss the concept of Backtracking, the 8 queen's problem.	CO 5	T1:7.1-7.2
54	Apply Working with the classes NP - Hard and NP.	CO 6	T1:11.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
55	Time and space complexity, Asymptotic notations	CO 1	T1:1.1,1.2, T1:1.2.7, 1.2.8
56	Divide and conquer Algorithms	CO 2	T1:1.5, 1.4.2,1.4.3
57	Binary traversal, BFS,DFS Algorithms	CO 3	R2:8:2

58	General method of greedy method, job sequencing with deadlines, knapsack problem,minimum cost spanning trees, single source shortest paths.	CO 4	R2: 9.1-9.3 ,R2: 9.8, 9.9
59	The concept of Hamiltonian cycles, Branch and bound, Basic concepts of Deterministic and non deterministic Problems	CO 5 and 6	T1:7.5, 8.1.1
DISCUSSION OF QUESTION BANK			
60	Questions on module-1	CO 1, 2	T1:1.1,1.2, T1:1.2.7, 1.2.8
61	Questions on module-2	CO 3	T1:3.1,3.2
62	Questions on module-3	CO4	R2: 9.8, 9.9,
63	Questions on module-4	CO5	T1:5.8-5.9
64	Questions on module-5	CO6	T1:11.1

Signature of Course Coordinator **HOD,CSE(DS)**
Dr.S.Sreekanth, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING (DS)				
Course Title	WEB APPLICATION DEVELOPMENT				
Course Code	AITC10				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	1.5
Course Coordinator	Mrs. S. ASWANI, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming
B.Tech	ACSC04	IV	Programming For Problem Solving Using C

II COURSE OVERVIEW:

This course introduces students to create concurrently a web app and a native app (for Android and iOS) with React Native and React Native Web. It covers HTML5 for structuring and presenting content on the World Wide Web. CSS3 being used to format structured content. To create a dynamic and interactive experience for the user it covers JAVASCRIPT. How build the applications using React concepts such as JSX, REDUX.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Foundations of Cyber Security	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
33.3%	Remember
55.5 %	Understand
11.1 %	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

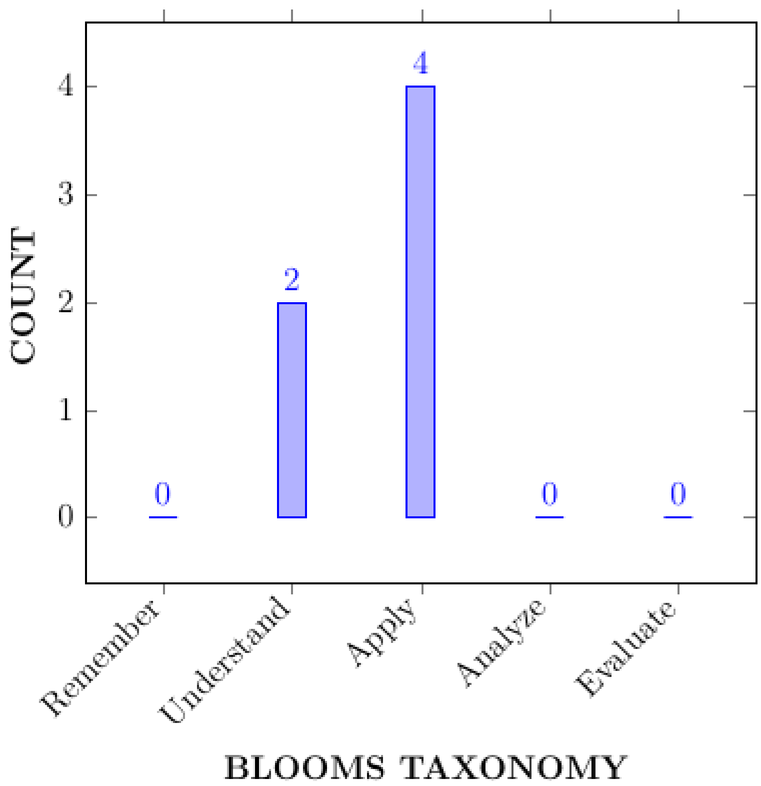
I	The characteristics, systematic methods, model for developing web applications.
II	The fundamentals of HTML and CSS to design static and dynamic web pages.
III	The concepts of client - server programming with JavaScript, Servlets, JSX.
IV	The MVC architecture, about React and built single and multiple page applications using REACT with REDUX.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Classify** HTML elements and attributes for structuring and presenting content of webpage based on the requirement .	Understand
CO 2	**Classify** CSS properties for formatting webpages.	Understand
CO 3	**Develop** responsive webpage using Bootstrap for viewing web pages in various devices	Apply
CO 4	**Utilize** the concepts of JS with event actions for displaying information on webpages.	Apply
CO 5	**Identify** UI binding library elements for deploying a reusable complex UI.	Apply
CO 6	**Develop** a native web application with the help of React framework.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES :

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	6	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	4	Assignments/ Discussion
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE/Quiz/AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	CIE/Quiz/AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	Quiz
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1	Quiz
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1	Quiz

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-
CO 2	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	✓	-			-	-	-	-	-		-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	✓	-	-	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**	3
	PO 3	**Designing and developing** static and dynamic web pages can help the student to design and develop **practical solutions**, to common problems, over the web.	2
	PO 12	Moderately mapped as students describe rationale for requirement for **continuing professional development**.	1
	PSO1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	1

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 2	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**	3
	PO 3	**Designing and developing** static and dynamic web pages can help the student to **design and develop** practical solutions, to common problems, over the web.	2
CO 3	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**.	3
	PO4	**Design of experiments** with the **knowledge** in web architecture	2
	PO 5	**Developing** real world web application using Javascript familiarize the student to modern tools for web development	1
	PSO1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	
CO 4	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**	3
	PO 3	**Designing and developing** static and dynamic web pages can help the student to design and develop **practical solutions**, to common problems, over the web.	2
CO 5	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**	3
CO 6	PO 1	**Knowledge** of web and components strongly helps student to **design and develop** web based **engineering solutions**	3
	PO 2	With the **analysis** of Javascript applications Analyze **complex engineering** problems.	2
	PO 3	**Designing and developing** static and dynamic web pages can help the student to design and develop **practical solutions**, to common problems, over the web.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	2	-	-	-	-	-	-	-	-	1	1	-	-
CO 2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	2	1	-	-	-	-	-	-	-	2	-	-
CO 4	3	-	2	-	-	-	-	-	-	-	-		-	-	-

CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	2	2	-	-	-	-	-	-	-	-		-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	-	20	-	-	-	-	-	-	-	-	8	16.6	-	-
CO 2	100	-	20	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	-	-	18	100	-	-	-	-	-	-	-	66.6	-	-
CO 4	100	-	20	-	100	-	-	-	-	-	-		-	-	-
CO 5	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	100	20	20	-	-	-	-	-	-	-	-		-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq$ C$\leq$ 5% – No correlation

1 -5 <C$\leq$ 40% – Low/ Slight

2 - 40 % <C < 60% –Moderate

3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	1	-	-	-	-	-	-	-	-	1	1	-	-
CO 2	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	1	3	-	-	-	-	-	-	-	3	-	-
CO 4	3	-	1	-	3	-	-	-	-	-	-		-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	1	1	-	-	-	-	-	-	-	-		-	-	2
TOTAL	18	1	4	-	6		-	-	-	-	-	1	4	-	-
AVERAGE	3	1	1	1	4		-	-	-	-	-	1	2	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	-	-	-	

XVII ASSESSMENT METHODOLOGY-INDIRECT:

-	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION TO WEB APPLICATION AND HYPERTEXT MODELLING**
	Introduction to web application, Basics of hypertext modeling, hypertext structure modeling concepts, access modeling concepts, relation to content modeling, presentation modeling, relation to hypertext modeling, customization modeling, relation to content, hypertext, and presentation modeling. Basics of HTML5 and web design, creating tables, HTML forms, styles and classes to your web pages, web page layouts with CSS, introduction to responsive web design with CSS3 and HTML5.
MODULE II	**BUILD INTERFCAES USING BOOTSTARP**
	Introduction to web design from an evolutionary perspective, user interface design through bootstrap, containers, tables, jumptrons, list, cards, carousal, navigation, modals, flex and forms, responsive web page design, basic UI grid structure.
MODULE III	**INTERACTIVE USER INFERFACE AND WEB APPLICATION DEVELOPMENT**
	JavaScript variable naming rules, data types, expressions and operators, pattern matching with regular expressions, managing web page styles using JavaScript and CSS, script forms, introduction to AJAX. Introduction to web design from an evolutionary perspective, create a native and web app, JSX, class and function components, props, state, lifecycle methods, and hooks
MODULE IV	**UI BINDING LIBRARY FOR REACT**
	Introduction to client-side routing using React Router, global state management and transitions using REDUX, server side rendering and testing using Jest, Enzyme and more. Web Development Using REACT is delivered both in a blended learning and self-paced mode.
MODULE V	**CONNECT TO AN EXTERNAL API**
	REDUX store using the official create store function, REDUX toolkit has a configure store API, loading state for that particular API, adding an API service as a middleware, example uses create REACT App.

TEXTBOOKS

1. Alok Ranjan Abhilasha Sinha, Ranjit Battewad, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript", 1st Edition,2020.

2. Alex Banks and Eve Porcello, "Learning React: Functional Web Development with React and Redux", 2017

REFERENCE BOOKS:

1. Adam Boduch and Roy Derks, "React and React Native: A complete hands-on guide to modern web and mobile development with React.js", 3rd Edition, 2020.

2. W Hans Bergsten, "Java Server Pages", O'Reilly, 3rd Edition, 2003.

3. D.Flanagan, "Java Script", O'Reilly, 6th Edition, 2011.

4. Jon Duckett, "Beginning Web Programming", WROX, 2nd Edition, 2008.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students, Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes. In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1-2	Introduction to web application	CO1	T2: 1.1-1.3
2-5	Basics of hypertext modeling	CO2	T1: 2.2-2.3
6-9	presentation modeling,	CO2	T1: 2.1,2-3-2.6
11-12	introduction to responsive web design with CSS3 and HTML5	CO2	R2: 3.4-3.9
11-12	user interface design through bootstrap	CO3	R2: 4.1-4.3
12-13	flex and forms, responsive web page design	CO3	T1: 27.1, T1:27.2, 27.6
14	JavaScript variable naming rules, data types, expressions and operators	CO3	T1: 28.1
15-17	web page styles using JavaScript and CSS	CO3	T2: 4.1-4.3
18-19	create a native and web app, JSX, class and function components	CO5,CO4	T1: 4.4-4.7
20-21	, props, state, lifecycle methods, and hooks	CO4	R1: 1.1-1.4
22-24	Introduction to client-side routing using React Router	CO5	T1 8.1-8.4
25-28	global state management and transitions using REDUX	CO5, CO6	T1:9.1, 9.3,9.4,9.6
29-33	server side rendering and testing using Jest	CO5	T1:11.1,11.3-11.4
34-37	Web Development Using REACT	CO5	T1:10.2, 10.5

38-44	Web Development Using REACT is delivered both in a blended learning and self-paced mode.	CO5	T1:17.3,17.6-17.8 T1:18.1-18.6
45-47	REDUX store using the official create store function	CO6	T1:10.1-1.3
48-51	REDUX toolkit	CO6	T1: 26.2, 26.6.4, T2:26.6.6, 26.10
52-55	state for that particular API	CO5,CO6	T1:26.1-26.3 28.1-28.7
56-59	adding an API service as a middleware	CO5,CO6	T1:27.1-27.6
60-62	example uses create REACT App	CO6	T1:25.1-25.6
CASE STUDIES			
1	Design the static web pages required for an online book store web site	CO 2	T1:11.2.1
2	Design A basic Bootstrap table has a light padding and only horizontal dividers.	CO3	T1:11.2.2
3	Creating buttons with Bootstrap 2Creating outline buttons styles in Bootstrap 3.Creating large buttons with Bootstrap 4.Creating small buttons with Bootstrap 5.Creating block buttons with Bootstrap 6.Creating disabled Bootstrap buttons using the input and button element	CO3	T1:11.2.18
4	Write a sum method which will work properly when invoked using either syntax below. console.log(sum(2,3)); // Outputs 5 console.log(sum(2)(3)); // Outputs 5	CO4	T1:11.2.25
5	How would you create a private variable in JavaScript?.	CO 6	T1:11.4.1
6	Write a recursive function that performs a binary search.	CO 4	T1:11.4.2
7	What are the different ways to style a React component?define them with example?	CO 4	R2:7.5
8	Write down the program to create a switching component for displaying different pages?	CO 6	R2:7.5
9	Write down the program to create forms in React?	CO 6	R2:7.5
10	layers of software engineering.	CO 6	R2:7.5
11	COCOMO model.	CO 6	T1:11.4.1
12	callback function	CO 6	T1:11.4.2
13	a recursive function that performs a binary search	CO 6	T1:11.5.1
14	types of functions	CO 6	T1:11.5.2
15	“native” methods using javascript? s	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Module I: Introduction To Web Application and Hypertext Modelling	CO 1	R1:2.1-2.11

2	Module II:Build Interfcaes using Bootstarp	CO 2, 3	R1:4.2-4.11
3	Module III:Interactive user Interface and Web Application Development	CO 4	R2:5.6-5.9
4	Module IV:UI Binding Library for React	CO 5	R4:8.1-8.9
5	Module V:Connect to an External API	CO 6	R2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	Module I: Introduction To Web Application and Hypertext Modelling	CO 1	R1:2.1-2.11
2	Module II:Build Interfcaes using Bootstarp	CO 2, 3	R1:4.2-4.11
3	Module III:Interactive user Interface and Web Application Development	CO 4	R2:5.6-5.9
4	Module IV:UI Binding Library for React	CO 5	R4:8.1-8.9
5	Module V:Connect to an External API	CO 6	R2:12.1-12.16

Signature of Course Coordinator **HOD, CSE (DS)**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE ENGINEERING(DS)**				
Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHSC13				
Program	B.Tech				
Semester	IV				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. S. Sivasankara Rao, Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The present course is designed in such a way that it gives an overview of concepts of Economics. Managerial Economics enables students to understand micro environment in which markets operate how price determination is done under different kinds of competitions. Financial Analysis gives clear idea about concepts, conventions and accounting procedures along with introducing students to fundamentals of ratio analysis and interpretation of financial statements. Break Even Analysis is very helpful to the Business Concern for Decision Making, controlling and forward Strategic Planning. Ratio analysis gives an idea about financial forecasting, financial planning, controlling the business and decision making.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
BEFA	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	✓	Seminars	x	Mini Project	✓	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
50%	Understand
20%	Apply
15 %	Analyze
0 %	Evaluate
0 %	Create

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

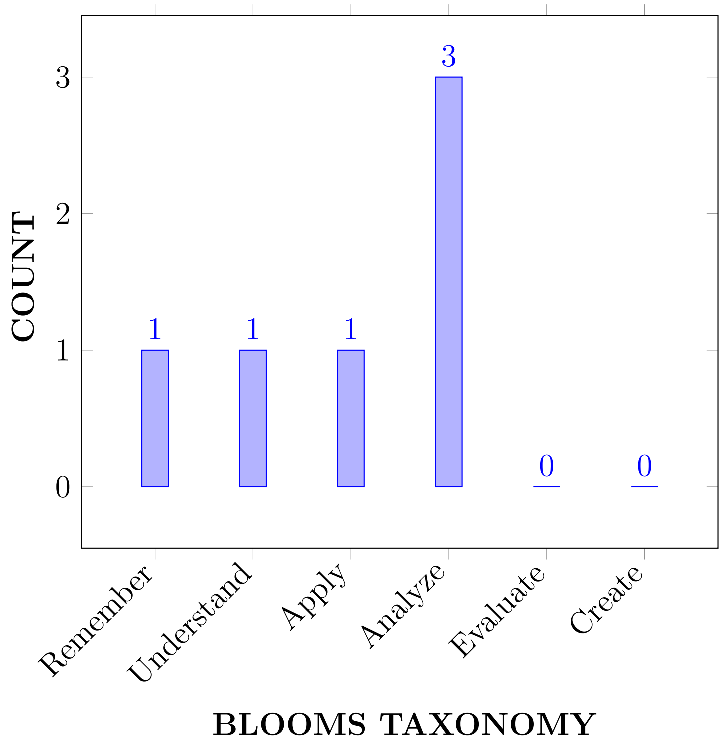
I	The concepts of business economics and demand analysis helps in optimal decision making in business environment
II	The functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis.
III	The features, merits and demerits of different forms of business organizations existing in the modern business environment and market structures.
IV	The concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems for project management.
V	Various accounting concepts and different types of financial ratios for knowing financial positions of business concern.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**List** the basic concepts of managerial economics and analysis, measurement of demand and its forecasting to know the current status of goods and services.	Remember
CO 2	**Examine** to know the current status of goods and services. to know the economies and diseconomies of scale in manufacturing sector.	Analyze
CO 3	**Summarize** the four basic market models like perfect competition, monopoly, monopolistic competition, and oligopoly to know the price and quantity are determined in each model.	Understand
CO 4	**Compare** various types of business organizations and discuss their implications for resource allocation to strengthen the market environment.	Analyze
CO 5	**Analyze** different project proposals by applying capital budgeting techniques to interpret the solutions for real time problems in various business projects.	Analyze
CO 6	**Develop** the ability to use a basic accounting system along with the application of ratios to create (record, classify, and summarize) the data needed to know the financial position of the organization.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	1	Seminar/ Conferences
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Assignments/ Discussion
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	-	-
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	-	-
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	-	-

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
CO 3	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
CO 5	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
CO 6	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	**Recall** (knowledge) the scientific fundamentals of economic activities performed by the businessmen in the business for profit earning.	2
	PO 2	**Interpret** and identify the demand and its analysis with the mathematical and natural principles of demand forecasting methods.	6
	PO 8	**Define** (knowledge) the responsibilities of the engineering practices by knowing the best economical practices.	1
	PO 9	**Match** (knowledge) the economical implication to effectively function as a team member, and as a member or leader in diverse teams.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 11	**Relate** (knowledge) the knowledge and understanding of the economic principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	6
CO 2	PO 1	**Recall** (Knowledge) the knowledge of mathematics, science in the production function through Different Combination of variable inputs with Economies of Scale.	2
	PO 2	**Demonstrate** the different cost concepts and determine the significance of Break Even Analysis.	5
	PO 8	**Relate** (Knowledge) (Knowledge) the ethical principles and commit to professional ethics and responsibilities and norms of the production management	2
	PO 9	**Show** (Fundamentals) the production function implications for effective implementation of gang compositions in a team work and in multidisciplinary settings.	6
	PO 11	**Define** the economies of scale in production function and Break Even Analysis knowledge applied in one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	5
CO 3	PO 8	**List** (Knowledge) (Knowledge) different structures of market and how price is determined under different market structures commit to professional ethics and responsibilities and norms of the engineering practice.	2
	PO 9	**Match** the market structures and the market entry strategies as an individual, and as a member in diverse teams.	6
CO 4	PO 8	**Categorize** the ethical principles and commit to professional ethics and responsibilities belongs to different forms of business organizations existing in the modern business.	2
	PO 9	**Classify** various business organizations and their functioning as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	6
CO 5	PO 1	**Explain** the ethical issues involved in the allocation of funds under the concept of capital budgeting.	1
	PO 11	**Summarize** the concept of capital budgeting and allocations of the resources through capital budgeting methods of the management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	8
CO 6	PO 2	**Explain** the GAAP principles and ratios to analyse complex engineering problems reaching substantiated conclusions using first principles of accounts and profitability and efficiency of the organization.	6

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 11	**Illustrate**the accounting methods and procedures and accounting principles to manage the financial aspects in a project.	8

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	6	-	-	-	-	-	1	5	-	6	-	-	-	-
CO 2	2	5	-	-	-	-	-	2	6	-	5	-	-	-	-
CO 3	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	2	6	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	8	-	-	-	-
CO 6	-	2	-	-	-	-	-	-	-	-	8	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	60.0	-	-	-	-	-	33.3	41.6	-	50.0	-	-	-	-
CO 2	66.7	50.0	-	-	-	-	-	66.7	50.0	-	41.6	-	-	-	-
CO 3	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	66.7	50.0	-	-	-	-	-	-
CO 5	33.3	-	-	-	-	-	-	-	-	-	75.0	-	-	-	-
CO 6	-	20.0	-	-	-	-	-	-	-	-	75.0	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	1	2	-	2	-	-	-	-
CO 2	3	2	-	-	-	-	-	3	2	-	2	-	-	-	-
CO 3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
CO 5	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 6	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-
TOTAL	7	7	-	-	-	-	-	10	8	-	-	-	-	-	-
AVERAGE	2.3	2.3	-	-	-	-	-	2.5	2	-	2.5	-	-	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	SEE Exams	PO 1, PO 2, PO 8,PO 9 PO 11	Seminars	PO8
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	PO 1, PO 2, PO 8,PO 9 PO 11	Open Ended Experiments	-
Assignments	PO 9				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

X	Assessment of mini projects by experts	✓	End Semester OBE Feedback

XVIII SYLLABUS:

MODULE I	**INTRODUCTION&DEMAND ANALYSIS**
	Introduction to Business Economics: Definition, Nature and Scope of Managerial Economics – Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting
MODULE II	**PRODUCTION & COST ANALYSIS**
	Theory of Production and Cost Analysis: Production Function – Iso-quants and Iso-costs, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts; Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.
MODULE III	**MARKETS & NEW ECONOMIC ENVIRONMENT**
	LMarket structures: Types of competition, Features of perfect competition, Monopoly and monopolistic competition. Price determination & Price Statistics: Price Output determination in case of perfect competition and monopoly. Features and evaluation of different forms of Business organization: Sole proprietorship, partnership, Joint Stock Company, public enterprises and their types.

MODULE IV	**CAPITAL BUDGETING**
	Capital and its significance, types of capital, estimation of fixed and working capital requirements, methods and sources of raising capital- Trading Forecast, Capital budget, Cash Budget. Features of capital budgeting proposals, methods of capital budgeting – payback method, Accounting rate of return(ARR), Net Present Value Method (simple problems).
MODULE V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
	Financial accounting objectives, functions, importance; Accounting concepts and accounting conventions - double-entry book keeping, journal, ledger, trial balance; Final accounts: Trading account, profit and loss account and balance sheet with simple adjustments; Financial analysis: Analysis and interpretation of liquidity ratios, activity ratios, capital structure ratios and profitability ratios (simple problems), Du Pont chart.

TEXTBOOKS

1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4thEdition,2012.

2. M. KasiReddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 2ndEdition,2012.

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1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2ndEdition,2012.

2. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd,4thEdition, 2012.

3. R.NarayanaSwamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1stIndian Reprint Edition,2012.

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2. https://theintactone.com/2019/10/01/me-u3-topic-2-cost-output-relationship-in-short-run-long-run-cost-curves/

3. https://corporatefinanceinstitute.com/resources/knowledge/modeling/break-even-analysis/

4. https://corporatefinanceinstitute.com/resources/knowledge/economics/market-structure/#: :text=The%20four%20popular%20types%20of,monopoly%20market%2C%20and%20mo

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6. https://courses.lumenlearning.com/boundless-finance/chapter/introduction-to-capital-budgeting/

7. https://jkbhardwaj.com/20-transactions-with-their-journal-entries-ledger-and-trial-balance/

8. https://www.iedunote.com/write-accounting-ledger

9. https://opentextbc.ca/principlesofaccountingv1openstax/chapter/prepare-a-trial-balance/
10. https://caknowledge.com/how-to-prepare-final-accounts/
11. https://corporatefinanceinstitute.com/resources/knowledge/finance/ratio-analysis/

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=publicprofile&id=5201

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Discussion on Course Outcomes and how these COs mapped with POs and PSOs.		
CONTENT DELIVERY (THEORY)			
2-3	Explain about managerial economics according to the business	CO 1	T1- 1.3-1.8 R1-1.5-1.7
4-5	Describe about demand analysis, the Law of Demand and Demand Function.	CO 1	T1-2.2-2.11 R1-3.3-3.20
6-7	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CO 1	T1-3.3-3.20 R1- 5.29-6.8
8	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CO 1	T1-4.6-4.19
9-10	Demonstrate the Production function, features of Iso-Quants and Iso-Costs, different types of Internal Economies, External Economies and Law of Returns.	CO 2	T1- 5.3-5.18 R1- 5.29-6.8
11-13	Different types of Internal Economies, External Economies ad Law of Returns with appropriate examples.	CO 2	T1- 5.3-5.18
14-15	Illustrate different types of costs	CO 2	T1- 5.29-6.8
16-17	Explain the Significance and Limitations of Break-Even Analysis	CO 2	T1- 7.13-7.14
18-19	Calculate Break-Even Point (Simple Problems)	CO 2	T1- 7.1-7.12
20-21	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CO 3	T1- 8.4-8.16 R2- 5.29-6.8
22-24	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CO 3	T1- 8.21-8.25
25-26	Describe Features of business, Definitions of Various forms of Business Units.	CO 4	T1-9.3-9.15
27-30	State the Merits & Demerits of Different types of Public Enterprises and Changing Business Environment to Post Liberalization Scenario.	CO 4	T1-9.2-10.23 R1- 8.21-8.25
31-32	Explain the significance and classification of capital, Methods and Sources of Raising Finance.	CO 6	T1-9.2-10.23

33-34	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CO 6	T1-11.3-11.5 R2-12.3-12.5
35-37	Illustrate the Significance of Financial Accounting, Double Entry, Accounts, Accounting Concepts and Conventions	CO 6	T1-12.1-12.26
38-40	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance and Final Accounts and Solve simple Problems.	CO 6	T1-13.4-13.15 R2-11.3-11.5
41-42	Describe Meaning, Definitions and Limitations of Ratio Analysis	CO 6	T1-13.4-13.15 R2-11.7-11.8
43-45	Compute different types of Financial Ratios (Problems)	CO 6	T1-13.5-13.68
PROBLEM SOLVING/ CASE STUDIES			
46	Problems relating to Demand elasticty measurement and Forecasting	CO 1	T1: 1.1 - 2.8, R1:2.1
47	Problems relation to Break Even Point	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
48	Problems in determining the price in different types of markets	CO 3,4	T3: 6.0 to 6.4, R1:5.1
49	Problems relating to Capital Budgeting Decisions	CO 5	R2:7.5
50	Problems relating to Final Accounts and Calculation of Ratios	CO 6	R3: 4.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
51	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
52	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4
53	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
54	Capital Budgeting	CO 5	R2:7.5
55	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1
DISCUSSION OF QUESTION BANK			
56	Introduction and Demand Analysis	CO 1	T1: 1.1 - 2.8, R1:2.1
57	Production and Cost Analysis	CO 2	T2: 3.0 to 3.6, 5.0 to5.5 , R2:4.4

58	Markets and New Environment	CO 3,4	T3: 6.0 to 6.4, R1:5.1
59	Capital Budgeting	CO 5	R2:7.5
60	Introduciton to Financial Accounting and Financial Analysis	CO 6	R3: 4.1

Signature of Course Coordinator **HOD,MBA**
Dr. S. Sivasankara Rao, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

COURSE DESCRIPTION

Course Title	**WEB APPLICATION DEVELOPMENT LABORATORY**				
Course Code	AITC10				
Program	B.Tech				
Semester	IV	DATA SCIENCE			
Course Type	CORE				
Regulation	IARE-UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr. D.Durga Bhavan,i Associate Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming
B.Tech	ACSC04	IV	Programming For Problem Solving Using C

II COURSE OVERVIEW:

This course introduces students to developing web applications. This course presents the basics of HTML5 and CSS3, Other HTML tags for Web application Development. Learn to create links in HTML, Uses of HTML forms. Introduction to the use of Reacts trap for Bootstrap 4-based responsive UI design. React router and its use in developing single-page applications, designing controlled forms. Redux and use it to develop React-Redux powered applications, client-server communication and the use of REST API on the server side, React primitives render to native platform UI.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Web Application Development	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

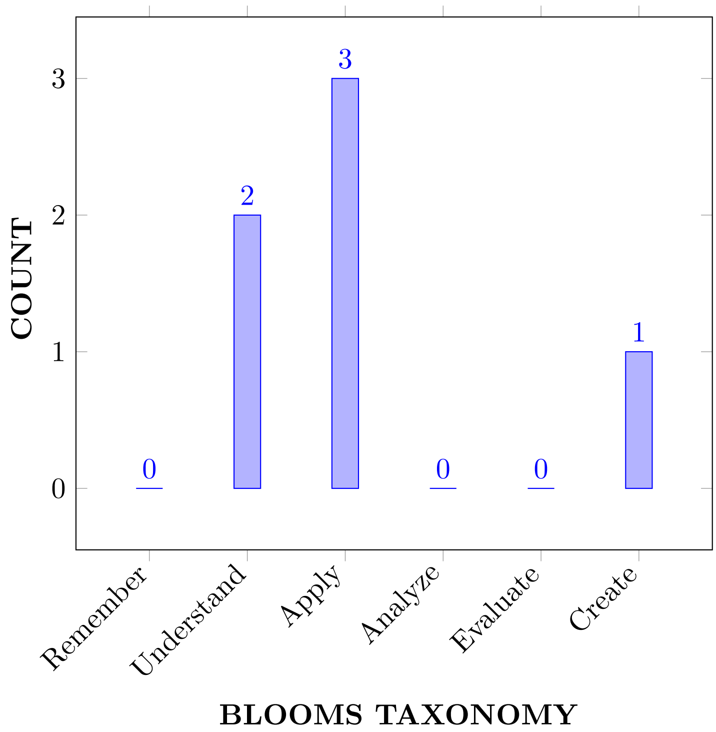
I	The characteristics, systematic methods, model for developing web applications.
II	The fundamentals of HTML and CSS to design static and dynamic web pages.
III	The concepts of client - server programming with JavaScript, Servlets, JSX..
IV	The MVC architecture, about React and built single and multiple page applications using REACT with REDUX.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Classifyf** HTML elements and attributes for structuring and presenting content of webpage based on the requirement . .	Understand
CO 2	**Classify** CSS properties for formatting webpages.	Understand
CO 3	**Develop** responsive webpage using Bootstrap for viewing web pages in various devices .	Apply
CO 4	**Utilize** the concepts of JS with event actions for displaying information on webpages.	Apply
CO 5	**Identify** UI binding library elements for deploying a reusable complex UI.	Apply
CO 6	**Develop** ea native web application with the help of React framework.	Create

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Lab Exercise, CIE,SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complexengineering-problemsreachingsubstantiatedconclusionsusingfirst principles of mathematics, natural sciences ,and engineering sciences.	2	Lab Exercise, CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	Lab Exercise, CIE,SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercise, CIE,SEE
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Lab Exercise, CIE,SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	3	Lab Exercise, CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 1	PBuild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	Lab Exercises
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	Lab Exercises
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Make use of Usage of HTML elements and fundamentals **using principles of mathematics, science, and engineering fundamentals.**	3
	PO 2	Make use of Usage of HTML elements and fundamentals **with Problem statement and system definition, Problem formulation.**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3
	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	2
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 2	PO 1	Describe to use CSS properties for formatting web pages **using principles of mathematics ,and engineering fundamentals..**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3
	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	3
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 3	PO 1	Develop responsive webpage using Bootstrap **using fundamentals of mathematics ,science, and engineering.**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3

	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	3
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
CO 4	PO 1	Describe the use of Java Script with event actions **using the knowledge of mathematics, science, and engineering fundamentals.**	3
	PO 3	Usage of Demonstrate the importance of Java Script for developing programs in real-time scenarios **by communicating effectively with engineering community.**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3
	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	3
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 5	PO 1	Describe the importance of UI binding library elements **by understanding and applying the fundamentals of mathematics, science and engineering.**	3
	PO 3	Usage of Build strong foundation of UI binding library elements for deploying a reusable complex UI **By communicating effectively with engineering community.**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3
	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	3
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3
CO 6	PO 1	Make use of appropriate React framework **using the knowledge of mathematics, science, and engineering fundamentals.**	3

	PO 3	Usage of Demonstrate the usage of React Framework in designing and developing **solutions of complex engineering applications..**	2
	PO 5	Understanding **of the limitations of Modern Tool Usage.**	3
	PO 10	Build strong foundation of programming Schemes for career building by communicating **effectively with engineering community.**	3
	PO 12	Build strong foundation of programming schemes for career **building by communicating effectively with engineering concepts.**	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

Course Outcomes	Program Outcomes						Program Specific Outcomes		
	PO1	PO2	PO3	PO5	PO10	PO12	PSO1	PSO2	PSO3
CO1	1	2		3	2	1	-	2	2
CO2	2			3	3	2	2	2	2
CO3	2			3	3	2	-	2	
CO4	1		2	3	2	4	3		2
CO5	1		2	3	3	-	-	3	
CO6	2	2		3	3	3	2	3	2

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams ✓	Seminars	-	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**HTML LAYOUTS AND LINKS**
	1. Develop a web application to control over different layouts. 2. Create a webpage with HTML describing your department use paragraph and list tags. 3. Apply various colors to suitable distinguish key words, also apply font styling like italics, underline and two other fonts to words you find appropriate, also use header tags. 4. Create links on the words e.g. "Wi-Fi" and "LAN" to link them to Wikipedia pages .
WEEK II	**WEB APLLICATION DESIGN FORMNG**
	1.Develop a web application with background banner image and navigation menus. 2. Develop a web application with responsive images. 3. Develop a web application using left menu. 4. Develop setting to change the theme of entire web Application.
WEEK III	**INTRODUCTION TO RESPONSIVE INTERFACE USING BOOTSRAP**
	1.Write code for developing responsive web application with Admin panel and tables with static data.
WEEK IV	**BUIDLING INTERFACES USING JAVASCRIPT**
	1. Set up the Folder Structure. 2. Write the Model code and initialize the application. 3. Implement the list objects and use cases. 4. Implement the create object use case. 5. Implement the update object use case.
WEEK V	**INTRODUCTION TO INTERATIVE FORMS AND AJAX DATA BINIDNG**
	1. Developing Web Page Styles using JavaScript and CSS, 2. Develop Script interactive forms 3. Data binding using Ajax.
WEEK VI	**REACT ENVIRONMENT SETUP**
	1.Setting up development environment. 2. Integration with Existing Apps. 3. Running on Device. 4. Debugging 5. Testing 6. Write source code using Typescript
WEEK VII	**PROGRAMMING WITH REACT**
	1.Basics Interactive examples. 2. Function Components and Class Components 3. React Native Fundamental, Handling Text Input, 4. Using a scroll View, using List View. 5. Platform Specific Code.
WEEK VIII	**BUILD A DRUNKEN SNAKE GAME USING HOOKS**
	1. Introduction and scaffolding the project. 2. Components, Props and Styles. 3. State and Lifecycle Events. 4. Extended Game Functionality. 5. Finishing up and Deployment.

WEEK IX	**PHP SESSIONS BOX React FOR DATA VISUALIZATION**
	1.Introduction and scaffolding the Project. 2. Pages and Layout. 3. Working with an API, CSS-in-JS. 4. Dynamic Pages and React Hooks. 5. Custom React Hooks, Dynamic CSS-in-JS. 6. Finishing up and Deployment. 7. Optimization and PWA.
WEEK X	**CHAT APPLICATION**
	1. Firebase Environment. Introduction and Scaffolding the project. 2. Private and Public pages, Context API. 3. Creating Side bar and Dashboard 4. Creating and displaying Chat Rooms. 5. Creating Layout for Chat page.
WEEK XI	**CHAT APPLICATION API RESPONSES**
	1.Context API Problem-solution for the chat messages. 2. De normalization of the data to be stored in app. 3. Displaying chat feed for Interactive UI along with Real time user presence.
WEEK XII	**DATABASES HANDLING**
	1. Role Based Access. 2. Messages Likes and deletion. 3. File and Audio Chat Messages 4. Extended Chat Features and Deployment

TEXTBOOKS

1. 1. Alok Ranjan Abhilasha Sinha, Ranjit Battewad, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript", 1st Edition, 2020.
2. 2. Alex Banks and Eve Porcello, "Learning React: Functional Web Development with React and Redux", 2017.

REFERENCE BOOKS:

1. Adam Boduch and Roy Derks, "React and React Native: A Complete Hands-on Guide to Modern Web and Mobile Development with React.js", 3rd Edition, 2020.
2. W Hans Bergsten, "Java Server Pages", O'Reilly, 3rd Edition, 2003.
3. D. Flanagan, "Java Script", O'Reilly, 6th Edition, 2011.
4. Jon Duckett, "Beginning Web Programming", WROX, 2nd Edition, 2008.

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2. https://nptel.ac.in/courses/106/105/106105084/
3. https://medium.com/@aureliomerenda/create-a-native-web-app-with-react-native-web-419acac86b82
4. https://www.coursera.org/learn/react-native
5. https://desirecourse.net/react-native-and-redux-course-using-hooks/

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1-2	Introduction to web application.	CO 1	T2: 1.1-1.3

2-5	Basics of Hypertext Modeling	CO 2	T1: 2.2-2.3
6-9	Presentation Modeling.	CO 2	T1: 2.1,2-3-2.6
11-12	Introduction to responsive web design with CSS3 and HTML5.	CO 2	R2: 3.4-3.9
11-12	User Interface Design through Bootstrap.	CO 3	R2: 4.1-4.3
12-13	flex and forms, responsive web page design	CO 3	T1: 27.1,T1:27.2, 27.6
14	JavaScript variable naming rules, data types, expressions and operators.	CO 3	T2: 4.1-4.3
15-17	Web Page Styles using JavaScript and CSS.	CO 3	T2: 4.1-4.3
9	Event handling and layouts.	CO 2, CO 6	T2:24.1–24.6 T2:21.61
18-19	Create a native and web app, JSX, class and function components	CO 5,CO 4	T1: 4.4-4.7
20-21	props, state, lifecycle methods, and hooks.	CO 4	R1: 1.1-1.4
22-24	Introduction to client-side routing using React Router.	CO 5	T1 8.1-8.4
25-28	Global State Management and Transitions using REDUX.	CO 5 , CO 6	T1:9.1, 9.3,9.4,9.6
29-33	Server Side Rendering and Testing using Jest.	CO 5	T1:11.1,11.3 11.4
34-37	Web Development Using REACT.	CO5	T1:10.2, 10.5
38-44	Web Development Using REACT is delivered both in a blended learning and self-paced mode..	CO 5	T1:17.3,17.6 17.8 T1:18.1-18.6
45-47	REDUX store using the official create store function.	CO 6	T1:10.1- 1.3
48-51	REDUX toolkit	CO 6	T1: 26.2, 26.6.4, T2:26.6.6, 26.10
52-55	State for that particular API	CO 5, CO 6	T1:26.1-26.3 28.1-28.7
56-59	Adding an API Service as a Middleware	CO 5, CO 6	T1:27.1-27.6
60-62	Example uses Create REACT App	CO 6	T1:25.1-25.6

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	You are the owner of a big company. You are so rich, that the government has allowed you to print as many notes as you want of any single value that you like. You also have peculiar behavior altra its and you often do things that look weird to a third person. You have N N employees, where the employee has salary Ai Ai. You want to pay them using a denomination that you create. You are also eco friendly and wish to save paper. So, you wish to pay them using as few notes as possible. Find out the minimum number of notes required if you can alter the salary of at most one employee to any positive integer that you like, and choose the positive integer value that each note is worth (called its denomination). Each employee must receive the exact value of his/her salary and no more.
2	You're given a tree with N vertices numbered from 1 to N Your go a list of handle queries. For each query you are given K nodes v1,v2,...,vK. Find if there exists a simple path in the tree covering the give n vertices.

Signature of Course Coordinator **HOD,CSE(DS)**
Dr. D.Durga Bhavani, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
COURSE DESCRIPTION

Course Title	LINUX PROGRAMMING LABORATORY				
Course Code	ACSC16				
Program	B.Tech				
Semester	III				
Course Type	Laboratory				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	2	2
Course Coordinator	Mrs. J Alekhya, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC04	I	PPS

II COURSE OVERVIEW:

This course covers operating system concepts in linux environment. It focuses on practice on shell commands and demonstration of process concepts such as creation and establishing communication using linux system calls. The main objective of the course is to teach the students how to work with linux environment and demonstration of operating systems concepts using linux system calls in C programs. This course reaches to student by power point presentations, lecture notes, and lab which involve the problem solving in mathematical and engineering areas.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Linux Programming Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

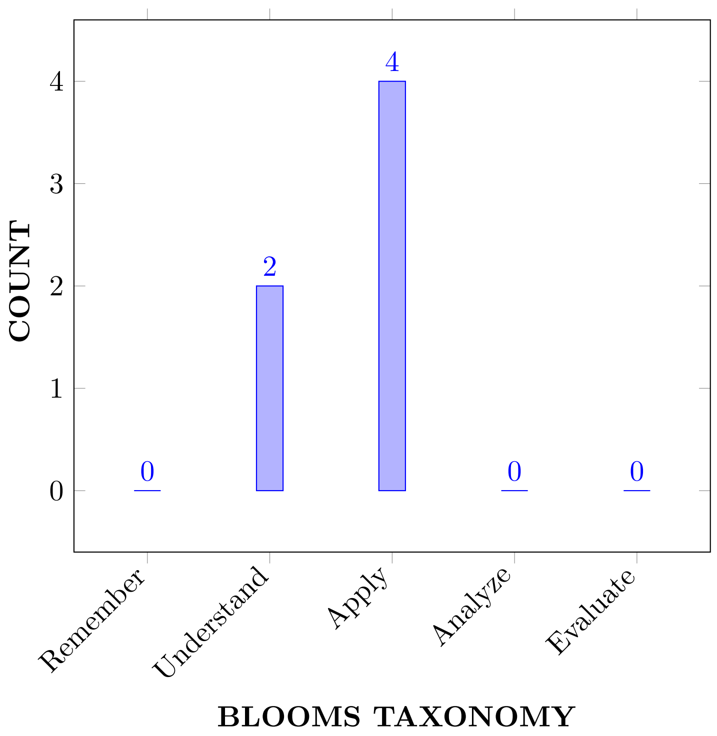
I	Familiar with the Linux command-line environment.
II	Understand system administration processes by providing a hands-on experience.
III	Understand Process management and inter-process communications techniques.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** text processing utilities, file handling utilities, security by file permissions, process utilities, disk utilities and networking commands with different options available for solving problems.	Understand
CO 2	**Make use of** bourne shell constructs, decision structures and loops in designing programs for complex problems.	Apply
CO 3	**Interpret** to write, compile, debug and run C language program in linux shell environment for implementing kernel level concepts.	Understand
CO 4	**Identify** basic methods and techniques used in solving simple programming tasks in the area of execution environment, processes signals and threads.	Apply
CO 5	**Experiment with** IPC mechanisms such as pipes, named pipes, shared memory, message queues, semaphores and sockets for interprocess communication.	Apply
CO 6	**Choose** the appropriate protocol such as TCP or UDP for effective communication in client-server applications.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / SEE/ Lab Exercises

PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE / SEE/ Lab Exercises
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE / SEE/ Lab Exercises
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	CIE / SEE/ Lab Exercises
PO 12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	CIE / SEE/ Lab Exercises

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	Lab Exercises
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	Lab Exercises
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE	**Program Outcomes**												**PSO'S**		
OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 6	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**BASIC COMMANDS I**
	Problem Statement: A person X in a company wants to organize the company's data by making some changes. For that he need to execute some basic commands in linux to organize different types of files so that he can quickly get to the type of file he want to view. 1. ali.c 2. gff.py 3. ree.txt 4. uee.c 5. see.png 6. qee.png Solutions Expected: 1. Listing files by file extension 2. Listing files in reverse name order 3. List out all .c extension files 4. Listing directories only 5. Listing files by size
WEEK II	**BASIC COMMANDS II**

	Problem Statement: Consider two files having name state.txt and capital.txt contains all the names of the Indian states and capitals respectively. For **state.txt** the list is 1.Andhra Pradesh 2.Arunachal Pradesh 3.Assam 4.Bihar 5.Chhattisgarh 6,Goa 7.Gujarat 8.Haryana 9.Himachal Pradesh 10.Jammu and Kashmir 11.Jharkhand 12.Karnataka 13.Kerala 14.Madhya Pradesh 15.Maharashtra 16.Manipur 17.Meghalaya 18.Mizoram 19.Nagaland 20.Odisha 21.Punjab 22.Rajasthan 23.Sikkim 24.Tamil Nadu 25.Telangana 26.Tripura 27.Uttar Pradesh 28.Uttarakhand 29.West Bengal For **capital.txt** the list is 1.Amaravati 2.Itanagar 3.Dispur 4.Patna 5.Raipur 6.Panaji 7.Gandhinagar 8.Chandigarh 9.Shimla 10.Ranchi 11.Bengaluru 12.Thiruvananthapuram 13.Bhopal 14.Mumbai 15.Imphal 16.Shillong 17.Aizawl 18.Kohima

	19.Bhubaneswar 20.Chandigarh 21.Jaipur 22.Gangtok 23.Chennai 24.Hyderabad 25.Agartala 26.Lucknow 27.Dehradun 28.Kolkata Solutions Expected: 1. Without any option display the last 10 lines of the file state,txt. 2. With option display the last 3 lines of the file state.txt. 3. Display the last 6 bytes of data from the each file named state.txt and capital.txt respectively. 4. Display the lines in a reverse order in each file.
WEEK III	**SHELL PROGRAMMING I**

Problem Statement:

A manager Y in a company wants to fetch the employees details as the input. Employee list scripting take input as allowance,deduction,basic as storing variable by using the Linux and scripting.Write a shell program to calculate gross and net salary.

Emp_id	**Allowance**	**Deduction**	**Basic**
100	1600	2100	30,000
101	1500	2000	27,000
102	1000	1500	25,000
103	1600	1000	22,000

Solutions Expected:

1. List out number of employees in the company
2. Display the gross salary of each employee
3. Display the basic salary of employees less than Rs.25,000
4. Calculate the gross salary whose salary is greater than 25,000
5. Calculate the gross salary whose salary is less than 25,000
6. Calculate the net salary whose salary is greater than 20,000
7. Calculate the net salary whose salary is less than 25,000

WEEK IV	**SHELL PROGRAMMING II**
	Problem Statement: Monitoring Officer in a company want to maintain a log list of the employees which is having currently logged in a specific time and the officer want to send a message to a particular employee or some list of employees or for all. write a shell program with the solutions expected below. Solutions Expected: 1. Display all the users who are currently logged in with id and the time and date of user login. 2. Print the usernames of logged-in to the current host. 3. Display all the users who are logged in after 5 p.m. 4. Send hi message to the employees who logged in after 5 p.m. 5. Send hi message to all employees who logged. 6. Move a set of files to a specified directory.
WEEK V	**SIMULATING COMMANDS I**
	Problem Statement: A directory having 3 files i.e file1.txt, file2.txt and file3.txt which is having student_names, student_totalmarks and student_percent respectively. Create a new file file.txt using shell program with the help of simulating commands with the solutions expected below. Solutions Expected: 1. Create files naming file files i.e file1.txt, file2.txt and file3.txt. which is having student_names, student_totalmarks and student_percent respectively. 2. Create a file naming file4.txt and combine the contents of the three text files into the text file file4.txt and make them appear in your terminal. 3. Combine the lists of items from multiple files and make them alphabetized in the combined file, sort the combined items in the resulting file, file4.txt. 4. Display the contents of file1.txt and file2.txt side by side. 5. Display the contents of file1.txt and file3.txt side by side. 6. Display the contents of file1.txt, file2.txtand file3.txt side by side.
WEEK VI	**SIMULATING COMMANDS II**

	Problem Statement: Consider two files having name asian_countries.txt and europe_countries.txt contains all the names of the asian countries and europe countries respectively. asian_countries.txt contains 1. Afghanistan 2.Armenia 3.Azerbaijan 4.Bahrain 5.Bangladesh 6.Bhutan 7. British Indian Ocean Territory 8.Brunei 9.Cambodia 10.China 11.Christmas Island 12. Cocos (Keeling) Islands 13.Cyprus 14.Georgia 15.Hong Kong 16.India europe_countries file contains 1.Austria 2.Belgium 3. Bulgaria 4.Croatia 5.Republic of Cyprus 6. Czech Republic 7.Denmark 8.Estonia 9.Finland 10. France 11.Germany 12.Greece 13.Hungary 14.Ireland 15. Italy Solutions Expected: 1. Displays only the first 10 lines of the file specified. 2. Display the lines from 5 to 13 in the file asian_countries.txt 3. Skip the lines from 6 to 10 in europe_countries.txt and print the remaining lines. 4. Dispaly the first line of each file in europe_countries.txt and asian_countries.txt 5. Redirect the contents of the above output to a new file output.txt 6. Display the first 5 lines of two files europe_countries.txt and asian_countries.txt respectively.

WEEK VII	**SIMULATING COMMANDS III**
	Problem Statement: Let us consider 4 files having names a.txt, b.txt, and so on till d.txt.Execute the following solutions expected. Solutions Expected: 1. List out all the files in the directory 2. Move a.txt file to geek.txt 3. List out the files after executing the above solution 4. cheack if the content has been transferred or not 5. overrids a file b.txt which is write - protected and overwrites the destination file forcefully and deletes the source file. 6. prevent an existing file from being overwritten 7. backup of an existing file that will be overwritten as a result of transferring files from a.txt to geek.txt
WEEK VIII	**SIGNAL HANDLING**

	Problem Statement: Let us consider a program that never end
	#include stdlib.h
	#include unistd.h
	int main()
	{
	while(1)
	{
	printf("wasting your cycles, %d", getpid);
	sleep;
	}
	}
	Solutions Expected:
	1. Pass a signal for intrepting the process
	2. Pass a signal to the process to terminate itself
	3. List out all the available signals
	4. Pass a signal to detect any illegal mathematical operation is attempted
	5. pass a signal to schedule a timer for making the system shutdown after 1 hour.

WEEK IX	**INTERPROCESS COMMUNICATIONS**
	Problem Statement: We will write two programs for IPC using shared memory as an example. Program 1 will create the shared segment, attach it, and then write some content in it. Then Program 2 will attach itself to the shared segment and read the value written by Program 1 Solutions Expected: 1. creates a segment with key 2345, size 1024 bytes, and reads and writes permissions for all users 2. use an identifier to attach the shared segment to the process's address space. 3. display the process id in each of the programs.
WEEK X	**MESSAGE QUEUES**
	Problem Statement: There is a Pizza shop like say Dominos. So multiple clients request for pizzas and they get their responses immediately like: "Please sit down" or "Can you come back after sometime?" or" This is your order number please collect your order from the counter. From the list, the order items move to a Queue, that the Chefs maintains. Write a C program(shop.c) to create a message queue with read and write permissions to write 3 messages to it with different priority numbers and another C program(customer.c) that receives the messages (from the above message queue as specified and displays them. Solutions Expected: 1. send a message from shop to customer that the message has been placed. 2. Display a message sent by the shop to the client
WEEK XI	**SHARED MEMORY**
	Problem Statement: Write a C program to implement inter process communication using shared memory. Solutions Expected: 1. Allocate a shared memory segment 2. By using ftok to generate unique key 3. Return an identifier in shared memory using shmget function 4. Display the data read from memory in child process

WEEK XII	**SOCKET PROGRAMMING**
	Problem Statement: When a bank customer accesses online banking services with a web browser (the client), the client initiates a request to the bank's web server. The customer's login credentials may be stored in a database, and the webserver accesses the database server as a client. An application server interprets the returned data by applying the bank's business logic and provides the output to the webserver. Finally, the webserver returns the result to the client web browser for display. Write a c program to establish the connection between the client and server and execute the following solutions expected. Solutions Expected: 1. Construct connection between the client and server using socket system call 2. Read the message from the server into the buffer 3. Send message to the socket of the incoming connection in server 4. print the received message

TEXTBOOKS

1. Sumitabha Das, "Your Unix The Ultimate Guide", Tata McGraw-Hill, New Delhi, India, 2007.
2. B. A. Forouzan and R. F. Gilberg, "Unix and Shell Programming", Cengage Learning.

REFERENCE BOOKS:

1. Robert Love, "Linux System Programming", O'Reilly, SPD.
2. Stephen G. Kochan, Patrick Wood, "Unix Shell Programming", Sams publications, 3rd Edition, 2007.
3. T. Chan, "Unix System Programming using C++", Prentice Hall India, 1999

Web References:

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2. Shttps://www.redhat.com/en/files/resources/en-rhel-whats-new-in-rhel-712030417.pdf
3. http:// www.tutorialspoint.com/unix/ 4. http://cse09-iiith.virtual-labs.ac.in

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Basic Commands I	CO 1	T2: 4.7-4.8, 5.3-5.4
2	Basic Commands II.	CO 1	T2: 4.7-4.8, 5.3-5.4
3	Shell Programming I	CO 2	T2: 8.5, 14.14

4	Shell Programming II	CO 2	T2: 8.5, 14.14
5	Simulating Commands I	CO 3	T2: 12.3-12.9, 15.9-15.10
6	Simulating Commands II .	CO 3	T2: 3.10,15.6, 17.5-17.6
7	Simulating Commands III	CO 3	T2: 3.10,15.6, 17.5-17.6
8	Signal Handling	CO 4	R4: 10.4-10.19
9	Inter process Communications.	CO 5	R4: 14.1-14.5
10	Message Queues	CO 5	R4: 14.1-14.5
11	Shared Memory	CO 5	R4: 14.7
12	Socket Programming	CO 5, CO 6	R2: 15.5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Write a C program to create a child process and allow the parent to display parent and the child to display child on the screen.
2	Write a C program to create a child process and allow the parent to display parent and the child to display child on the screen.
3	Write a Shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. Whenever the argument is a file, the number of lines on it is also reported.
4	Write a C Program that makes a copy of a file using standard I/O and system calls.
5	Write a C program in which a parent writes a message to a pipe and the child reads the message.
6	Write a C program that illustrates how an orphan is created.

Signature of Course Coordinator **HOD CSE (DS)**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE**				
Course Title	**DATABASE MANAGEMENT SYSTEMS LABORATORY**				
Course Code	AITC07				
Program	B.Tech				
Semester	IV	DATA SCIENCE			
Course Type	Core				
Regulation	IARE - UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr Y. Manohar Reddy, Assistant Professor				

I COURSE OVERVIEW:

This Laboratory course introduces the query language for design and development of a database by using various software's such as SQL, ORACLE, and MS – Access etc. It provides practice on built-in SQL functions using languages like DDL, DCL, DML and TCL to create and manage database systems and perform Set operations, Sub Queries, Joins; and PL/SQL programs to implement Exceptions, Cursors, Stored Functions, Views, Sequences, Locks and Triggers. This is essential for mobile and web application development for business, scientific and engineering applications.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC08	III	Data Structures

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Database Management Systems Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

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20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

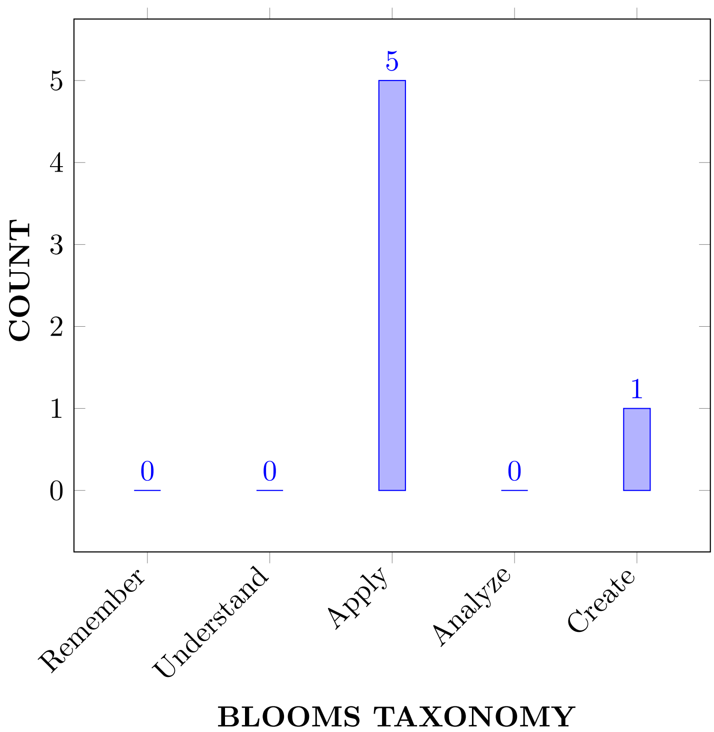
I	The SQL commands for data definition, manipulation, control and perform transactions in database systems.
II	The procedural language for implementation of functions, procedures, cursors and triggers using PL/SQL programs.
III	The logical design of a real time database system with the help of Entity Relationship diagrams.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** database creation and manipulation concepts with the help of SQL queries. .	Apply
CO 2	**Make use of** inbuilt functions of SQL queries to perform data aggregations, subqueries, embedded queries and views.	Apply
CO 3	**Apply** key constraints on database for maintaining integrity and quality of data.	Apply
CO 4	**Demonstrate** normalization by using referential key constraint.	Apply
CO 5	**Implement** PL/SQL programs on procedures, cursors and triggers for enhancing the features of database system to handle exceptions..	Apply
CO 6	**Design** database model with the help of Entity Relationship diagrams for a real time system or scenario.	Create

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 2	**Problem Analysis::** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Lab Exercises,CIE,SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	CIA
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	Lab Exercises
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions..	3	Lab Exercises,CIE,SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change..	2	Lab Exercises,CIE,SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 2	Demonstrate the use of SQL for database creation and maintenance with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	3
	PO 3	Demonstrate the use of SQL for database creation and maintenance with the help of Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes,	4
	PO 5	Demonstrate the use of SQL for database creation and maintenance by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	1
CO 2	PO 2	Make Use of SQL queries for data aggregation, calculations, views, sub-queries, embedded queries manipulation with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	3
	PO 3	Demonstrate the use of SQL for database creation and maintenance with the help of Investigate and define a problem and identify constraints Manage the design process and evaluate outcomes,	4
	PO 5	Make Use of SQL queries for data aggregation, calculations, views, sub-queries, embedded queries manipulation by Understanding of contexts in which engineering knowledge can be applied, understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	3
	PO 10	Build strong foundation on SQL queries for career building by communicating effectively with engineering community.,	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	4
	PO 10	Build strong foundation on relational model and keys for career building by communicating effectively with engineering community..	2
CO 4	PO 2	Apply normalization techniques to normalize a database with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	4

	PO 3	Apply normalization techniques to normalize a database Investigate and define a problem and identify constraints, understand customer and user needs, Manage the design process and evaluate outcomes, Investigate and define a problem and identify constraints, understand customer and user needsManage the design process and evaluate outcomes	4
	PO 5	Apply normalization techniques to normalize a database by Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1
CO 5	PO 2	Define PL/SQL programs on procedures, cursors and triggers for enhancing the features of database system to handle exceptions. with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	4
CO 6	PO 2	Model the real-world database systems using Entity Relationship Diagrams from the requirement specification with the Problem statement and system definition, Problem formulation and abstraction, Information and data collection, Model translation	4
	PO 3	Model the real-world database systems using Entity Relationship Diagrams from the requirement specification through Investigate and define a problem and identify constraints, Understand customer and user needs, Manage the design process and evaluate outcomes.	4
	PO 5	Model the real- world database systems using Entity Relationship Diagrams from the requirement specification Understanding of contexts in which engineering knowledge can be applied, Understanding use of technical literature, Understanding of appropriate codes of practice and industry standards.	3
	PO 12	Build strong foundation on SQL and ER diagrams for career building by communicating effectively with engineering community.	2
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE	PROGRAM OUTCOMES					PSO'S
OUTCOMES	PO 2	PO 3	PO 5	PO 10	PO12	PSO 2
CO 1	2	3	3			3
CO 2	2	3	3	2		3
CO 3	2			3		
CO 4	2	3	3			2
CO 5	2					
CO 6	2	3	3		2	3

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**CREATION OF TABLES**
	1. Create a table called Employee with the following structure. Name Type Emp no Number E name Varchar2(20) Job Varchar2(20) Mgr Number Sal Number • Add a column commission with domain to the Employee table • Insert any five records into the table. • Update the column details of job • Rename the column of Employ table using alter command. • Delete the employee whose empno is19. 2.Create department table with the following structure. Name Type Dept no Number Dept name Varchar2(20) location Varchar2(20) • Add column designation to the department table. • Insert values into the table. • List the records of emp table grouped by dept no. Update the record where dept no is 9. • Delete any column data from the table. 3. Create a table called Customer table Name Type Cust Name Varchar2(20) Cust city Varchar2(20) Cust city Varchar2(20) • Insert records into the table. • Add salary column to the table. • Alter the table column domain. • Drop salary column of the customer table. • Delete the rows of customer table whose cust city is hyd. 4. Create a table called branch table. Name Type Branch Name Varchar2(20) Branch city Varchar2(20) Asserts Number • Increase the size of data type for asserts to the branch. • Add and drop a column to the branch table. • Insert values to the table. • Update the branch name column • Delete any two columns from the table 5. Create a table called sailor table Name Type S Name Varchar2(20) Rating Varchar2(20) Sid Number • Add column age to the sailor table. • Insert values into the sailor table. • Delete the row with rating¿8. • Update the column details of sailor. • Insert null values into the table. 6. Create a table called reserves table. Name Type Boat Id Number Day Number Sid Number • Insert values into the reserves table. • Add column time to the reserves table. • Alter the column day data type to date. • Drop the column time in the table. • Delete the row of the table with some condition.

WEEK II	**QUERIES USING DDL AND DML**
	1. a. Create a user and grant all permissions to the user. b. Insert the any three records in the employee table and use rollback. Check the result. c. Add primary key constraint and not null constraint to the employee table. d. Insert null values to the employee table and verify the result. 2. a. Create a user and grant all permissions to the user. b. Insert values in the department table and use commit. c. Add constraints like unique and not null to the department table. d. Insert repeated values and null values into the table. 3. a. Create a user and grant all permissions to the user. b. Insert values into the table and use commit. c. Delete any three records in the department table and use rollback. d. Add constraint primary key and foreign key to the table. 4. a. Create a user and grant all permissions to the user. b. Insert records in the sailor table and use commit. c. Add save point after insertion of records and verify savepoint. d. Add constraints not null and primary key to the sailor table. 5. a. Create a user and grant all permissions to the user. b. Use revoke command to remove user permissions. c. Change password of the user created. d. Add constraint foreign key and not null. 6. a. Create a user and grant all permissions to the user. b. Update the table reserves and use savepoint and rollback. c. Add constraint primary key , foreign key and not null to the reserves table

WEEK III	**QUERIES USING AGGREGATE FUNCTIONS**
	1. a. By using the group by clause, display the enames who belongs to deptno 10 , whose salary is same as respective departments average salary. b. Display lowest paid employee details under each department. c. Display number of employees working in each department and their department number. d. Using builtin functions, display number of employees working in each department and their department name from dept table. Insert deptname to dept table and insert deptname for each row, do the required thing specified above. e. List all employees which start with either B or C. f. Display only these ename of employees where the maximum salary is greater than or equal to 5000. Page 9 2. a. Calculate the average salary for each different job. b. Show the average salary of each job excluding manager. c. Show the average salary for all departments employing more than three people. d. Display employees who earn more than the lowest salary in department 30 e. Show that value returned by sign (n)function. f. How many days between day of birth to current date. 3. a. Show that two substring as single string. b. List all employee names, salary and 15c. Display lowest paid emp details under each manager d. Display the average monthly salary bill for each deptno. e. Show the average salary for all departments employing more than two people. f. By using the group by clause, display the eid who belongs to deptno 05 along with average salary. 4. a. Count the number of employees in department20 b. Find the minimum salary earned by clerk. c. Find minimum, maximum, average salary of all employees. d. List the minimum and maximum salaries for each job type. e. List the employee names in descending order. f. List the employee id, names in ascending order by empid. 5. a. Find the sids ,names of sailors who have reserved all boats called "INTERLAKE Find the age of youngest sailor who is eligible to vote for each rating level with at least two such sailors. b. Find the sname , bid and reservation date for each reservation. c. Find the ages of sailors whose name begin and end with B and has at least 3 characters. d. List in alphabetic order all sailors who have reserved red boat. e. Find the age of youngest sailor for each rating level. 6. a. List the Vendors who have delivered products within 6 months from order date. b. Display the Vendor details who have supplied both Assembled and Subparts. c. Display the Sub parts by grouping the Vendor type (Local or NonLocal). d. Display the Vendor details in ascending order.

WEEK IV	**PROGRAMS ON PL/SQL**
	1. a. Write a PL/SQL program to swap two numbers. b. Write a PL/SQL program to find the largest of three numbers. 2. a. Write a PL/SQL program to find the total and average of 6 subjects and display the grade. b. Write a PL/SQL program to find the sum of digits in a given number. Page 10 3. a. Write a PL/SQL program to display the number in reverse order. b. Write a PL / SQL program to check whether the given number is prime or not. 4. a. Write a PL/SQL program to find the factorial of a given number. b. Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 3 to 7. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns radius and area. 5. a. Write a PL/SQL program to accept a string and remove the vowels from the string. (When hello passed to the program it should display Hll removing e and o from the world Hello). b. Write a PL/SQL program to accept a number and a divisor. Make sure the divisor is less than or equal to 10. Else display an error message. Otherwise Display the remainder in words
WEEK V	**PROCEDURES AND FUNCTIONS**
	1. Write a function to accept employee number as parameter and return Basic +HRA together as single column. 2. Accept year as parameter and write a Function to return the total net salary spent for a given year. 3. Create a function to find the factorial of a given number and hence find NCR. 4. Write a PL/SQL block o pint prime Fibonacci series using local functions. 5. Create a procedure to find the lucky number of a given birthdate. 6. Create function to the reverse of given number.
WEEK VI	**TRIGGERS**
	1. Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old values and new values: CUSTOMERS table. 2. Creation of insert trigger, delete trigger, update trigger practice triggers using the passenger database. Passenger (Passport id INTEGER PRIMARY KEY, Name VARCHAR (50) Not NULL, Age Integer Not NULL, Sex Char, Address VARCHAR (50) Not NULL); a. Write a Insert Trigger to check the Passport id is exactly six digits or not. b. Write a trigger on passenger to display messages 1 Record is inserted, 1 record is deleted, 1 record is updated when insertion, deletion and updation are done on passenger respectively. Page 11 3. Insert row in employee table using Triggers. Every trigger is created with name any trigger have same name must be replaced by new name. These triggers can raised before insert, update or delete rows on data base. The main difference between a trigger and a stored procedure is that the former is attached to a table and is only fired when an INSERT, UPDATE or DELETE occurs. 4. Convert employee name into uppercase whenever an employee record is inserted or updated. Trigger to fire before the insert or update. 5. Trigger before deleting a record from emp table. Trigger will insert the row to be deleted into table called delete emp and also record user who has deleted the record and date and time of delete. 6. Create a transparent audit system for a table CUST MSTR. The system must keep track of the records that are being deleted or updated.

WEEK VII	**PROCEDURES**
	1. Create the procedure for palindrome of given number. 2. Create the procedure for GCD: Program should load two registers with two Numbers and then apply the logic for GCD of two numbers. GCD of two numbers is performed by dividing the greater number by the smaller number till the remainder is zero. If it is zero, the divisor is the GCD if not the remainder and the divisors of the previous division are the new set of two numbers. The process is repeated by dividing greater of the two numbers by the smaller number till the remainder is zero and GCD is found. 3. Write the PL/SQL programs to create the procedure for factorial of given number. 4. Write the PL/SQL programs to create the procedure to find sum of N natural number. 5. Write the PL/SQL programs to create the procedure to find Fibonacci series. 6. Write the PL/SQL programs to create the procedure to check the given number is perfect or not.
WEEK VIII	**CURSORS**
	1. Write a PL/SQL block that will display the name, dept no, salary of fist highest paid employees. 2. Update the balance stock in the item master table each time a transaction takes place in the item transaction table. The change in item master table depends on the item id is already present in the item master then update operation is performed to decrease the balance stock by the quantity specified in the item transaction in case the item id is not present in the item master table then the record is inserted in the item master table. 3. Write a PL/SQL block that will display the employee details along with salary using cursors. 4. To write a Cursor to display the list of employees who are working as a Managers or Analyst. Page 12 5. To write a Cursor to find employee with given job and deptno. 6. Write a PL/SQL block using implicit cursor that will display message, the salaries of all the employees in the employee table are updated. If none of the employees salary are updated we get a message 'None of the salaries were updated'. Else we get a message like for example, 'Salaries for 1000 employees are updated' if there are 1000 rows in "employee table.
WEEK IX	**CASE STUDY: BOOK PUBLISHING COMPANY**
	A publishing company produces scientific books on various subjects. The books are written by authors who specialize in one particular subject. The company employs editors who, not necessarily being specialists in a particular area, each take sole responsibility for editing one or more publications. A publication covers essentially one of the specialist subjects and is normally written by a single author. When writing a particular book, each author works with on editor, but may submit another work for publication to be supervised by other editors. To improve their competitiveness, the company tries to employ a variety of authors, more than one author being a specialist in a particular subject for the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. Create the logical data model using E-R diagrams.

WEEK X	**CASE STUDY GENERAL HOSPITAL**
	A General Hospital consists of a number of specialized wards (such as Maternity, Pediatric, Oncology, etc). Each ward hosts a number of patients, who were admitted on the recommendation of their own GP and confirmed by a consultant employed by the Hospital. On admission, the personal details of every patient are recorded. A separate register is to be held to store the information of the tests undertaken and the results of a prescribed treatment. A number of tests may be conducted for each patient. Each patient is assigned to one leading consultant but may be examined by another doctor, if required. Doctors are specialists in some branch of medicine and may be leading consultants for a number of patients, not necessarily from the same ward. For the above case study, do the following. 1. Analyze the data required. 2. Normalize the attributes. 3. Create the logical data model using E-R diagrams.
WEEK XI	**CASE STUDY: CAR RENTAL COMPANY**
	A database is to be designed for a car rental company. The information required includes a description of cars, subcontractors (i.e. garages), company expenditures, company revenues and customers. Cars are to be described by such data as: make, model, year of production, engine size, fuel type, number of passengers, registration number, purchase price, purchase date, rent price and insurance details. It is the company policy not to keep any car for a period exceeding one year. All major repairs and maintenance are done by subcontractors (i.e. franchised garages), with whom CRC has long-term agreements. Therefore the data about garages to be kept in the database includes garage names, addresses, range of services and the like. Some garages require payments immediately after a repair has been made; with others CRC has made arrangements for credit facilities. Company expenditures are to be registered for all outgoings connected with purchases, repairs, maintenance, insurance etc. Similarly the cash inflow coming from all sources: Car hire, car sales, insurance claims must be kept of file. CRC maintains a reasonably stable client base. For this privileged category of customers special credit card facilities are provided. These customers may also book in advance a particular car. These reservations can be made for any period of time up to one month. Casual customers must pay a deposit for an estimated time of rental, unless they wish to pay by credit card. All major credit cards are accepted. Personal details such as name, address, telephone number, driving license, number about each customer are kept in the database. For the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes

WEEK XII	**CASE STUDY: STUDENT PROGRESS MONITORING SYSTEM**
	A database is to be designed for a college to monitor students' progress throughout their course of study. The students are reading for a degree (such as BA, BA (Hons) M.Sc., etc) within the framework of the modular system. The college provides a number of modules, each being characterized by its code, title, credit value, module leader, teaching staff and the department they come from. A module is coordinated by a module leader who shares teaching duties with one or more lecturers. A lecturer may teach (and be a module leader for) more than one module. Students are free to choose any module they wish but the following rules must be observed: Some modules require pre- requisites modules and some degree programme have compulsory modules. The database is also to contain some information about students including their numbers, names, addresses, degrees they read for, and their past performance i.e. modules taken and examination results. For the above case study, do the following:1. Analyze the data required. 2. Normalize the attributes. 3. Create the logical data model i.e., ER diagrams. 4. Comprehend the data given in the case study by creating respective tables with primary keys and foreign keys wherever required. 5. Insert values into the tables created (Be vigilant about Master- Slave tables). 6. Display the Students who have taken M.Sc course. 7. Display the Module code and Number of Modules taught by each Lecturer. 8. Retrieve the Lecturer names who are not Module Leaders. 9. Display the Department name which offers "English" module. 10. Retrieve the Prerequisite Courses offered by every Department(with department names). 11. Present the Lecturer ID and Name who teaches "Mathematics. 12. Discover the number of years a Module is taught. 13. List out all the Faculties who work for Statistics Department. 14. List out the number of Modules taught by each Module Leader. 15. List out the number of Modules taught by a particular Lecturer. 16. Create a view which contains the fields of both Department and Module tables. (Hint The fields like Module code, title, credit, Department code and its name). 17. Update the credits of all the prerequisite courses to 5. Delete the Module ":History from the Module table.

TEXTBOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Mc raw-Hill, 4th Edition,2002

2. Ivan Bayross, "SQL, PL/SQL The programming language of oracle", BPB publications, 4th Revised Edition, 2010.

REFERENCE BOOKS:

1. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013

2. Peter Rob, Carles Coronel, "Database System Concepts", Cengage Learning, 7th Edition, 2008

3. M L Gillenson, "Introduction to Database Management", Wiley Student Edition,2012.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Introduction to database management system environments.	CO 1	T1:4.1, T2:1.1
2	Creation of tables using DDL and DML commands.	CO 2	T1:4.9,4.11, T2:7
3	Working with integrity constraints	CO 3	T1:3, T2:8
4	Working with DCL and TCL commands	CO 1,CO 2	T1:6.6, T2:12
5	Queries using aggregate functions.	CO 3	T1:4.4, T2:10
6	Nested queries using comparison keywords and logical operators.	CO	T1:4.6, T2:10
7	Working with Programs on pl/sql.	CO 6	T2:15
8	Working with Procedures. .	CO 3,CO 6	T2:18
9	Working with Triggers.	CO 6	R2: 5.2
10	Working with functions.	CO 5	T2:18
11	Working with Cursors. .	CO 6	T2:10
12	Case study	CO 6	T1:2, T2:1

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Twin vortex formation:** Implementation of views using SQL.
2	**Open channel:** Practical Implementation of assertions using PL/SQL..

Signature of Course Coordinator **HOD,CSE(DS)**
Mr.Y Manohar Reddy, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE)				
Course Title	**THEORY OF COMPUTATION**				
Course Code	AITC04				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. U Sivaji, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AHSC08	II	Probability and Statistics.
B.Tech	ACSB03	III	Data Structures
B.Tech	ACSB04	III	Discrete Mathematical Structures

II COURSE OVERVIEW:

This course focuses on infinite languages in finite ways, and classifies machines by their power to recognize. It includes finite automata, regular grammar, push down automata, context free grammars, and Turing machines It is applicable in designing phrasing and lexical analysis of a compiler, genetic programming and recursively enumerable languages

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Theory of computation	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
x	Quiz						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could

be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
20%	Remember
20 %	Understand
0%	Apply
0%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

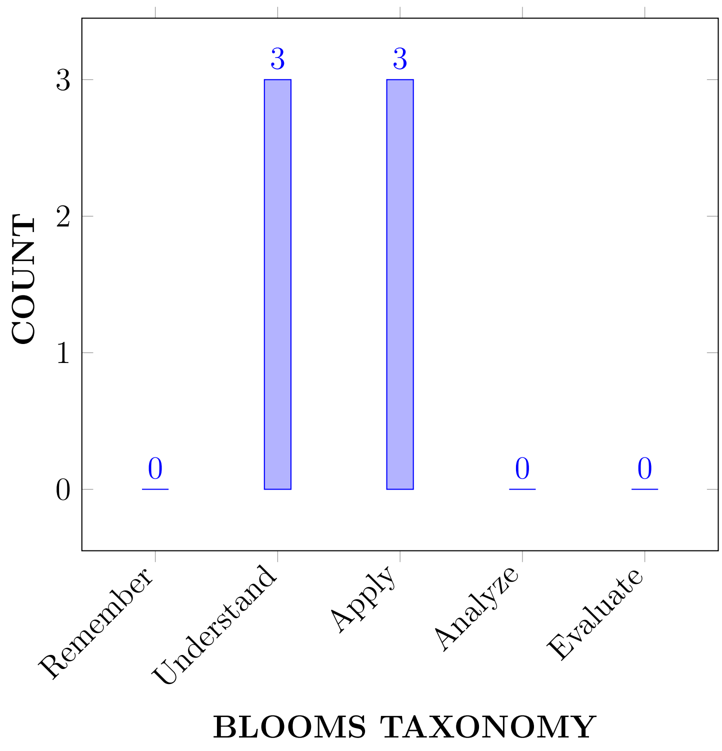
I	The fundamental knowledge of automata theory which is used to solve computational problems
II	The reorganization of context free language for processing infinite information using push down automata.
III	The computer based algorithms with the help of an abstract machine to solve recursively Enumerable problems

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Make use of** deterministic finite automata and non deterministic finite automata for modeling lexical analysis and text editors.	Apply
CO 2	**Extend** regular expressions and regular grammars for parsing and designing programming languages.	Understand
CO 3	**Illusrate** the pumping lemma on regular and context free languages for perform negative test .	Understand
CO 4	**Demonstarte** context free grammars, normal forms for generating patterns of strings and minimize the ambiguity in parsing the given strings.	Understand
CO 5	**Construct** push down automata for context free languages for developing parsing phase of a compiler.	Apply
CO 6	**Apply** Turing machines and Linear bounded automata for recognizing the languages,complex problems.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Program Outcomes	
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE / SEE
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1.2	AAT

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1.5	SEE / AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE / Quiz / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1.5	CIE / Quiz / AAT /Tech-Talk

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2.3	Group discussion/ Short term courses
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1.0	Research papers/ Industry exposure

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	✓
CO 2	✓	-	-	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓
CO 6	✓	✓	✓	✓		-	-	-	-	-	-	-	✓	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Evaluate properties of grammar for the given problem with the help of alphabet and strings and language by applying the mathematical principles and scientific principles.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 2	PO 1	Understand the basics of context free grammars, its types and properties for finding pumping lemma by applying mathematical principles and scientific principles.	2
	PO 10	Understand the types of grammars and their properties and write effective reports and documentation .	1
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	3
CO 3	PO 1	Find an optimized solution for the given problem using regular grammar by applying the knowledge of mathematical principles and computer engineering methodologies.	2
	PO 2	Understand the given problem and develop the solution using right and left linear grammar from the provided information and interpret of results.	4
	PO 3	Explain and demonstrate the translation of simple statements, by applying grammars by engineering processes.	2
CO 4	PO 1	Describe the role of Ambiguity in construction of context free grammars by understanding mathematical principles and scientific principles.	2
	PO 2	Understand the given problem and analyze the grammar and eliminate ambiguity using derivation trees and document the results for interpretation. .	3
	PO 10	Understand normalization techniques such as (Chomsky and griebach)to minimize the ambiguity.	1
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
CO 5	PO 1	Describe acceptance of context free language by final state and by empty stack problems by understanding mathematical principles, engineering methodologies and scientific principles.	3
	PO 2	Understand equivalence of context free language and pushdown automata for validation and design of inter conversionforsolving the given problem related to engineering from the provided information and data.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 6	PO 1	Describe the recursively enumerable languages and churchs hypothesis using mathematical principles and scientific principles.	3
	PO 2	Understand the given problem statement and formulate the (complex) engineering problems in the Design of Turing machine in reaching substantiated conclusions by the interpretation of results.	3
	PO 3	Make Use ofTuring machinesto develop programs (define problem)for finding the solution (innovative) of complex engineering problems which satisfy the user constraints.	4
	PO 4	Ability to identify ,classify and describe the performance of turing machine by using analytical methods and modeling techniques.	4
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	6

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-		-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-	3	-	-
CO 3	2	4	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-		-	-	-	-	1	-	-	3	-	-
CO 5	2	3	2	-	-	-	-	-	-	-	-	-	-	-	1
CO 6	3	3	4	4	-	-	-	-	-	-	-		6	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.7	-	-	-	-	-	-	-	-	-	-		-	-	33.3
CO 2	66.7	-	-	-	-	-	-	-	-	20.0	-	-	50.0	-	-
CO 3	66.7	40.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.7	30.0	-	-		-	-	-	-	20.0	-	-	50.0	-	-
CO 5	100.0	30.0	-	-	-	-	-	-	-	-	-	-	-	-	33.3
CO 6	100.0	30.0	40.0	36.3		-	-	-	-	-	-		100.0	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -5 $< C \leq 40\%$ – Low/ Slight

2 - 40 % $< C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO 2	3	-	-	-	-	-	-	-	-	1	-	-	2	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	1	-	-	-	-	-	-	-	1	-	-	2	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO 6	3	1	2	1	-	-	-	-	-	-	-	-	3	-	-
TOTAL	18	5	3	1	-	-	-	-	-	2	-	-	7	-	2
AVERAGE	3.0	1.25	1.5	1.0	-	-	-	-	-	1	-	-	2.3	0	1.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	✓
Assignments					

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**FINITE AUTOMATA**
	Fundamentals: Alphabet, strings, language, operations; Introduction to finite automata: The central concepts of automata theory, deterministic finite automata, nondeterministic finite automata, an application of finite automata, finite automata with and without epsilon transitions, Conversion of NFA to DFA, Moore and Melay Machines.
MODULE II	**REGULAR LANGUAGES**
	Regular sets, regular expressions, identity rules, constructing finite automata for a given regular expressions, conversion of finite automata to regular expressions, pumping lemma of regular sets, closure properties of regular sets (proofs not required), regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and finite automata, inter conversion.
MODULE III	**CONTEXT FREE GRAMMARS**
	Context free grammars and languages: Context free grammar, derivation trees, sentential forms, right most and leftmost derivation of strings, applications. Ambiguity in context free grammars, minimization of context free grammars, Chomsky normal form, Greibach normal form, pumping lemma for context free languages, enumeration of properties of context free language (proofs omitted)
MODULE IV	**PUSHDOWN AUTOMATA**
	Pushdown automata, definition, model, acceptance of context free language, acceptance by final state and acceptance by empty stack and its equivalence, equivalence of context free language and pushdown automata, inter conversion;(Proofs not required); Introduction to deterministic context free languages and deterministic pushdown automata.
MODULE V	**TURING MACHINE**
	Turing machine: Turing machine, definition, model, design of Turing machine, computable functions, recursivey enumerable languages, Church's hypothesis, counter machine, types of Turing machines (proofs not required), linear bounded automata and context sensitive language, Chomsky hierarchy of languages.

TEXTBOOKS

1. John E. Hopcroft , Rajeev Motwani, Jeffrey D. Ullman, —Introduction to Automata, Theory, Languages and Computation, Pearson Education, 3rd Edition, 2007.

REFERENCE BOOKS:

1. John C Martin, —Introduction to Languages and Automata Theory, Tata McGraw Hill, 3rd Edition, 2017

2. Daniel I.A. Cohen, Introduction to Computer Theory, John Wiley Sons, 2nd Edition, 2004.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106103070

COURSE WEB PAGE:

https://lms.iare.ac.in/index?route=account/login

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	In Outcome-Based Education (OBE), we discussed about course delivery assessment that are planned to achieve stated objectives and outcomes. We will focuses on measuring student performance i.e. outcomes at different levels. Course outcomes(CO),Program Outcomes(PO)and Program Specific Outcomes(PSO) and also mapping of CO's to PO's PSO's and their attainments are discussed.		
CONTENT DELIVERY (THEORY)			
1	Alphabet, strings, language and operations	CO1	T1:1.5-1.6
2	finite automata and concepts of automata theory	CO1	T1:2.1-2.2, R2:38-64
3	Demonstrate the behavior of deterministic finite automata	CO 1	T1:2.2-2.3
4-6	Understand the functionality of non- deterministic finite automata and Finite automata with epsilon transitions.	CO 1	T1:2.3-2.4, R1:3.1-3.3, R2:142-148
7	application of finite automata,Conversion of NFA to DFA, Moore and Melay Machines.	CO 1	T1:2.3-2.4, R1:3.1-3.3, R2:142-148
8-10	understand the Regular sets, regular expressions, identity rules	CO 2	T1: 3.1-3.2
11-13	finite automata for a given regular expressions, finite automata to regular expressions	CO 2	T1: 3.1-3.2
14-15	find the pumping lemma of regular sets, regular grammars, right linear and left linear grammars	CO 3	T1: 4.1-4.2
16-19	Regular grammars-right linear and left linear grammars	CO 4	T1: 4.4-4.5
20-22	regular linear grammar and finite automata, inter conversion.	CO 2	T1: 4.4-4.5
23-24	Apply Context free grammar on derivation trees	CO 4	T1: 5.1-5.5, R1:4.2-4.4
25-27	sentential forms, right most and leftmost derivation of strings	CO 4	T1: 5.1-5.5, R1:4.2-4.4
28-29	Ambiguity in context free grammars	CO 4	T1: 5.1-5.5, R1:4.2-4.4
30-32	Understand Minimization of context free grammars, Chomsky normal form, Greibach normal form	CO 4	T1: 7.4-7.5, R1:6.1-6.2
33-34	Pumping lemma for context free languages, properties	CO 3	T1: 7.4-7.5, R1:6.1-6.2

35-37	Apply the push down automata for acceptance of context free Languages	CO 5	T1: 6.1-6.2, R1:5.2-5.4
38-41	push down automata for given context free languages	CO 5	T1: 6.1-6.2, R1:5.2-5.4
42-43	acceptance by empty stack and its Equivalence.	CO 5	T1: 6.1-6.2, R1:5.2-5.4
44-45	Describe Equivalence of context free language and pushdown automata	CO 5	T1: 6.3-6.4
46-47	inter conversion, deterministic push down automata.	CO 5	T1: 6.3-6.4
48-53	Describe Turing machine, definition, model, computable functions	CO 6	T1: 8.1-8.2, R1:7.2-7.4
54-56	Apply Recursively enumerable languages	CO 6	T1: 8.2-8.6, R1:7.5-7.6
57-58	Types of Turing machines and Church's hypothesis.	CO 6	T1: 8.2-8.6, R1:7.5-7.6
59-60	Linear bounded automata and context sensitive language.	CO 6	T1:9.1-9.8, R2:551-560
61-62	Chomsky hierarchy of languages.	CO 6	T1:9.1-9.8, R2:551-560
PROBLEM SOLVING/ CASE STUDIES			
1	Describe a DFA for the following language L={w/|w | mod5=0,w belongs to (a,b)*} L={w/|w | mod5=1,w belongs to (a,b)*}	CO 1	T1:2.3-2.4, R1:3.1-3.3
2	Convert NFA with ϵ to equivalent NFA M=({q0,q1,q2},{0,1,2}, δ, q0, {q2}) where δ is given by [δ (q0,0)={q0}, δ (q0,1)=ϕ, δ (q0,2)=ϕ, δ(q0, ϵ)=q1] [δ (q1,0)=ϕ, δ (q1,1)=q1 , δ (q1,2)=ϕ ,δ (q1, ϵ)=q2] [δ (q2,0)=ϕ, δ (q2,1)= ϕ , δ (q2,2)= {q2},δ (q2, ϵ)= ϕ]	CO1	T1:2.3-2.4, R1:3.1-3.3
3	Convert NFA with ϵ to equivalent DFA Picture5.jpg	CO 1	T1:2.3-2.4, R1:3.1-3.3
4	Describe Pumping Lemma for Regular Languages. Prove that the language L = {a^n/ n is a n^5} is not regular	CO 3	T1: 7.4-7.5, R1:6.1-6.2
5	Convert the following automata into Regular expression M=({q1,q2,q3},{0,1}, δ, q1, {q2,q3}) where δ is given by [δ (q1,0)={q2}, δ (q1,1)={q3}] [δ (q2,0)={q1}, δ (q2,1)={q3}] [δ (q3,0)={q2}, δ (q3,1)= {q2}]	CO 2	T1: 3.1-3.2
6	Describe the DFA Transition diagram for equivalent Regular expression (ab+a) *(aa+b)	CO 1	T1:3.1-3.2
7	Convert the following grammar into GNF S$\rightarrow$ABA/AB/BA/AA/B A$\rightarrow$aA/a, B$\rightarrow$bB/b	CO 4	T1: 7.4-7.5, R1:6.1-6.2
8	Describe the context free grammars in the four tuple form.(V,T,P,S) for the given languages on $\sum$={a,b} i. All strings having at least two a's ii. All possible strings not containing triple b's	CO 4	T1: 7.4-7.5, R1:6.1-6.2

9	Describe the steps to show the following is not CFG. { a$^m b^n c^p$| m< n or n< p}	CO 4	T1: 7.4-7.5, R1:6.1-6.2
10	Construct PDA for equal number of x's and y's. eg: xyyxxy	CO 5	T1: 6.1-6.2, R1:5.2-5.4
11	Construct NDPDA for L = { W≠W$^R/W$∈(X + Y)*}	CO 5	T1: 6.1-6.2, R1:5.2-5.4
12	Construct DPDA for L = { W≠W$^R/W$∈(X + Y)*}	CO 5	T1: 6.1-6.2, R1:5.2-5.4
13	Construct a Turing Machine that accepts the language L = {a$^{2n}b^n$|n≥0}.Give the transition diagram for the Turing Machine obtained.	CO 6	T1: 8.2-8.6, R1:7.5-7.6
14	Construct a Turing Machine to accept the following languages L = { w$^n x^n y^n z^n$| n≥1}	CO 6	T1:8.2-8.6, R1:7.5-7.6
15	Design a Turing Machine that accepts the language denoted by regular expression (000)*	CO 6	T1:8.2-8.6, R1:7.5-7.6
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Alphabet, strings, language and operations	CO 1	T1:1.5-1.6
2	understand the Regular sets, regular expressions, identity rules	CO 2	T1:3.1-3.2
3	Understand Minimization of context free grammars, Chomsky normal form, Greibach normal form	CO 4	T1:7.4-7.5, R1:6.1-6.2
4	push down automata for given context free languages	CO 5	T1:6.1-6.2, R1:5.2-5.4
5	Types of Turing machines and Church's hypothesis.	CO 6	T1:8.2-8.6, R1:7.5-7.6
DISCUSSION OF QUESTION BANK			
1	Describe the DFA with the set of strings having "aaa as a substring over an alphabet $\sum$ ={a,b}.	CO 1	T1:1.5-1.6
2	Convert Regular Expression (11+0)*(00+1)* to Finite Automata.	CO 2	T1:3.1-3.2
3	Describe a CFG for the languages L={a$^i b^j$| i≤2j}	CO 4	T1:7.4-7.5, R1:6.1-6.2
4	Define the NPDA(Nondeterministic PDA) and DPDA(deterministic PDA) equivalent? Illustrate with an example.	CO 5	T1:6.1-6.2, R1:5.2-5.4
5	Describe a Turing Machine. With a neat diagram explain the working of a Turing Machine.	CO 6	T1: 8.2-8.6, R1:7.5-7.6

Signature of Course Coordinator
HOD,CSE(DS)

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING (DS)**				
Course Title	**COMPUTER NETWORKS**				
Course Code	AITC06				
Program	B.Tech				
Semester	V				
Course Type	Core				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Mr. S Vinod Kumar , Assistant Professor				

I COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks (LANs) wide area networks (WANs). The course includes learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, and web and email protocols. The applications of this course are to design, implement and maintain a basic computer networks.

II COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	ACSB07	III	Computer Organization and Architecture

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Computer Networks	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	x	Chalk & Talk	x	Assignments	x	MOOC
✓	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
%	Remember
%	Understand
%	Apply
0 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

<table>
<tr><th colspan="2">Component</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="4">CIA</td><td>Continuous Internal Examination – 1 (Mid-term)</td><td>10</td><td rowspan="4">30</td></tr>
<tr><td>Continuous Internal Examination – 2 (Mid-term)</td><td>10</td></tr>
<tr><td>AAT-1</td><td>5</td></tr>
<tr><td>AAT-2</td><td>5</td></tr>
<tr><td>SEE</td><td>Semester End Examination (SEE)</td><td>70</td><td>70</td></tr>
<tr><td colspan="3">Total Marks</td><td>100</td></tr>
</table>

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

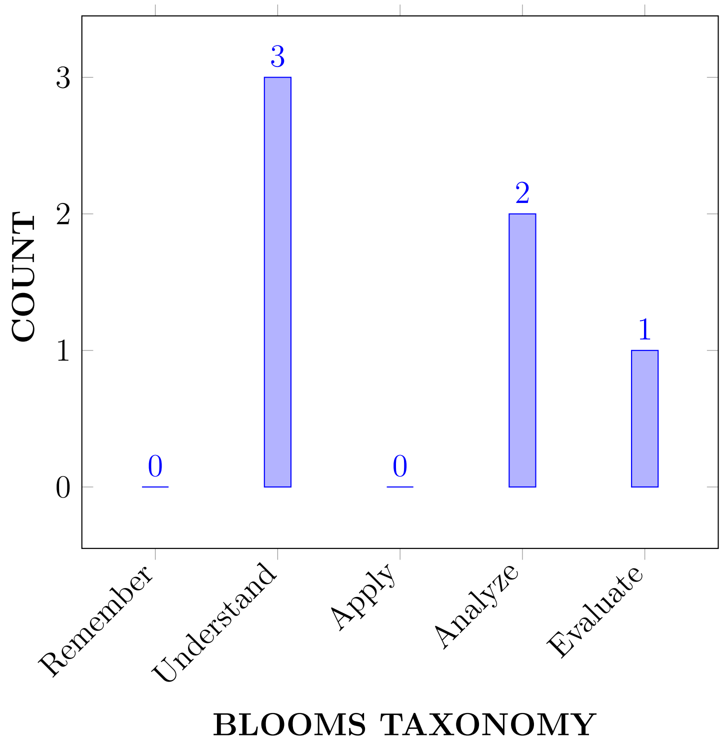
I	How computer network hardware and software operate
II	Investigate the fundamental issues driving network design
III	The data transmission through protocols across the network in wired and wireless using routing algorithms.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** the basic concepts of data communications including the key aspects of networking and their interrelationship, packet, circuit and cell switching as internal and external operations, physical structures, types, models, and internetworking	Understand
CO 2	**Make use of** different types of of bit errors and the concept of bit redundancy for error detection and error correction.	Understand
CO 3	**Identify** the suitable design parameters and algorithms for assuring quality of service and internetworking in various internet protocols	Understand
CO 4	**Interpret** transport protocols (TCP,UDP) for measuring the network performance	Evaluate
CO 5	**Illustrate** the various protocols (FTP, SMTP,TELNET, EMAIL,WWW) and standards (DNS) in data communications among network.	Analyze
CO 6	**Compare** various networking models (OSI, TCP/IP) in terms of design parameters and communication modes.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Program Outcomes	
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering .community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions..	2	Discussion on Innovations / Presentation
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Short term courses

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	2	Research papers / Group discussion / Short term courses
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions papers / Industry exposure		

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	✓	-	-	-
CO 3	✓	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 4	✓	-	✓	✓	-	-	-	-	-	✓	-		✓	-	✓
CO 5	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-	✓
CO 6	✓	-	✓	-	-	-	-	-	-	-	-		-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Understand the importance of network types, suitable transmission medium, devices and the Internet in supporting business communications and everyday activities by understanding **fundamentals of Computer engineering specialization** and **scientific principles.**	1
CO 2	PO 1	Understand the importance of network types, suitable transmission medium, devices and the Internet in supporting business communications and everyday activities by understanding **fundamentals of Computer engineering specialization** and **scientific principles.**	2
	PO 2	Understand the **problem** statement and **choose appropriate techniques** by **analyzing** the importance of data hiding **interpretation of results.**	4

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively** with **engineering community.**	2
	PO 12	Build strong foundation of the performance of a single link, logical process-to-process (end-to-end) channel, and a network as a whole (latency, bandwidth, and throughput) for career **building** by **communicating effectively** with **engineering community.**	4
CO 3	PO 1	Explain the concept of Hamming distance, and the significance of the minimum Hamming Distance and its relationship to errors by **understanding mathematical principles** and **scientific principles.**	3
	PO 2	Understand the **problem** statement and **choose appropriate techniques** by **analyzing**the importance of data hiding **interpretation of results.**	4
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively** with **engineering community.**	2
	PSO 1	**Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .**	6
CO 4	PO 1	Describe the relationship between data and signals, their types, behavior, properties, characterization and transmission through the physical layer by **understanding mathematical principles** and **scientific principles.**	2
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 4	Evaluate the performance of a single link, logical process-to-process (end-to-end) channel, a and **a network as a whole (latency, bandwidth, and throughput).**	2
	PO 10	Recognize the importance of error detection and correction techniques for optimizing the efficiency of the networks by **communicating effectively with engineering community.**	2
	PSO 1	**Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.**	6
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 5	PO 1	Understand the basic design problems of data communications including the checksum, flow control, error control, reliability by apply the **knowledge of computer engineering fundamentals and mathematical principles.**	2
	PO 2	Understand the **problem** statement and **choose appropriate techniques by analyzing**analyzing the importance of data hiding **interpretation of results.**	3
	PO 3	**Understand the concepts** E-mail, telnet, secure shell for **innovative solutions, evaluate the solution of the complex issues.**	3
	PO 12	Build strong foundation of the performance of a single link, logical process-to-process (end-to-end) channel, and a network as a whole (latency, bandwidth, and throughput) for career **building by communicating effectively with engineering community.**	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	2	4	-	-	-	-	-	-	-	2	-	4	-	-	-
CO 3	3	4	3	-	-	-	-	-	-	2	-	-	6	-	-
CO 4	2	-	3	2	-	-	-	-	-	2	-	-	6	-	3
CO 5	2	3	3	-	-	-	-	-	-	-	-	2	6	-	3
CO 6	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	66.7	40	-	-	-	-	-	-	-	40	-	33.3	-	-	-
CO 3	100	40	30	-	-	-	-	-	-	40	-	-	100	-	-
CO 4	66.7	-	30	18	-	-	-	-	-	40	-	-	100	100	-
CO 5	66.7	30	30	-	-	-	-	-	-	-	-	17	100	100	-
CO 6	66.7	30	-	-	-	-	-	-	-	-	-	-	-	-	-

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -5 <C$\leq$ 40% – Low/ Slight
2 - 40 % <C < 60% –Moderate
3 - 60% $\leq$ C < 100% – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	2	-	1	-	-	-
CO 3	3	2	1	-	-	-	-	-	-	1	-	-	3	-	-
CO 4	3	-	1	1	-	-	-	-	-	1	-	-	3	3	-
CO 5	3	1	1	-	-	-	-	-	-	-	-	1	3	-	3
CO 6	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	15	5	4	1	-	-	-	-	-	4	-	2	9	3	3
AVERAGE	2.5	1.6	1.3	1.0	-	-	-	-	-	1.3	-	1.0	3.0	1.0	1.0

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	✓
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	-	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY-INDIRECT:

X	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**INTRODUCTION**
	Introduction: Networks, network types, internet history, standards and administration; Network models: Protocol layering, TCP/IP protocol suite, the OSI model Transmission media: Introduction, guided media, unguided media; Switching: Introduction, circuit switched networks, packet switching.
MODULE II	**DATA LINK LAYER**
	Introduction: Link layer addressing; Error detection and correction: Cyclic codes, checksum, forward error correction; Data link control: DLC services, data link layer protocols, media access control: Random access, virtual LAN.

MODULE III	**NETWORK LAYER**
	Network layer design issues, routing algorithms, congestion control algorithms, quality of service, and internetworking. The network layer in the internet: IPv4 addresses, IPv6, internet control protocols, OSPF(Open Shortest Path First), IP (Internet Protocol)
MODULE IV	**TRANSPORT LAYER**
	The transport service, elements of transport protocols, congestion control; The internet transport protocols: UDP (User Datagram Protocol), TCP (Transport Control Protocol), performance problems in computer networks, network performance measurement.
MODULE V	**APPLICATION LAYER**
	Introduction, client server programming, WWW (World Wide Web) and HTTP (Hyper Text Transfer Protocol), FTP (File Transfer Protocol), E-mail, telnet, DNS (Domain Naming System), SNMP (Simple Network Management Protocol).

TEXTBOOKS

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 5th Edition, 2012.
2. Andrew S. Tanenbaum, David.j.Wetherall, "Computer Networks", Prentice-Hall, 5th Edition, 2010.

REFERENCE BOOKS:

1. Douglas E. Comer, "Internetworking with TCP/IP", Prentice-Hall, 5th Edition, 2011
2. Peterson, Davie, Elsevier, "Computer Networks", 5th Edition,2011
3. Comer, "Computer Networks and Internets with Internet Applications", 4th Edition, 2004.
4. Chwan-Hwa Wu, Irwin, "Introduction to Computer Networks and Cyber Security", CRC publications, 2014.

WEB REFERENCES:

1. https://www.geeksforgeeks.org/computer-network-tutorials/

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference T1: 4.1
OBE DISCUSSION			
1	OBE Discussion		
CONTENT DELIVERY (THEORY)			
2	40 topics		T2: 1.1-1.5, T1: 4.1
PROBLEM SOLVING/ CASE STUDIES			
1	15 problem solving classes	CO 1	R2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	5 classes	CO 1,2, 3	R4:2.1
DISCUSSION OF QUESTION BANK			
1	Understand and explore the basics of computer networks and various network Types	CO 1	T2:2.1
2	Recognize knowledge on previous versions of internet	CO 1	T2:2.3
3	Understands on the various standards and administrations	CO 1	T2:2.3.1
4-5	Discuss on networks models and understand layering scenarios and protocols	CO 1	T2:7.2,7.3
6-9	Demonstrate on TCP/IP models	CO 1	T2:10.3.1
10-11	Demonstrate on Guided and Unguided medium.	CO 2	T2:13.3.2, 13.4.1
12	Understand the addressing mechanism of network layer	CO 3	T2:17.1.1, 17.1.3
13-15	Demonstrate on Error detection and correction Cyclic codes, checksum, and forward error correctionr	CO 3	T2:18.1, 18.2.1
23	Understand Network layer services provided to transport layer	CO 3	T2:18.4, 18.4.3
24-26	Discuss Static and Non static routing algorithms	CO 4	T2:19.2, 18.4.4
27-30	Demonstrate on various congestion control algorithms	CO 4	T2:23.1.1, 23.1.3
31-32	Understand quality service provided by network layer and discuss on internetworking	CO 3	T2:18.3.4, 18.3, 4.17
33-41	Explain IPv4 IPv6 IP addressing, OSPF, IP protocols	CO 4	T2:24.2,28.4
42-45	Discuss about TCP and UDP CO 10,	CO 5	T1: 276-296
46-47	Explain Performance problems in computer networks, network performance measurement	CO 5	T2:24.3.6, 24.3.9
48-51	Discuss about application layer and client server programming	CO 5	T2:25.1, 25.1.2

52-56	Discuss WWW, FTP, DNS, SNMP and HTTP protocols	CO 5	T2:26.1.2, 26.2, 26.3, 26.4,26.5

Signature of Course Coordinator
HOD,CSE(DS)
Mr. S Vinod Kumar , Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE)**				
Course Title	**SOFTWARE ENGINEERING**				
Course Code	ACDC04				
Program	B.Tech				
Semester	V	CSE(DS)			
Course Type	Core				
Regulation	IARE - UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Ms. G Nishwitha, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	-	-	Basic knowledge of computer Hardware and Software

II COURSE OVERVIEW:

Software engineering is a discipline that allows us to apply engineering and computer science concepts in the development and maintenance of reliable, usable, and dependable software.This course is designed to present software engineering concepts and principles in parallel with the Software Development Life Cycle. At the end of this course, students will learn the project management for the purpose of delivering high-quality software that satisfies customer needs and is within the budget.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Software Engineering	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	PPT	x	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	x	Videos
x	Others						

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
40%	Understand
40%	Apply
10%	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include teck-talk (Prasentation beyond the syllabus)and concept videos (Prasentation will be given on the topic which was assigned by the concerned faculty). The AAT chosen for this course is given in table

Concept Video	Tech-talk	critical thinking
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

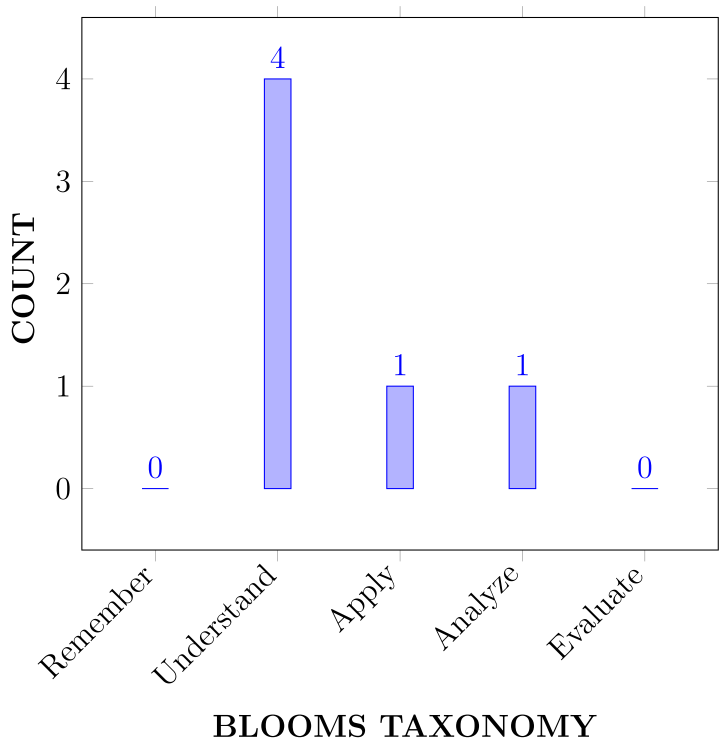
I	The elicitated requirements for a software development life cycles.
II	The design considerations for enterprise integration and deployment.
III	Quality assurance techniques and testing methodologies.
IV	The plan for a software project that includes the size , effort, schedule, resource allocation, configuration control, and project risk.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** process models, approaches and techniques for managing a software development process.	Understand
CO 2	**Summarize** the importance of project planning activities that accurately help in selection and initiation of individual projects and portfolios of projects in the enterprise.	Understand
CO 3	**Explain** software design model and behavior of a software system.	Understand
CO 4	**Develop** the approaches for implementaion,verification and validation including static analysis and reviews.	Apply
CO 5	**Demonstrate** the concept of risk management through risk identification, risk measurement and mitigation.	Understand
CO 6	**Make use of** earned value analysis and project metric for scheduling and improving the quality of software.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIE/Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	2	CIE/Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	CIE / Quiz / AAT
PO 5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	3	CIE / Quiz / AAT
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1	CIE / Quiz / AAT
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	CIE / Quiz / AAT
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	CIE / Quiz / AAT
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	CIE / Quiz / AAT

PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	CIE / Quiz / AAT
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		**Strength**	**Proficiency Assessed by**
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2	CIE / Quiz / AAT
PSO 2	Focus on improving software reliability, network security and information retrieval systems.	2	CIE / Quiz / AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	3	CIE / Quiz / AAT

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	**PROGRAM OUTCOMES**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	-	✓	-	-	✓	-	-	-	✓	✓	-	-	✓	✓	✓
CO 2	✓	✓	-	-	✓	-	-	✓	✓	✓	-	✓	✓	✓	✓
CO 3	✓	✓	✓	-	✓	-	-	✓	✓	✓	✓	-	✓	✓	✓
CO 4	✓	-	✓	-	✓	-	-	-	✓	✓	✓	✓	✓	✓	✓
CO 5	-	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-
CO 6	-	✓	-	✓	-	-	-	-	-	-	-	-	-	✓	-

XII JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	**PO'S PSO'S**	**Justification for mapping (Students will be able to)**	**No. of Key Competencies**
CO 1	PO 2	Analyze features of software by **identifying, formulating, reviewing** complex engineering problems there by reaching to conclusion by following principles of SDLC.	10
	PO 5	Make use of appropriate design techniques and **Modern Engineering IT tools** for developing the software.	1

	PO 9	Function effectively as an **individual or a team member** in the software development process.	10
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation with the engineering community by having major focus on clarity on content, **Grammar/Punctuation with appropriate References, good Speaking style and depth in subject matter.**	5
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	5
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	1
CO 2	PO 1	Compare process models, approaches and techniques to manage a given software development process by using the **mathematical principles and computer science methodologies.**	3
	PO 2	**Understand** the given problem and **system definition, problem formulation, collecting data, modelling, solution development** for specifying structure and interaction of objects during runtime.	10
	PO 5	Make use of appropriate design techniques and **Modern Engineering IT tools** for developing the software.	1
	PO 8	**Apply ethical principles** and commit to professional ethics and responsibilities.	3
	PO 9	Function effectively as an **individual or a team member** in the software development process.	12
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation with the engineering community by having major focus on clarity on content, **Grammar/Punctuation with appropriate References, good Speaking style and depth in subject matter.**	5
	PO 12	Recognize the need for **advanced concepts** , testing technologies for developing applications through **continuing education efforts with ongoing learning** – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	7
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	2
	PSO 2	**M**ake use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2

	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 3	PO 1	Understand the concept of Earned Value Analysis (EVA) to measure the projects progress at any given point in time by applying **mathematical principles and computer science methodologies**	1
	PO 2	Understand the key issues in **problems identification and formulation, data collection, model translation, validation, interpretation of results and documentatio**n in optimizing business decisions.	1
	PO 3	**Design** the software by making sure it fits for purpose for all aspects of the problem for modeling simple to complex engineering activities with understanding requirements and limitations of user.	10
	PO 5	Make use of appropriate design techniques and **Modern Engineering IT tools** for developing the software.	1
	PO 8	**Apply ethical principles** and commit to professional ethics and responsibilities.	3
	PO 9	Function effectively as an **individual or a team member** in the software development process.	12
	PO 10	Communicate in written form by comprehending and writing effective reports and design documentation with the engineering community by having major focus on clarity on content, **Grammar/Punctuation with appropriate References, good Speaking style and depth in subject matter.**	5
	PO 11	Classify the key issues in terms of **defining various problems, customer and user needs, cost effective and creative solutions, design process, economic context and management techniques.**	8
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems. .	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 4	PO 1	Explain the concept of data dictionary process and querying the software by applying **mathematical principles and computer science methodologies**	3
	PO 3	Understand the **problem and develop solutions using different data technologies and document the results for interpretation**	10
	PO 5	Make use of appropriate design techniques and **Modern Engineering IT tools** for developing the software.	1

	PO 9	Function effectively as an **individual or a team member** in the software development process.	12
	PO 10	Communicate effectively in orally and written by comprehend and write effective **reports and design documentation with the**	5
	PO 11	Classify the key issues in terms of **defining various problems, customer and user needs, cost effective and creative solutions, design process, economic context and management techniques.**	8
	PO 12	Recognize the need for **advanced concepts** , testing technologies for developing applications through **continuing education efforts with ongoing learning** – stays up with industry trends/ new technology and continued personal development in the broadest context of technological change.	7
	PSO 1	**B**uild suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	6
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 5	PO 3	Understand the **problem and develop solutions using different data technologies and document the results for interpretation**	2
	PO 6	Awareness of the framework of relevant legal requirements governing engineering activities including **personnel,health,safety and risk issues**	1
CO 6	PO 2	Understand the key issues in **problems identification and formulation, data collection, model translation, validation, interpretation of results and documentatio**n in optimizing business decisions.	1
	PO 4	Understand the **experimental designs** and development of project analysis and development of software requirement Specifications.	2
	PSO 2	**F**ocus on improving software reliability, network security or information retrieval systems.	2

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	Program Outcomes/ No. of Key Competencies Matched												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	-	10	-	-	1	-	-	-	10	5	-	-	5	2	1
CO 2	3	10	-	-	1	-	-	3	12	5	-	7	2	2	2

CO 3	1	1	10	-	1	-	-	3	12	5	8	-	3	2	2
CO 4	3	-	10	-	1	-	-	-	12	5	8	7	6	2	2
CO 5	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-
CO 6	-	1	-	2	-	-	-	-	-	-	-	-	-	2	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	-	100	-	-	100	-	-	-	83.3	100	-	-	83.3	100	50.0
CO 2	100	100	-	-	100	-	-	100	100	100	-	87.5	33.3	100	100
CO 3	33.3	10.0	100	-	100	-	-	100	100	100	66.6	-	50.0	100	100
CO 4	100	-	100	-	100	-	-	-	100	100	66.6	87.5	100	100	100
CO 5	-	-	20.0	-	-	20.0	-	-	-	-	-	-	-	-	-
CO 6	-	10.0	-	18.1	-	-	-	-	-	-	-	-	-	100	-

XV COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\ \% < C < 60\%$ –Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	-	3	-	-	3	-	-	-	3	3	-	-	3	3	2
CO 2	3	3	-	-	3	-	-	3	3	3	-	3	1	3	3
CO 3	1	1	3	-	3	-	-	3	3	3	3	-	2	3	3
CO 4	3	-	3	-	3	-	-	-	3	3	3	3	3	3	3
CO 5	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO 6	-	1	-	1	-	-	-	-	-	-	-	-	-	3	-
TOTAL	7	8	7	1	12	1	-	6	12	12	6	6	9	15	11
AVERAGE	2.3	2	2.3	1	3.0	1.0	-	3.0	3.0	3.0	3.0	3.0	2.2	3.0	2.7

XVI ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

XVII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XVIII SYLLABUS:

MODULE I	**SOFTWARE PROCESS AND PROJECT MANAGEMENT**
	Software process and project management: Introduction to software engineering, software process, perspective and specialized process models; Software project management: Estimation: LOC and FP based estimation, COCOMO model; Project scheduling: Scheduling, earned value analysis, risk management.
MODULE II	**REQUIREMENT ANALYSIS AND SPECIFICATION**
	Requirement Analysis and Specification: Software requirements: Functional and nonfunctional, user requirements, system requirements, software requirements document; Requirement engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management; Classical analysis: Structured system analysis, petri nets, data dictionary.
MODULE III	**SOFTWARE DESIGN**
	Software Design: Design process: Design concepts, design model, design heuristic, architectural design, architectural styles, accessing alternative architectural designs, and architectural mapping using data flow. User interface design: Interface analysis, interface design; Component level design: Designing class based components, traditional components.
MODULE IV	**TESTING AND IMPLEMENTATION**
	Testing and Implementation : Software testing fundamentals: Internal and external views of testing, white box testing, basis path testing, control structure testing, black box testing, regression testing, unit testing, integration testing, validation testing, system testing and debugging; Software implementation techniques: Coding practices, refactoring.
MODULE V	**PROJECT MANAGEMENT**
	Project Management: Estimation: FP based, LOC based, make/buy decision; COCOMO II: Planning, project plan, planning process, RFP risk management, identification, projection; RMMM: Scheduling and tracking, relationship between people and effort, task set and network, scheduling; EVA: Process and project metrics.

TEXTBOOKS

1. Roger S. Pressman, “Software Engineering – A Practitioner's Approach”, McGraw-Hill International Edition, 7th Edition, 2010.
2. Ian Somerville, “Software Engineering”, Pearson Education Asia, 9th Edition, 2011.

REFERENCE BOOKS:

1. Rajib Mall, “Fundamentals of Software Engineering”, PHI Learning Private Limited, 3rd Edition, 2009.

2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 1st Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1

COURSE WEB PAGE:

1. lms.iare.ac.in

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Institutions adopting OBE try to bring changes to the curriculum by dynamically adapting to the requirements of the different stakeholders like Students, Parents, Industry Personnel and Recruiters. OBE is all about feedback and outcomes. In this we will discuss about the course outcomes and program outcomes and their attainment		
CONTENT DELIVERY (THEORY)			
1	Introduction to Software Engineering	CO1	T2: 1.1-1.3
2	Software processes and Project Management	CO1	T1: 2.2-2.3
3	Process models	CO1	T1: 2.1,2-3-2.6
4	Software Project Management	CO1	R2: 3.4-3.9
5	LOC and FP based estimation COCOMO model	CO6	R2: 4.1-4.3
6	Project Scheduling, EVA	CO5	T1: 27.1
7	Risk management	CO5	T1: 28.1
8	Software Requirement Analysis and Specification	CO2	T2: 4.1-4.3
9	Software Requirements: Functional ,Non functional	CO2	T1: 4.4-4.7
10	User requirements,System requirements	CO2	T1: 1.1-1.4
11	Requirements engineering process	CO2	T1: 4.4-4.7
13	Requirements Elicitation and analysis	CO3	T1: 4.4-4.7
14	Requirements management,petri nets,Data Dictionary	CO3	T1:11.1,11.3-11.4
15	Software design: Design process and design concepts	CO3	T1 8.1-8.4
16	Architectural Design and Styles	CO2	T1 8.1-8.4

17	User interface Design, Interface analysis	CO4	T1:10.1-10.3
18	Component Level Design	CO4	T1: 14.2-14.6.,
19	Designing class based components	CO4	T1:26.1-26.3 28.1-28.7
20	Traditional Components	CO3	T1:16.1-16.6
21	Testing and Implementation	CO4	T1:18.1-18.6
22	Internal and external views of testing	CO4	T1:9.1, 9.3,9.4,9.6
23	White box and basic path testing	CO4	T1:20.1-20.6
24	Black box and Unit testing	CO4	T1:22.1-22.6
25	Integration and Validation testing,Debugging	CO4	T1:23.1-23.6
26	Software Implementation techniques	CO4	T1:17.3
27	Coding practices , Refactoring	CO4	T1:28.1-28.6
28	Project Management	CO5	T1:25.2-25.3
29	Estimation: FP and LOC based, make/buy decision	CO5	T1:29.1-29.4
30	COCOMO II: Planning	CO5	T1:25.1-25.4
31	RFP Risk Management	CO5	T1:25.3-25.4
32	Identification,Projection	CO5	T1:26.1-26.3
33	RMMM:Scheduling and tracking	CO5	T1:28.1-28.2
34	Relation between people and effort	CO5	T1:27.1-27.2
35	Task set and network	CO5	T1:25.1-25.6
36	Scheduling	CO6	T1:25.1-25.2
37	EVA: Process and Project metrics	CO6	T1:25.1-25.3
38	Project Metrics	CO6	T1:25.1-25.6
CASE STUDIES			
1	Develop a set of actions for the communication activity. Select one action and define a task set for it.	CO 6	T1:11.2.1
2	Developing software in which quality is “good enough”	CO 6	T1:11.2.2

3	Explain why systems developed as prototypes should not normally be used as production systems.	CO 6	T1:11.2.18
4	Software myth	CO 6	T1:11.2.25
5	layered technology of software engineering.	CO 6	T1:11.4.1
6	Software myth.	CO 6	T1:11.4.2
7	Evolutionary process models	CO 6	R2:7.5
8	Spiral model	CO 6	R2:7.5
4	concurrent development model (or) concurrent engineering model.	CO 6	R2:7.5
10	layers of software engineering.	CO 6	R2:7.5
11	COCOMO model.	CO 6	T1:11.4.1
12	component level design and deployment level design elements.	CO 6	T1:11.4.2
13	software architecture	CO 6	T1:11.5.1
14	system representation in architectural context	CO 6	T1:11.5.2
15	Coupling and Cohesion in designing class based components. s	CO 6	T2:7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definations of Software Process and Poject Management	CO 1	R1:2.1-2.11
2	Definations of Requirement Analysis and Specification	CO 2, 3	R1:4.2-4.11
3	Definations of Software Design	CO 4	R2:5.6-5.9
4	Definations of Testing and Implementation	CO 5	R4:8.1-8.9
5	Definations of Project Management	CO 6	R2:12.1-12.16
DISCUSSION OF QUESTION BANK			
1	Software Process and Poject Management	CO 1,	R1:2.1-2.11
2	Requirement Analysis and Specification	CO 2, 3	R1:4.2-4.11
3	Software Design	CO 4	R2:5.6-5.9
4	Testing and Implementation	CO 5	R4:8.1-8.9
5	Project Management	CO 6	R2:12.1-12.16

Signature of Course Coordinator **HOD,CSE(DS)**
Ms. G Nishwitha, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Computer Science and Engineering (Data Science)**				
Course Title	**Data Wrangling with Python**				
Course Code	ACDC05				
Program	B. Tech				
Semester	FIVE				
Course Type	CORE				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Dr M V Krishna Rao, Professor, CSE dept				

I COURSE PRE-REQUISITES

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming
B.Tech	ACSC02	I	Python Programming Laboratory
B.Tech	ACDC01	III	Principles of Data Science
B.Tech	ACDC02	III	Data Science Laboratory

II COURSE OVERVIEW

Data wrangling is the process of cleaning and unifying messy and complex data sets for easy access and analysis. This course describes the importing of data from CSV and PDF files, data clean-up tasks such as elimination of bad data, duplicates and outliers, and data conditioning steps such as normalization and standardization. The course also discusses the data exploration for correlations and associations, and for providing statistical summaries of the given data. Several data visualizations such as plots, charts, maps, tables are also discussed. Finally, the principles of web scraping, web crawlers and spiders are presented. The knowledge and skills gained in this course are prerequisites for full-fledged data analysis.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Wrangling with Python	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES

✓	Power Point Presentations	✓	Chalk & Talk	x	Assignments	x	MOOC
✓	Concept Videos	✓	Tech talk	x	Miniproject	x	Videos
x	Complex Problem Solving	x	Others				

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), and 10 marks for Alternative Assessment Tool (AAT).

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.
The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
15%	Remember
35%	Understand
35%	Apply
15 %	Analyze

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks, with 20 marks for continuous internal examination (CIE) and 10 marks for Alternative Assessment Tool (AAT).

Component		Marks	Total Marks
CIA	Continuous Internal Examination – 1 (Mid-term)	10	30
	Continuous Internal Examination – 2 (Mid-term)	10	
	AAT-1	5	
	AAT-2	5	
SEE	Semester End Examination (SEE)	70	70
Total Marks			100

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively for 10 marks each of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered.

Alternative Assessment Tool (AAT)
This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
50%	50%	0%

VI COURSE OBJECTIVES

The students will try to learn:

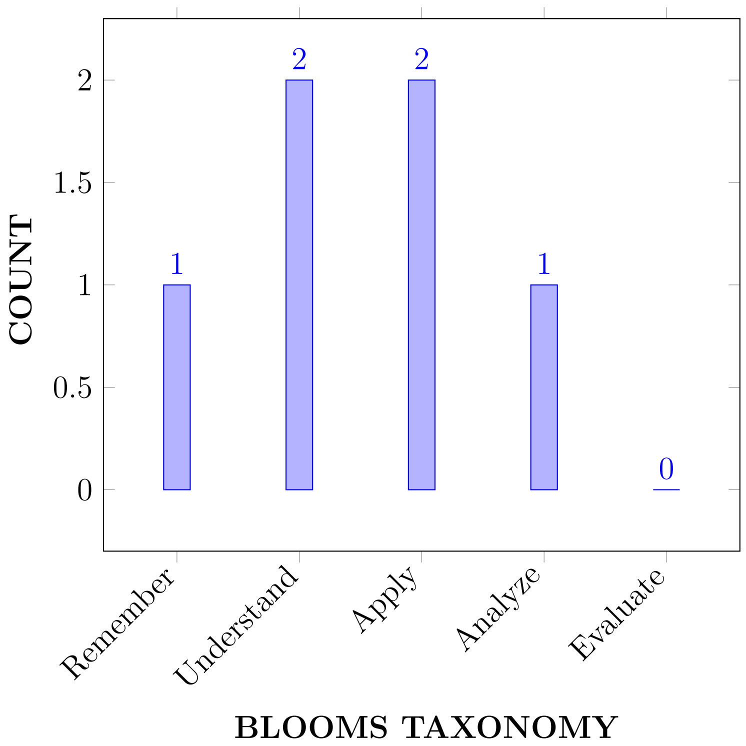
I	The concept and importance of data wrangling using Python.
II	The data cleaning and formatting techniques using Python.
III	The working with Excel, PDF and with non-relational database not supported by SQL using python.
IV	The application of techniques suitable for Web mining applications.

VII COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	**Outline** the concept of and the steps in data wrangling process and the python basics necessary for implementing the data wrangling.	Remember
CO 2	**Summerize** the parsing approaches of the Excel as well as PDF Files for devising techniques to deal with uncommon file types.	Understand
CO 3	**Distinguish** between MySQL/PostgreSQL and NoSQL for storing and acquiring of data to and from the relational and the non-relational databases respectively.	Analyze
CO 4	**Explain** the operations involved in formatting and cleaning the data using Python for subsequent data analysis.	Understand
CO 5	**Make use of** python libraries for identifying outliers and correlations in the data, and visualizing the same efficiently.	Apply
CO 6	**Choose** appropriate method of web scraping and crawling based on web site model for acquring and storing data from world web within python framework.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:**Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	SEE / CIE / AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	2	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	1	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X PROGRAM SPECIFIC OUTCOMES

Program Specific Outcomes	
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.
PSO 2	Focus on improving software reliability, network security or information retrieval systems.
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions

XI HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	SEE / CIE / AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	SEE / CIE / AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

XII MAPPING OF EACH CO WITH PO(s),PSO(s)

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-
CO 4	-	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 5	-	✓	-	-	✓	-	-	-	-	✓	-	-	-	✓	-
CO 6	-	-	✓	-	✓	-	-	-	-	-	-	-	-	-	✓

XIII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT

Course Outcome	PO PSO	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Recall the concepts of probability and statistics (**mathematics**) and programming basics of python (**engineering fundamentals**) useful for data wrangling analytics (**an engineering specialization**.	3
CO 2	PO 2	Understand the techniques of parsing Excel and PDF data (**engineering sciences**), **review** the available parsing techniques, **select** and/or **formulate** appropriate for parsing uncommon file types (**complex engineering problem**).	5
	PO 5	Identify python libraries for parsing Excel and PDF data, **select**, **devise** and/or **apply appropriate IT tools** and **resources** for parsing uncommon file types (Identify python libraries for parsing Excel and PDF data, select, devise and/or apply appropriate IT tools and resources for parsing uncommon file types (complex engineering activity) with the knowledge of limitations.) with the **knowledge of limitations**.	5

Course Outcome	PO PSO	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 5	Experiment with MySQL and PostgreSQL (**appropriate techniques, IT tools**) and with relational and the non-relational databases (**resources**) for data acquisition and storage.	3
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	4
CO 4	PO 2	**Review**, **Identify** and **analyse** the data format to transform from machine readable to human readable (**principles of mathematics**), identify (**complex engineering problem**) and clean the data for inconsistencies (**engineering sciences**)and prepare the data for subsequent data analysis using Python libraries.	6
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. .	2
CO 5	PO 2	Apply python libraries (**solution implementation**), to remove outliers in the data (**modelling**), carry out explorative analysis (**complex engineering problem**) using Pearson correlation.	3
	PO 5	Make use of python libraries (**IT tools**) for identifying outliers and correlations in the data, and visualizing the same efficiently.	1
	PO 10	Visually publish (**clarity**) and explain (**oral skills**) the analysis results (**subject matter**) to all stake holders involved in the project or process.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3
CO 6	PO 3	Design **innovative** web scraper and spiders (**web engineering tools**) for multiple web site models (**complex engineering problem**) with **optimal resources** ensuring the **fitness** of technique **meeting specified needs** for acquiring data from world web within python framework with the knowledge of copyright and proprietorship rights (**legal aspects**) of the data being scrapped.	7
	PO 5	Choose appropriate python method of web scraping and crawling based on web site model (**IT tools**) for acquiring and storing data from world web with optimal resources.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions .	3

Note: For Key Attributes refer **Annexure - I**

XIV TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO / PSO) MAPPING

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	2	3	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	5	-	-	5	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	3	-	-	-	-	-	-	-	2	-	-
CO 4	-	6	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	3	-	-	1	-	-	-	-	3	-	-	-	3	-
CO 6	-	-	7	-	1	-	-	-	-	-	-	-	-	-	3

XV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO) MAPPING

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	2	3	3
CO 1	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	50	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	60	-	-	-	-	-	-	-	100	-	-
CO 4	-	60	-	-	-	-	-	-	-	-	-	-	100	-	-
CO 5	-	30	-	-	20	-	-	-	-	30	-	-	-	100	-
CO 6	-	-	7	-	20	-	-	-	-	-	-	-	-	-	100

XVI COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	**Program Outcomes**												**PSO'S**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	2	3	3
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO 4	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 5	-	1	-	-	1	-	-	-	-	1	-	-	-	3	-
CO 6	-	-	3	-	1	-	-	-	-	-	-	-	-	-	3
TOTAL	3	5	3	-	8	-	-	-	-	1	-	-	6	3	3
AVERAGE	3	1.67	3	-	2	-	-	-	-	1	-	-	3	3	3

XVII ASSESSMENT METHODOLOGY - DIRECT

CIE examinations	✓	SEE examinations	✓	Assignments	×
Quiz	×	Tech - Talk	✓	Certification	×
Term Paper	×	Seminars	×	Student Viva	×
Laboratory Practices	×	Concept Video	✓	Complex problem solving	×
Micro Projects	×	-	-	-	-

XVIII ASSESSMENT METHODOLOGY - INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✓	Assessment of activities / Modeling and Experimental Tools in Engineering by Experts		

XIX SYLLABUS

MODULE I	INTRODUCTION TO DATA WRANGLING (09)
	What Is Data Wrangling? Importance of Data Wrangling, how is Data Wrangling performed? Tasks of Data Wrangling, Data Wrangling Tools, Introduction to Python, Python Basics, Data Meant to Be Read by Machines, CSV Data, JSON Data, XML Data.

MODULE II	**WORKING WITH EXCEL FILES AND PDFS (09)**
	Installing Python Packages, Parsing Excel Files, Getting Started with Parsing, PDFs and Problem Solving in Python, Programmatic Approaches to PDF Parsing, Converting PDF to Text, Parsing PDFs Using pdf miner, Acquiring and Storing Data, Databases: A Brief Introduction-Relational Databases: MySQL and PostgreSQL, Non-Relational Databases: NoSQL, When to use a Simple File, Alternative Data Storage.
MODULE III	**DATA CLEANUP (09)**
	Why Clean Data? Data Cleanup Basics, Identifying Values for Data Cleanup, Formatting Data, Finding Outliers and Bad Data, Finding Duplicates, Fuzzy Matching, RegEx Matching. Normalizing and Standardizing the Data, Saving the Data, determining suitable Data Cleanup, Scripting the Cleanup, Testing with New Data.
MODULE IV	**DATA EXPLORATION AND ANALYSIS (09)**
	Exploring Data, Importing Data, Exploring Table Functions, Joining Numerous Datasets, Identifying Correlations, Identifying Outliers, Creating Groupings, Analyzing Data - Separating and Focusing the Data, Presenting Data, Visualizing the Data, Charts, Time-Related Data, Maps, Interactives, Words, Images, Video, and Illustrations, Presentation Tools, Publishing the Data - Open-Source Platforms.
MODULE V	**WEB SCRAPING (09)**
	What to Scrape and How, analyzing a Web Page, Network/Timeline, interacting with JavaScript, In-Depth Analysis of a Page, Getting Pages, Reading a Web Page - Reading a Web Page with LXML and XPath, Advanced Web Scraping - Browser-Based Parsing, Screen Reading with Selenium, Screen Reading with Ghost.Py, Spidering the Web - Building a Spider with Scrapy, Crawling Whole Websites with Scrapy.

TEXTBOOKS

1. Jacqueline Kazil and Katharine Jarmul,” Data Wrangling with Python”, O’Reilly MediaInc., 2016.

REFERENCE BOOKS

1. Dr. Tirthajyoti Sarkar, Shubhadeep,” Data Wrangling with Python: Creating actionable data from raw sources”, Packt Publishing Ltd., 2019.
2. Stefanie Molin,” Hands-On Data Analysis with Pandas”, Packt Publishing Ltd.,2019
3. Allan Visochek,” Practical Data Wrangling”, Packt Publishing Ltd., 2017
4. TyeRattenbury, Joseph M. Hellerstein, Jeffrey Heer, Sean Kandel, Connor Carreras,”Principles of Data Wrangling: Practical Techniques for Data Preparation”, O’Reilly Media Inc., 2017.

WEB REFERENCES

1. http://www.gbv.de/dms/ilmenau/toc/827365454.pdf
2. https://www.udemy.com/course/data-wrangling-with-python/
3. http://www.openculture.com/free-online-data-science-courses
4. https://www.classcentral.com/course/dataanalysiswithpython-11177

XX COURSE PLAN

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
0	Course Description: Program Outcomes (PO), Course Objectives, Course Outcomes (CO) and CO-PO Mapping	-	-
CONTENT DELIVERY (THEORY)			
1	Introduction to Data Wrangling, Tasks in Data Wrangling, Data wrangling tools	CO 1	T1: 1.1
2	Python basics: basic data types & data containers	CO 1	T1: 2.1
3	Python basics: helpful tools: type, dir, and help.	CO 1	T1: 2.2
4	Data meant to be read by machines: CSV data, JSON Data	CO 1	T1: 3.1
5	Data meant to be read by machines: XML Data.	CO 1	T1: 3.2
6	Installing python packages, setting up python on your machine.	CO1	T1: 4.1-4.2
7	Getting Started with Parsing.	CO 2	T1: 4.3
8	Parsing Excel files: range, counter & indexing.	CO 2	T1: 4.4
9	Programmatic approaches to PDF parsing: slate package.	CO 2	T1: 5.1
10	Parsing PDFs Using pdf miner, PDF to text conversion.	CO 2	T1: 5.2-5.3
11	Automating the data checking.	CO 2	T1: 5.4
12	Solving of problem in PDF parsing & uncommon file formats.	CO 2	T1: 5.5-5.6
13	Acquiring data: where to find data.	CO 2	T1: 6.1
14	Case studies: data examination.	CO 2	T1: 6.2
15	Relational databases: MySQL and PostgreSQL.	CO 3	T1:6.3-6.4
16	Non-relational databases: NoSQL, Local databases with python.	CO 3	T1: 6.5-6.6
17	Data storage: Local, Cloud, HDF and Hadoop.	CO 3	T1: 6.7-6.9
18	Data cleanup basics: Identifying values for data clean-up & Formatting data.	CO 4	T1: 7.1-7.2
19	Data cleanup basics: Finding outliers, bad data & duplicates.	CO 4	T1: 7.3-7.4
20	Data cleanup basics: Fuzzy matching & RegEx matching.	CO 4	T1: 7.5-7.6
21	Normalizing and standardizing data, Saving Data & Determining suitable data clean-up method	CO 4	T1: 8.1-8.3
22	Scripting the clean-up & Testing with new data with python standard library.	CO 4	T1: 8.4-8.5
23	Introduction to data exploration & Importing of data of various formats.	CO 5	T1: 9.1-9.2
24	Exploring table functions	CO 5	T1: 9.3
25	Joining numerous datasets.	CO 5	T1: 9.4

26	Identifying correlations and Outliers.	CO 5	T1: 9.5-9.6
27	Creating groupings of the data.	CO 5	T1: 9.7
28	Separating and focusing the data.	CO 5	T1: 9.8
29	Visualization of time-related data.	CO 5	T1: 10.1
30	Charts, maps, interactives, words.	CO 5	T1: 10.2
31	Images, video, and illustrations.	CO 5	T1: 10.3
32	Data presentation tools.	CO 5	T1: 10.4
33	Publishing the data - open-source platforms.	CO 5	T1: 10.5
34	What and how to scrape from a web page ?	CO 6	T1: 11.1
35	Analysing a Web Page: Markup structure, Network/Timeline.	CO 6	T1: 11.2-11.4
36	Analysing a Web Page: console-interacting, Page analysis, .	CO 6	T1: 11.5-11.9
37	Reading a web Page with LXML XPath.	CO 6	T1: 11.10-11.11
38	Browser based parsing: Screen reading with Selenium.	CO 6	T1: 12.1
39	Browser based parsing: Screen reading with Ghost.py	CO 6	T1: 12.2
40	Spidering and Crawling with Scrapy.	CO 6	T1: 12.3-12.4
PROBLEM SOLVING/ CASE STUDIES			
1	Intorduction to Data Wrangling, Tasks and Tools. Machine readable data	CO 1	T1: 1.1, T1: 3-4
2	Python programming basics	CO 1	T1: 2
3	Reading from Excel files	CO 2	T1: 3
4	Reading from PDF and unsupoorted formats	CO 2	T1: 4-5
5	Aquiring and Storing data: Relational and Non-relatinal databases.	CO 3	T1: 6
6	Formatting data & Data Clean-up: bad data and duplicates	CO 4	T1: 7.1-7.3
7	Data Clean-up: outliers.	CO 4	T1: 7.4
8	Data Clean-up: Fuzzy and RegEx matching	CO 4	T1: 7.5-7.6
9	Normalizing and standardizing data, Saving Data	CO 4	T1: 8.1-8.5
10	Table functions & Joining batabases	CO 4	T1: 9.1-9.4
11	Data Exploration, COrrelations & Statistical Summaries	CO 5	T1: 9.5-9.8
12	Data Visualization: charts & plots	CO 5	T1: 10.1-10.2
13	Data Visualization: Maps, Interactives, words, images.	CO 5	T1: 10.3-10.4
14	Browser based parsing, LXML & Xpath.	CO 5	T1: 11
15	Web crawlers and spiders	CO 6	T1: 12

DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction to Data Wrangling &Python Basics.	CO 1	T1:1-3
2	Working with Excel, PDF, and Nonstandard format files.	CO 2, CO 3	T1:4-6
3	Cleaning up, Formatting, Normalizing, Standardizing and Saving of data.	CO 4	T1:7-8
4	Exploration, Analysis and Visualization of data.	CO 5	T1: 10
5	Scraping, Crawling and Spidering the web data.	CO 6	T1:11-12
DISCUSSION OF QUESTION BANK			
1	Introduction to Data Wrangling &Python Basics.	CO 1	T1:1-3
2	Working with Excel, PDF, and Nonstandard format files.	CO 2, CO 3	T1:4-6
3	Cleaning up, Formatting, Normalizing, Standardizing and Saving of data.	CO 4	T1:7-8
4	Exploration, Analysis and Visualization of data.	CO 5	T1:9-10
5	Scraping, Crawling and Spidering the web data.	CO 6	T1:11-12

Signature of Course Coordinator **HOD,CSE(DS)**

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences **(Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations **(Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions 5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	**10**

PO 4.	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**

PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project. 6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	**12**
PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**

PO11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**
PO12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

ANNEXURE - II

KEY ATTRIBUTES FOR ASSESSING PROGRAM SPECIFIC OUTCOMES

PSO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PSO 1	Develop programming skills for software development in general and for data analysis in particular. **(Software Development).** 1. Acquire computer programming skills 2. Ability to work on SQL (relational) databases 3. Ability to work on noSQL (non-relational) databases 4. Acquire the knowledge of principles of Data Analytics	**4**
PSO 2	Acquire professional skills to build statistical models and techniques to visualize and analyse large real-world data sets in data science applications. (**Statistical Modelling).** 1. Acquire the knowledge of steps involved in data wrangling process 2. Understand the data science applications 3. Develop statistical models for real-world multi-dimensional data 4. Ability to visually represent the data in a meaningful way 5. Ability to explore the data for patterns, correlations and associations. 6. Identify and formulate the data science applications in multi-disciplinary areas of work 7. Identify and formulate the data science applications in inter-disciplinary areas of work	**7**
PSO 3	Acquire professional software skills required for Web mining applications towards multi-disciplinary problem solving. (**Web Mining)).** 1. Acquire the knowledge of web site models 2. Acquire the knowledge of web mining techniques 3. Ability to design web scarpers 4. Ability to design web crawlers and spiders	**4**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**COMPUTER SCIENCE AMD ENGINERING(Data Science)**				
Course Title	**IMAGE PROCESSING AND ANALYASIS**				
Course Code	ACDC08				
Program	B.Tech				
Semester	V				
Course Type	ELECTIVE - I				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Course Coordinator	Dr. B. Polaiah, Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

II COURSE OVERVIEW:

The course is deliberate to provide image processing fundamentals, sampling, image acquisition and histogram processing. Image segmentation techniques, restoration models and the applications of enhancement, morphology, and classification, visualization of 2D and 3D images.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
IMAGE PROCESSING AND ANALYASIS	70 Marks	30 Marks	100

IV CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Power Point Presentations	✓	Chalk & Talk	✓	Assignments	x	MOOC
x	Open Ended Experiments	x	Seminars	x	Mini Project	✓	Videos
✓	Quiz	x	Others				

V EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
0%	Remember
35%	Understand
35%	Apply
30 %	Analyze

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Component	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8^{th} and 16^{th} week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 50 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc. The AAT chosen for this course is given in table

Concept Video	Tech-talk	Complex Problem Solving
40%	40%	20%

VI COURSE OBJECTIVES:

The students will try to learn:

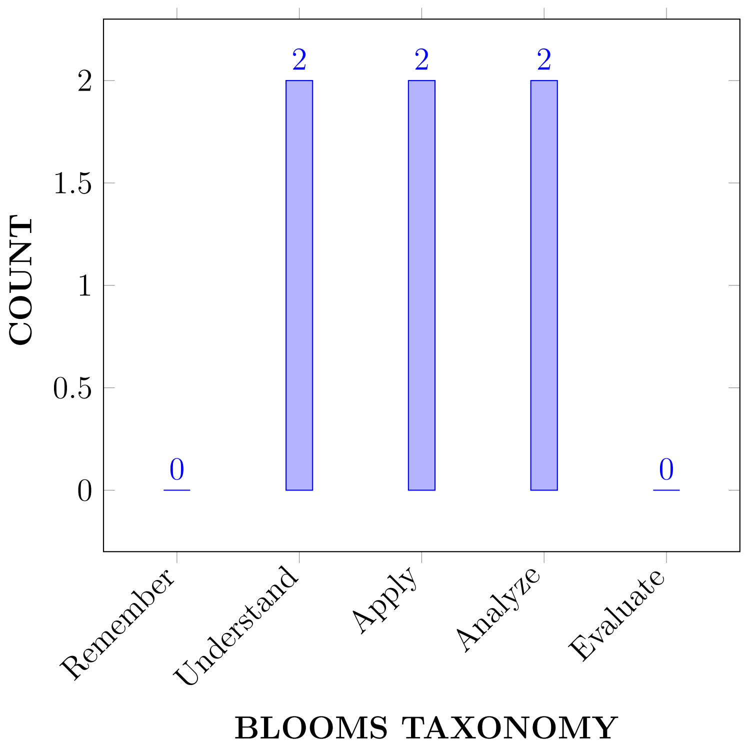
I	Image processing concepts, analysis and techniques.
II	The image analysis and its classifications.
III	Visualization of different kinds of images.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Understand** the principles of image processing and techniques for describing the Digital Imaging System (DIS).	Understand
CO 2	**Analyze** various techniques for image enhancement and develop image restoration models.	Analyze
CO 3	**Apply** image segmentation methods for transforming the image and conduct Image Morphology.	Apply
CO 4	**Apply** image segmentation techniques for the classification of image using the features of the image.	Apply
CO 5	**Understand** the different techniques for image registration.	Understand
CO 6	**Analyze** the Visualization methods and apply them for 2D and 3D images.	Analyze

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE/CIE/ Quiz/AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	SEE/CIE, Quiz/AAT
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	1	SEE/CIE, Quiz/AAT
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	SEE /CIE, Quiz/AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	1	TECH TALK/ CONCEPT VIDEOS
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.		

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build the Embedded software tool for the development platform of computer vision, embedded systems, and image processing applications.	2	SEE, PROJECTS

3 = High; 2 = Medium; 1 = Low

XI MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	✓	-	-	✓	-	-
CO 3	✓	✓	✓	✓	-	-	-	-	-	✓	-	✓	✓	-	-
CO 4	✓	✓	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	✓	-	✓	-	-	-

XII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT:

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Illustrate the principles of the Digital Image Processing terminology **(knowledge)** for understanding image and its representation, pixel, intensity, gray level, relationship between the pixels by applying the principles of **engineering science to complex engineering problems**	2
	PO 10	**Effective presentation and Speaking Style** on sampling and quantization and **write Subject Matter Effectively** the difference between analog and digital images.	4
CO 2	PO 1	**Develop a image with various** image transform properties types and its types using **Scientific principles and methodology fundamental mathematics.**	3
	PO 2	**Formulate and analyze (Problem analysis) complex Engineering problems** for image transforms using **first principles of mathematics and Engineering sciences.**	5
	PO 10	**Effective presentation and Speaking Style** on properties of transforms and **write Subject Matter Effectively** on types of transforms.	4
	PSO 1	**Design of experiments** on image transforms **with project development and execution process** of **modern** tools such as MATLAB with image processing tool box, python, CV2.	2
CO 3	PO 1	**Illustrate the principles of an image find by using engineering** techniques for image enhancement by using **mathematical methods.**	2
	PO 2	**Illustrate** the filter processing **model translation** for spatial domain and **formulate** the time domain filter.	2
	PO 3	**Develop** a histogram techniques **complex engineering problem with appropriate considerations** and environmental considerations for image enhancement.	5

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 4	**Demonstrate** the **Use** image enhancement **analyze and interpretation and Ability to apply quantitative methods** in frequency domain processing technique to **provide valid** digital image.	7
	PO 10	**Effective presentation and Speaking Style** on histogram processing **Write Subject Matter Effectively** on manipulation technique of an digital image.	4
	PO 12	**Recognize the need for** the image segmentation in different image applications and **ability to improve** the enhancement algorithms in the broadest context of **technological advancements.**	6
	PSO 1	**Design of experiments with project development and execution** modern tools such as MATLAB with image processing tool box, python, CV2.	6
CO 4	PO 1	Distinguish the image restoration in the spatial and frequency domains **(knowledge)** to remove the noise present the image by applying the principles of **(mathematics, engineering science for complex engineering problems.**	2
	PO 2	Formulate and analyze **(Problem analysis) complex Engineering problems** for image restoration using first principles of **mathematics and Engineering sciences**	5
	PO 3	**(Develop** spatial and frequency domain techniques **complex engineering problem with appropriate considerations** and **environmental considerations** for image restoration.	4
	PO 4	Understand the image restoration in the spatial and frequency domains **(knowledge)** methods **including design of experiments, analysis of complex problems.**	4
	PO 10	**Effective presentation and Speaking Style and write** on degradation models and noise sources for image restoration of digital images	3
	PSO 1	**Design of experiments with project development and execution** image restoration with modern tools such as MATLAB with image processing tool box, python, CV2.	2
CO 5	PO 1	**Interpret** Image Segmentation and formulate representation techniques to apply **Mathematical principles fundamental mathematics.**	3
	PO 2	**Apply Problem statement** the segmentation techniques for edge linking and boundaries by using **principles of mathematics and formulate** segmentation techniques.	3
	PO 10	**Effective presentation and Speaking Style and write on** image segmentation techniques.	3

Course Outcomes	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key competencies matched.
	PO 12	**Recognize** the **need** for image Segmentation technique, and **broadest context of technological change in digital image and advanced engineering concepts.**	6
	PSO1	**Design of experiments with project development and execution** image segmentation with modern tools such as MATLAB with image processing tool box, python, CV2.	2
CO6	PO 1	**Understand the** various source coding techniques and Interpret Image Compression standards using **engineering science and mathematical models.**	3
	PO 2	**Identify and analyze** fidelity criteria, image compression models **implement** using **engineering science, design system components** for source Encoder and decoder, error free compression and **model translation** using **principal of mathematics.**	5
	PO 10	**Present effectively** and **Clarity** source encoder and **write effectively subject matter** on decoder techniques.	4
	PO 12	**Recognize the ability** of image restoration algorithms for **life-long learning in the broadest context of** image processing.	4

XIII TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO/ PSO MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	3	5	-	-	-	-	-	-	-	2	-	-	2	-	-
CO 3	2	2	5	7	-	-	-	-	-	2	-	6	2	-	-
CO 4	2	5	5	4	-	-	-	-	-	2	-	-	2	-	-
CO 5	3	3	-	-	-	-	-	-	-	2	-	6	2	-	-
CO 6	3	5	-	-	-	-	-	-	-	2	-	4	-	-	-

XIV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO/ PSO

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0
CO 2	100	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	100	0.0	0.0
CO 3	66.6	20.0	50.0	63.6	0.0	0.0	0.0	0.0	0.0	40.0	0.0	50.0	100	0.0	0.0
CO 4	66.6	50.0	50.0	36.3	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	100	0.0	0.0

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	100	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	50.0	100	0.0	0.0
CO 6	100	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	33.3	0.0	0.0	0.0

XV COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation
1 -$5 < C \leq 40\%$ – Low/ Slight
2 - $40\ \% < C < 60\%$ –Moderate
3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	1	-	-	3	-	-
CO 3	3	1	2	3	-	-	-	-	-	1	-	2	3	-	-
CO 4	3	2	2	1	-	-	-	-	-	1	-	-	3	-	-
CO 5	3	1	-	-	-	-	-	-	-	1	-	2	3	-	-
CO 6	3	2	-	-	-	-	-	-	-	1	-	1	-	-	-
TOTAL	18	8	4	4	-	-	-	-	-	6	-	5	12	-	-
AVERAGE	3	1.6	2	2	-	-	-	-	-	1	-	1.6	3	-	-

XVI ASSESSMENT METHODOLOGY-DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	-	Tech-Talk	✓		

XVII ASSESSMENT METHODOLOGY-INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
x	Assessment of activities / Modeling and Experimental Tools in Engineering by Experts		

XVIII SYLLABUS:

MODULE I	**IMAGE PROCESSINGFUNDAMENTALS**
	Introduction – The Origins and fields of image processing – Steps in Digital Imaging System – Image Sensing and Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – color images and models - Image Operations – Arithmetic, logical, statistical and spatial operations
MODULE II	**IMAGE ENHANCEMENT AND RESTORATION**
	Basics of Intensity Transformation and Spatial functions – Intensity Transformation functions – Histogram Processing – Smoothing and Sharpening – Smoothing and Sharpening spatial filters – Homomorphic Filtering, Noise models, Constrained and Unconstrained restoration models.
MODULE III	**IMAGE SEGMENTATION AND MORPHOLOGY**
	Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.
MODULE IV	**IMAGE ANALYSIS AND CLASSIFICATION**
	Image segmentation- pixel based, edge based, region-based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification. Descriptors, Whole-image Features Object, Scale, Invariant Feature Transform (SIFT).
MODULE V	**IMAGE REGISTRATION AND VISUALISATION**
	Rigid body visualization, Principal axis registration, Interactive principal axis registration, feature based registration, Elastic deformation-based registration, Image visualization – 2D display methods, 3D displays methods, virtual reality based interactive visualization.

TEXTBOOKS

1. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Pearson Education, 3 rd Edition, 2008, New Delhi

2. S.Sridhar, "Digital Image Processing", Oxford University Press, 2011.

REFERENCE BOOKS:

1. . Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011,India

2. Anil J Jain, "Fundamentals of Digital Image Processing", PHI, 2006..

3. KavyanNajarian and Robert Splerstor, "Biomedical signals and Image processing",CRC – Taylor and Francis, New York, 2006

4. Somka, Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning, 1st Edition, 2008.

5. Adrain Low, "Introductory Computer vision Imaging Techniques and Solutions", Tata McGraw-Hill, 2nd Edition, 2008.

6. John C. Russ, J. Christian Russ, "Introduction to Image Processing & Analysis", CRC Press, 1st Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117105135
2. https://www.academia.edu/18324189/DigitalImageProcessing usingMatlabGonzalez.
3. https://pdfs.semanticscholar.org/15bd/427a1a5f9bc57a7f67fb1b1fc85c5bb39f46.pdf
4. https://www.udemy.com/topic/digital-image-processing
5. https://www.edx.org/course/image-processingand-analysis-for-life-scientists

COURSE WEB PAGE:

XIX COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Introduction to Image Processing	CO 1	T1:1.4-1.5
2	The Origins of image processing	CO 1	T1:1.4-1.5
3	The fields of image processing	CO 1	T1:2.4-2.5
4	Relationship between pixels	CO 1	T1:2.4-2.5
5	Steps in Digital Imaging System	CO 1	T1:2.4-2.5
6	Image Sensing and Acquisition	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
7	Sampling and Quantization, Pixel Relationships	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
8	Color images and models, Image Operations	CO 2	T1:3.1-3.6
9	Arithmetic, logical	CO 2	T1:3.1-3.6
10	Statistical and spatial operations	CO 2	T1:3.1-3.6
11	Basics of Intensity Transformation and Spatial functions	CO 2	T1:3.1-3.6

12	Introduction to image enhancement	CO 3	T1:3.1-3.6
13	Intensity Transformation functions	CO 3	T1:3.1-3.6
14	Histogram Processing, Smoothing and Sharpening spatial filters	CO 3	T1:3.1-3.8
15	Homomorphic Filtering, Noise models	CO 3	T1:3.1-3.8
16	Types of restoration models	CO 3	T1:3.1-3.8
17	Introduction to Image Segmentation and Morphology	CO 3	T1:3.1-3.8; R2: 7.4-7.5
18	Detection of Discontinuities,Edge Operators	CO 3	T1:3.1-3.8; R2: 7.4-7.5
19	Edge Linking and Boundary Detection	CO 3	T1:3.1-3.8; R2: 7.4-7.5
20	Threshold and Region Based Segmentation for image enhancement	CO 3	T1:3.1-3.8; R2: 7.4-7.5
21	Motion Segmentation, Image Morphology	CO 4	T1:4.1-4.6
22	Binary and Gray level morphology operations	CO 4	T1:4.1-4.6
23	Understand Erosion, Dilation, Opening	CO 4	T1:4.1-4.6
24	Closing Operations Distance Transform, Basic morphological Algorithms.	CO 4	T1:4.1-4.6
25	Feature Selection Techniques	CO 4	T1:4.1-4.6
26	Image segmentation- pixel based – Regional descriptors	CO 5	T1:10.1-10.6
27	Edge based, region-based segmentation.	CO 5	T1:10.1-10.6
28	Active contour models	CO 5	T1:10.1-10.6
29	Level sets for medical image segmentation	CO 5	T1:10.1-10.6
30	Image representation and analysis	CO 5	T1:10.1-10.6 ; T1:9.1-9.6
31	Feature extraction and representation, Statistical, Shape	CO 5	T1:10.1-10.6; T1:9.1-9.6

32	Understand Texture, feature and statistical image classification;	CO 5	T1:9.1-9.6
33	Descriptors and Whole-image Features Object, Scale	CO 5	T1:9.1-9.6
34	Invariant Feature Transform -SIFT	CO 5	T1:9.1-9.6
35	Introduction to Image Registration and Visualization	CO6	T1:8.1-8.3 ; R2: 7.4-7.5
36	Rigid body visualization	CO 6	T1:8.1-8.3; R2: 7.4-7.5
37	Principal axis registration, Interactive principal axis registration	CO 6	T1:8.1-8.3; R2: 7.4-7.5
38	Feature based registration	CO 6	T1-8.1-8.1.7
39	Elastic deformation-based registration	CO 6	T1-8.1-8.1.7
40	Image visualization-Methods & virtual reality based interactive visualization	CO 6	T1-8.1-8.1.7
	PROBLEM SOLVING/ CASE STUDIES		
1	Problem solving on Image Sensing and Acquisition	CO 2	T1:2.6-2.6.8; R2: 5.8-5.10
2	Problem solving on Sampling and Quantization	CO 2	T1:3.1-3.6
3	Problem solving on Histogram Processing	CO 2	T1:3.1-3.6
4	Problem solving on Smoothing and Sharpening spatial filters	CO 2	T1:3.1-3.6
5	Problem solving on image enhancement in spatial domain and point processing	CO 3	T1:3.1-3.6
6	Problem solving on Thresholding and Region Based Segmentation	CO 3	T1:3.1-3.8
7	Problem solving on Binary and Gray level morphology operations	CO 3	T1:3.1-3.8
8	Problem solving on Closing Operations Distance Transforms	CO 3	T1:4.1-4.6
9	Problem solving on Basic morphological Algorithms	CO 3	T1:4.1-4.6
10	Problem solving on Textures - Boundary representations using Feature Selection Techniques.	CO 4	T1:4.1-4.6
11	Problem solving on image segmentation using edge linking and boundary detection	CO 5	T1:10.1-10.6
12	Problem solving on image segmentation using region orientation morphological processing	CO 5	T1:10.1-10.6

13	Problem solving on visualization- axis registration	CO5	T1:10.1-10.6
14	Problem solving on Elastic deformation-based registration	CO 6	T1:8.1-8.3; R2: 7.4-7.5
15	Problem solving on Image visualization – 2D display methods, 3D displays methods	CO 6	T1:8.1-8.3; R2: 7.4-7.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Definitions and terminologies on Introduction to Digital image processing	CO 1	T1:1.4-1.5
2	Definitions and terminologies on image enhancement	CO 3	T1:3.1-3.8
3	Definitions and terminologies on image restoration	CO 4	T1:4.1-4.6
4	Definitions and terminologies on image segmentation	CO 5	T1:10.1-10.6
5	Definitions and terminologies on image visualization	CO 6	T1:8.1-8.3; R2: 7.4-7.5
DISCUSSION OF QUESTION BANK			
1	Discussion on question bank of introduction to digital image processing	CO 2	T1:1.4-1.5
2	Discussion on question bank of image enhancement	CO 3	T1:3.1-3.8
3	Discussion on question bank of image restoration	CO 4	T1:3.1-3.8; R2: 7.4-7.5
4	Discussion on question bank of image segmentation	CO 5	T1:10.1-10.6
5	Discussion on question bank of image visualization	CO 6	T1:8.1-8.3; R2: 7.4-7.5

Signature of Course Coordinator **HOD,CSE(DS)**
Dr. B. Polaiah, Professor

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

COURSE DESCRIPTION

Department	**Computer Science and Engineering (Data Science)**				
Course Title	**Data Wrangling and Visualization**				
Course Code	ACDC09				
Program	B. Tech				
Semester	FIVE				
Course Type	Laboratory				
Regulation	UG20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Dr M V Krishna Rao, Professor, CSE (Data Science) dept.				

I COURSE PRE-REQUISITES

Level	Course Code	Semester	Prerequisites
B.Tech	ACSC01	I	Python Programming
B.Tech	ACSC02	I	Python Programming Laboratory
B.Tech	ACDC02	III	Data Science Laboratory
B.Tech	ACDC05	III	Data Wrangling with Python

II COURSE OVERVIEW

Data wrangling is the process of cleaning and unifying messy and complex data sets for easy access and analysis. In this laboratory course the experiments are designed for importing of data from CSV and PDF files, data clean-up tasks such as elimination of bad data, duplicates and outliers, and data conditioning steps such as normalization and standardization. The laboratory also has some experiments for data exploration, and for providing statistical summaries of the given dataset. Experiments on data visualizations: plots, charts, maps, histograms, correlation plots, etc and an experiment on the design of web scraper are also included. The laboratory course also provides some critical thinking experiments to enhance the learning. The design skills gained in this laboratory course are quite useful for full-fledged real-world data analysis needed for an entry-level data science engineer.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Data Wrangling and Visualization Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES

The students will try to learn:

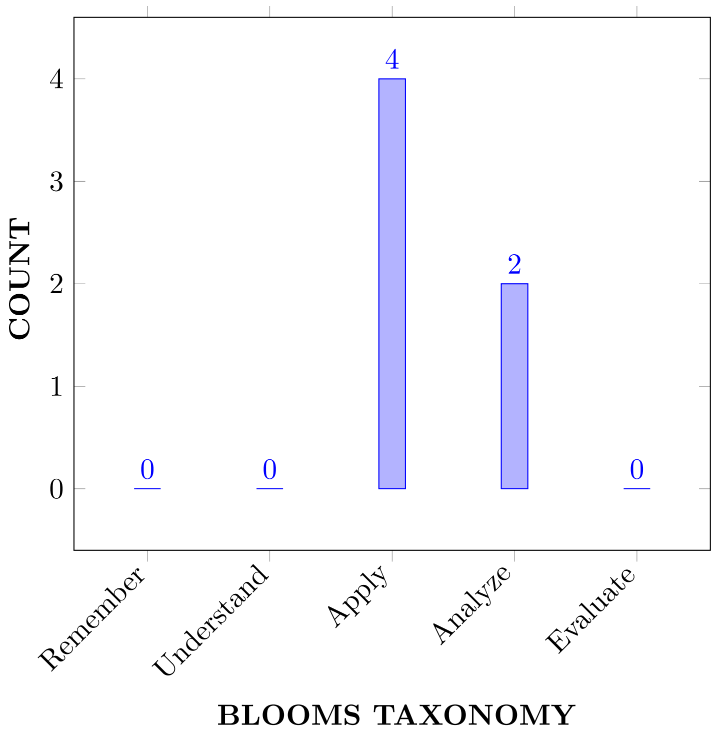
I	The importing (exporting) data from (to) Excel, CSV, JSON and XML files.
II	The working with data frames using Pandas.
III	The data exploration & statistical summarization
IV	The web scraping using Python.

VII COURSE OUTCOMES

After successful completion of the course, students should be able to:

CO 1	**Demonstrate** the vector and the matrix operations using numpy library in python environment.	Apply
CO 2	**Experiment with** Read, write, and data manipulations of Excel, CSV, JSON, PDF and XML files in Python.	Apply
CO 3	**Apply** the data clean-up and formatting operations on the given dataset to prepare it ready for further exploration.	Apply
CO 4	**Analyze** the data statistically to find correlations and patterns in the data.	Analyze
CO 5	**Analyze** the data using visual representations for understanding the statistical summaries and patterns.	Analyze
CO 6	**Make use of** python libraraies to fetch content from a web page.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED

PROGRAM OUTCOMES		Strength	Proficiency Assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	SEE / CIE / AAT
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	SEE / CIE / AAT
PO 3	**Design/Development of Solutions:**Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	SEE / CIE / AAT
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.	3	SEE / CIE / AAT
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	3	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

X PROGRAM SPECIFIC OUTCOMES

Program Specific Outcomes	
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.
PSO 2	Focus on improving software reliability, network security or information retrieval systems.
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions

XI HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

PROGRAM SPECIFIC OUTCOMES		Strength	Proficiency Assessed by
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	3	SEE / CIE / AAT
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	3	SEE / CIE / AAT
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3	SEE / CIE / AAT

3 = High; 2 = Medium; 1 = Low

XII MAPPING OF EACH CO WITH PO(s),PSO(s)

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 3	-	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 4	-	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-
CO 5	-	✓	-	-	✓	-	-	-	-	✓	-	-	-	✓	-
CO 6	-	-	✓	-	✓	-	-	-	-	-	-	-	-	-	✓

XIII JUSTIFICATIONS FOR CO – PO/ PSO MAPPING -DIRECT

Course Outcome	PO PSO	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 1	PO 1	Demonstrate the matrix operations (**mathematics**) and programming basics of python (**engineering fundamentals**) useful for data wrangling and analytics (**an engineering specialization**).	3
CO 2	PO 2	**Review** , **select** and/or **formulate** the appropriate parsing techniques in Python of parsing Excel, PDF data (**engineering sciences**), and the uncommon file types (**complex engineering problem**).	5
	PO 5	**Identify** python libraries for parsing Excel and PDF data, **select**, **devise** and/or apply appropriate **IT tools** and **resources** for parsing uncommon file types (Identify python libraries for parsing Excel and PDF data, select, devise and/or apply appropriate IT tools and resources for parsing uncommon file types (complex engineering activity) with the knowledge of limitations.) with the **knowledge of limitations**.	5

Course Outcome	PO PSO	Justification for mapping (Students will be able to)	No. of Key competencies matched.
CO 3	PO 2	**Review**, **Identify** and **analyse** the data format to transform from machine readable to human readable (**principles of mathematics**), identify (**complex engineering problem**) and clean the data for inconsistencies (**engineering sciences**)and prepare the data for subsequent data analysis using Python libraries.	6
	PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.	2
CO 4	PO 2	Apply python libraries (**solution implementation**), to remove outliers in the data (**modelling**), carry out explorative analysis (**complex engineering problem**) using Pearson correlation.	3
	PO 5	Make use of python libraries (**IT tools**) for **identifying** outliers and correlations (**model**) in the data	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	5
CO 5	PO 2	Apply python libraries (**solution implementation**), to remove outliers in the data (**modelling**), carry out explorative analysis (**complex engineering problem**) using Pearson correlation.	3
	PO 5	Make use of python libraries (**IT tools**) for effectively **identifying** outliers and correlations in the data useful for **modeling**.	3
	PO 10	Visually publish (**clarity**) and explain (**oral skills**) the analysis results (**subject matter**) to all stake holders involved in the project or process.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	5
CO 6	PO 3	Design **innovative** web scraper (**web engineering tools**) for a web site models (**complex engineering problem**) ensuring the **fitness** of technique **meeting specified needs** for acquiring data from world web within python framework with the knowledge of copyright and proprietorship rights (**legal aspects**) of the data being scrapped.	6
	PO 5	Choose **appropriate python met**hod of web scraping of a typical **web site model** such as that of a Wikipedia (**IT tools**) for acquiring and storing data.	3
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	3

Note: For Key Attributes refer Annexures-I & II

XIV TOTAL COUNT OF KEY COMPETENCIES FOR CO – PO / PSO) MAPPING

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	4	7	4
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	5	-	-	5	-	-	-	-	-	-	-	-	-	-
CO 3	-	6	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	3	-	-	3	-	-	-	-	-	-	-	-	5	-
CO 5	-	3	-	-	3	-	-	-	-	3	-	-	-	5	-
CO 6	-	-	6	-	3	-	-	-	-	-	-	-	-	-	2

XV PERCENTAGE OF KEY COMPETENCIES FOR CO – PO / PSO) MAPPING

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	4	7	4
CO 1	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	50	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 3	-	60	-	-	-	-	-	-	-	-	-	-	50	-	-
CO 4	-	30	-	-	60	-	-	-	-	-	-	-	-	71	-
CO 5	-	30	-	-	60	-	-	-	-	60	-	-	-	71	-
CO 6	-	-	70	-	60	-	-	-	-	-	-	-	-	-	50

XVI COURSE ARTICULATION MATRIX (PO / PSO MAPPING):

COs and PO'S and COs and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

1 -$5 < C \leq 40\%$ – Low/ Slight

2 - $40\% < C < 60\%$ –Moderate

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	3	10	10	11	5	5	3	3	12	5	12	8	4	7	4
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	1	-	-	3	-	-	-	-	-	-	-	2	3	-
CO 5	-	1	-	-	3	-	-	-	-	3	-	-	-	3	-
CO 6	-	-	3	-	3	-	-	-	-	-	-	-	-	-	2
TOTAL	3	7	3	-	12	-	-	-	-	3	-	-	6	6	6

COURSE OUTCOMES	Program Outcomes												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AVERAGE	3	1.75	3	-	3	-	-	-	-	3	-	-	3	3	3

XVII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XVIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
x	Assessment of Mini Projects by Experts		

XIX SYLLABUS:

WEEK I	**NUMPY**
	Introduction to Python libraries: NumPy, SciPy, Pandas, Matplotlib, Scikit-Learn Write a Python program to do the following operations: Library: NumPy a) Write a program to create a 3x3 matrix with values ranging from 2 to 10 b) Write a program to create a null vector of size 10 and update sixth value to 11 c) Write a program to multiply a 5x3 matrix by a 3x2 matrix and create a real matrix product. d) Write a program to create a 8x8 matrix and fill it with a checkerboard pattern e) Write a program to find the real and imaginary parts of an array of complex numbers f) Write a program compare two given arrays
WEEK II	**FILE HANDLING**
	a) Write a program to read each row from a given csv file and print a list of strings. b) Write a program to read a given CSV file as a dictionary. c) Write a program to convert Python dictionary object (sort by key) to CSV File. Print the object members with indent level 7.
WEEK III	**FILE HANDLING**
	a) Demonstrate Serializing Data with XML and JSON: i) Working with XML modules in Python ii) Start with Element Tree iii) Parsing XML iv) Updating an XML tree v) Creating a new document vi) YAML, other formats as time permits b) i) Reading, Writing JSON ii) Write a Python program to convert Python dictionary object (sort by key) to JSON data.

WEEK IV	DATA FRAMES
	Library: PANDAS Write a Pandas program to create and display a DataFrame from a specified dictionary data which has the index labels. Sample Python dictionary data and list labels: exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily', 'Michael', 'Matthew', 'Laura', 'Kevin','Jonas'], 'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19], 'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1], 'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']} labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j'] a) Write a program to select the 'name' and 'score' columns from the given DataFrame. b) Write a program to select the rows where the number of attempts in the examination is greater than 2. c) Write a program to count the number of rows and columns of a DataFrame. d) Write a program to select the rows the score is between 15 and 20. e) Write a program to calculate the mean score for each different student in DataFrame. f) Write a program to delete the 'attempts' column from the DataFrame.
WEEK V	READING AND WRITING FILES FROM A DATA SET
	Write a Python program to do the following operations: Data set: brain_size.csv Library: Pandas a) Loading data from CSV file b) Compute the basic statistics of given data - shape, no. of columns, mean c) Splitting a data frame on values of categorical variables d) Visualize data using Scatter plot
WEEK VI	TIME SERIES
	a) Demonstrate Basic date and time classes, Different time formats, converting between formats, Formatting dates and times, Parsing date/time information. b) Write a program that reads the current time and converts it to a time of day in hours, minutes, and seconds, plus thenumber of days since the epoch. c) Write a program to create a date from a given year, month, day, and another date from a given string formats. d) Write a program to print the day after and before a specified date. Also print the days between two given dates. e) Write a program to create a time-series with two index labels and random values. Also print the type of the index. f) Write a program to create a series of Timestamps from a DataFrame of integer or string columns and create a series of Timestamps using specified columns.

WEEK VII	**PLOTTING**
	Consider the given test data of Historical stock prices of Alphabet Inc. (GOOG) Time Period: April 01, 2020 - October 01, 2020 File path: https://www.w3resource.com/python-exercises/pandas/plotting/alphabet_stock_data.csv a) Write a program to create a line plot of the historical stock prices of Alphabet Inc. between two specific dates. b) Write a program to create a bar plot of opening, closing stock prices of Alphabet Inc. between two specific dates. c) Write a program to create a stacked bar plot of opening, closing stock prices of Alphabet Inc. between two specific dates. d) Write a program to create a histograms plot of opening, closing, high, low stock prices of Alphabet Inc. between two specific dates. e) Write a program to create a plot of Open, High, Low, Close, Adjusted Closing prices and Volume of Alphabet Inc. between two specific dates. f) Write a program to create a plot to visualize daily percentage returns of Alphabet Inc. stock price between two specific dates.
WEEK VIII	**DATA PREPROCESSING – HANDLING MISSING VALUES**
	Consider the given test data and do the following: a) Write a program to identify the column(s) of a given DataFrame which have at least one missing value. b) Write a program to count the number of missing values in each column of a given DataFrame. c) Write a program to find and replace the missing values in a given DataFrame which do not have any valuable information. d) Write a program to drop the rows where at least one element is missing in a given DataFrame. e) Write a program to drop the columns where at least one element is missing in a given DataFrame. f) Write a program to drop the rows where all elements are missing in a given DataFrame
WEEK IX	**EXCEL DATA ANALYSIS**
	Write a program to import excel data (coalpublic2013.xls) into a Pandas data frame and process the following File path: https://github.com/jbwhit/coal-exploration/blob/master/data/cleaned_coalpublic2013.csv a) Write a program to import excel data (coalpublic2013.xlsx) into a Pandas dataframe. b) Write a program to get the data types of the given excel data c) Write a program to find the sum, mean, max, min value of 'Production (short tons)' column of coalpublic2013.xlsx file. d) Write a program to read specific columns from a given excel file. e) Write a program to insert a column in the sixth position of the said excel sheet and fill it with NaN values. f) Write a program to import excel data (coalpublic2013.xlsx) into a dataframe and find details where "Mine Name" starts with "P". g) Write a program to import excel data (coalpublic2013.xlsx) into a dataframe and find details where $LaborHours > 20000$.

WEEK X	PDF FILES
	a). Develop a python program to parse the pdf files using PDFMiner. b). Extract the Table from the child labor and child marriage data.xlsx using PDFTables library
WEEK XI	CORRELATIONS
	a). Import the data into 'agate' then explores the table using agate methods and perform statistical correlations b). Draw the chart between perceived corruption scores compared to the child labor percentages using matplotlib
WEEK XII	WEB SCRAPING
	Install packages requests, flask and explore using (pip) a). Write a Python program that imports requests and fetch content from wiki page. b). Write a Python program to check the owner of the website c. Write a Python program to creating a soup object which will further be used to fetch details like title of the webpage.

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3. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O"Reilly, 2nd Edition, 2018.
4. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O"Reilly, 2017.
5. Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2012.

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3. https://archive.ics.uci.edu/ml/datasets.php
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5. http://math.ecnu.edu.cn/ lfzhou/seminar/Joel_Grus_Data_Science_from_Scratch _First_Princ.pdf

XX COURSE PLAN

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	COs	Reference
1	Numpy package	CO 1	T1: 1.1
2	File handling-I	CO 2	T1: 2.1
3	File handling-II	CO 2	T1: 2.2
4	Data frames	CO 3	T1: 3.1

5	Reading and writing files from a data set	CO 3	T1: 3.2
6	Time series	CO 3	T1: 3.2
7	Plotting	CO5	T1: 4.1-4.2
8	Data preprocessing–handling missing values	CO 3	T1: 4.3
9	Excel data analysis	CO 4	T1: 4.4
10	PDF files	CO 2	T1: 5.1
11	Correlations	CO 4	T1: 5.4
12	Web scraping	CO 6	T1: 5.5-5.6

XXI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

The course plan is meant as a guideline. Probably there may be changes.

S.No	Design Oriented Experiments	COs
1	Consider a labelled dataset with at least 500 data samples and at least 10 attributes (independent) variables. Carry out the Principal Component Analysis (PCA) on the data and eliminate the insignificant dimensions attributes. Data may be wrangled if needed.	CO 1, CO 4
2	Consider a labelled dataset with at least 500 data samples and at least 10 attributes (independent) variables. Carry out the singular value decomposition (SVD) on the data and eliminate the insignificant dimensions attributes. Data may be wrangled if needed.	CO 1, CO 4
3	Analyze the statistics of the labelled dataset used in problem 1 (or problem 2) and draw conclusion about the dependencies of feature vectors. Apply the wrangling on the data if required.	CO 3, CO 4
4	Generate two sets of gaussian attribute vector (i). uncorrelated and (ii) uncorrelated each of 12 dimensions and sample size of 1000. Explore the data and analyze using various visualizations such as plots, map, charts, histograms, probability matrices.	CO 3,CO 4, CO 5
5	Demonstrate the data wrangling tasks in sequence considering publicaly avaliable large datset having atleast 10 attributes and 1000 data samples. Consider an .xls(x) or a .csv file for the exploration. Print the summary of data anomalies corrected. Apply the wrangling on the data if required.	CO 1,CO 2, CO 4
6	Browse a company's web page using python-supported libraries. Extract the information about the job offers displayed on web site and print the statistical summaries of the same in a textural or visual form. You may consider the BeautifulSoup library for scraping the web.	CO 4,CO 5, CO 6

M V Krishna Rao
Signature of Course Coordinator **HOD,CSE(DS)**

ANNEXURE - I

KEY ATTRIBUTES FOR ASSESSING PROGRAM OUTCOMES

PO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems **(Engineering Knowledge).** Knowledge, understanding and application of 1. Scientific principles and methodology. 2. Mathematical principles. 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	3
PO 2	Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences (**Problem Analysis).** 1. Problem or opportunity identification 2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues 2. Understand customer and user needs and the importance of considerations such as aesthetics 3. Identify and manage cost drivers 4. Use creativity to establish innovative solutions 5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context 9. Understanding of the requirement for engineering activities to promote sustainable development 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues	**10**

PO 4.	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products 2. Workshop and laboratory skills 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.) 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues 5. Understanding of appropriate codes of practice and industry standards 6. Awareness of quality issues 7. Ability to work with technical uncertainty 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**
PO 5	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations **(Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources / literature search tools.	**1**
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context 3. Understanding of the requirement for engineering activities to promote sustainable development 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
PO 7	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic 2. Political 3. Environmental	**3**

PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen -week design project. 6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation 10. Ability to work with all levels of people in an organization 11. Ability to get along with others 12. Demonstrated ability to work well with a team	**12**
PO 10	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally" 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**

PO11	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**
PO12	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2-3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

ANNEXURE - II

KEY ATTRIBUTES FOR ASSESSING PROGRAM SPECIFIC OUTCOMES

PSO Number	NBA Statement / Key Competencies Features (KCF)	No. of KCF's
PSO 1	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation. 1. Acquire computer programming skills 2. Ability to work on SQL (relational) databases 3. Ability to work on noSQL (non-relational) databases 4. Acquire the knowledge of principles of Data Analytics	**4**
PSO 2	Focus on improving software reliability, network security or information retrieval systems. 1. Acquire the knowledge of steps involved in data wrangling process 2. Understand the data science applications 3. Develop statistical models for real-world multi-dimensional data 4. Ability to visually represent the data in a meaningful way 5. Ability to explore the data for patterns, correlations and associations. 6. Identify and formulate the data science applications in multi-disciplinary areas of work 7. Identify and formulate the data science applications in inter-disciplinary areas of work	**7**
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions 1. Acquire the knowledge of web site models 2. Acquire the knowledge of web mining techniques 3. Ability to design web scarpers 4. Ability to design web crawlers and spiders	**4**

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043
COMPUTER SCIENCE AND ENGINEERING(DATA SCIENCE)
COURSE DESCRIPTION

Course Title	**OBJECT ORIENTED SOFTWARE DESIGN LABORATORY**				
Course Code	ACSC21				
Program	B.Tech				
Semester	V	CSE(DS)			
Course Type	CORE				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Ms. D. Rajani, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AITC02	III	Object Oriented Programming with objects.

II COURSE OVERVIEW:

This Laboratory course introduces the Unified Modeling language for visualizing, specifying, constructing and documenting in preparing blueprint of a software intensive system. This lab covers Static and Dynamic aspects of the System with illustrations of Class,Object,Component, Deployment Use case, State chart, sequence, activity, collaboration Diagrams. These diagrams are used to create low level and high level design documents of the software system.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
Object Oriented Analysis Design Laboratory	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component			Total Marks
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	-

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

VI COURSE OBJECTIVES:

The students will try to learn:

I	The need for requirement analysis in designing real time applications.
II	The implementation of Architectural views for different case studies.

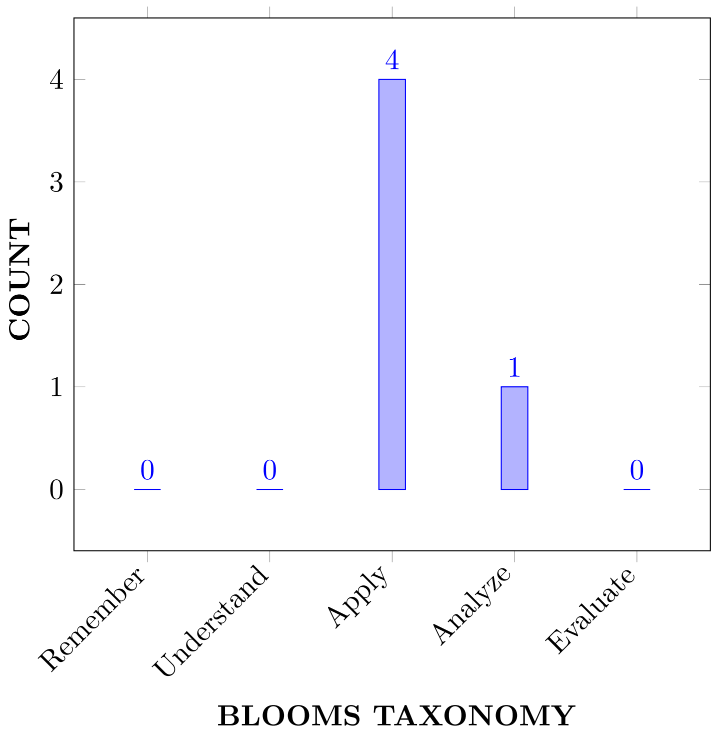
III	The case studies for analyzing modeling techniques.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Analyze** features of software in view of software development process.	Analyze
CO 2	**Make use of** UML notations to represent requirements of the systems.	Apply
CO 3	**Develop** a design model of the software system with the help of UML structural diagrams.	Apply
CO 4	**Design** a behavioral model of the software system with the help of UML structural diagrams.	Apply
CO 5	**Develop** a design model for different real time applications.	Apply

COURSE KNOWLEDGE COMPETENCY LEVEL



VIII HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Lab Exercise, CIE, SEE
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations	3	Lab Exercise, CIE, SEE
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Lab Exercise, CIE, SEE
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations	1	Lab Exercise, CIE, SEE
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	1	SEE

3 = High; 2 = Medium; 1 = Low

IX HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2	Lab Exercises
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2	Lab Exercises

3 = High; 2 = Medium; 1 = Low

X JUSTIFICATIONS FOR CO – (PO, PSO) MAPPING -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 2	**Analyze** features of software by **identifying, formulating, reviewing** complex engineering problems there by reaching to conclusion by following principles of SDLC.	6
	PO 3	**Design the solution** of software or system components by following designed guidelines.	10
	PO 4	**Identify the problems** and advantages for managing software requirement specifications.	5
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 2	PO 2	Make use of UML notations to identify the **problem statement** and to define **model translation.**	2
	PO 3	Ensure the UML notation fits the purpose of all aspects of problem and **assists the design process** thereby achieving the engineering objectives.	3
	PO 4	Make use of building blocks for creating architectural view of system using UML by **communicating effectively to engineering community**	2
	PO 5	Make use of appropriate design techniques and **modern Engineering IT tools** for modelling the UML to represent complex engineering requirements.	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 3	PO 2	**Understand** the given problem and **Design the software by making sure it fits for purpose for all aspects of the problem including**.	4
	PO 3	**Design** the software by making sure it fits for purpose for all aspects of the problem including**CASE tool** for modeling simple to complex engineering activities with understanding requirements and limitations of user.	1
	PO 4	**Understand** the given problem and **system definition, problem formulation, collecting data, modelling, solution development** for specifying structure and interaction of objects during runtime.	1

	PO 5	Translation of UML design notations that represent the requirement to actual implementation by **adopting techniques, resources and modern engineering tools..**	1
	PO 12	Classify the key issues in terms of **defining various problems, customer and user needs, cost effective and creative solutions, design process, economiccontext and management techniques.**	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1
	POS 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 4	PO 2	Classify the key issues in terms of**defining various problems, customer and user needs, cost effective and creative solutions, design process.**	5
	PO 3	**Communicate** effectively in orally and written by comprehend and write effective **reports and design documentation**	6
	PO 4	Design solutions for simple and complex problems by **Defining problem, understand customer requirements, identifying** basic building blocks to draw UML diagrams.	1
	PO 5	Understand the **problem and develop solutions using different data technologies and document the results for interpretation.**	1
	PO 12	**Improve the software**reliability issues, analyze the data / Information.	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions	2
CO 5	PO 2	**Understand** the given problem and system **definition, problem formulation, collecting data, modelling, solution development** definition, problem formulation, collecting data, modelling, solution development and documentation for design solution by using advanced building blocks of UML.	5
	PO 3	**Design** the software by making sure it fits for purpose for all aspects of the problem including **production, operation and maintenance by applying innovative solutions.**	5

	PO 4	Understand the **experimental designs** and development of project analysis and development of software requirement Specifications.	5
	PO 5	Translation of UML design notations that represent the requirement to actual implementation by **adopting techniques, resources and modern engineering tools.**	1
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	2
	PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.	2

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	Program Outcomes					Program Specific Outcomes	
	PO 2	PO 3	PO 4	PO 5	PO12	PSO 2	PSO 3
CO1	3	3	3	-	-	2	2
CO2	2	2	2	1	-	2	2
CO3	3	3	1	1	3	1	2
CO4	3	3	2	2	1	1	2
CO5	3	3	3	3	2	2	2

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-
Assignments	-				

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**REQUIREMENT DEVELOPMENT**
	problem statement Requirement engineering produces a specification of what a system should do. The intention of requirement engineering is to provide a clear definition of requirement of the systems. This phase is a very important phase because, if the customer requirements are not clearly understood, the ambiguity can get into the other phase of the development. To avoid such issues, requirement has to be elicited using the right elicitation techniques, to be analyzed effectively, specified clearly and verified thoroughly. All activities are collectively termed as requirement development activities. **solutions expected:**Identify the requirement development activities associated with each of the following scenarios: a. Joe is creating an online survey questionnaire for requesting user feedback on the desired features of the application to be developed. b. Mark is preparing a formal document which includes all of the desired features identified by the survey. c. Jack identified an incomplete requirement statement d. Jones is identifying all security related requirement and separating them from the performance related requirements e. Merlin a team member is sent to client to observe the business case and collect typical user requirements. g. Leo is team member is working on requirement and ensuring that requirement collected should not be vague and unclear. h. Lee is conducting a facilitated meeting with the stakeholder to capture the requirements. i. Amit a team member is distributing questionnaires to stack holder for gathering user requirements.
WEEK II	**ANALYSIS OF SYSTEM USING UML NOTATIONS**
	solutions expected: a. Demonstrate the Classes, relationships, common mechanisms. b.Illustrate the differences between functional and non-functional requirements.. c.Create SRS for Recruitment System
WEEK III	**DESIGN OF SYSTEM USING STRUCTURAL DIAGRAMS**
	problem statement: Design and illustrate the static part of the system using the UML structural diagrams (Object, and Class diagrams). **solutions expected:** a. Demonstrate differences between static and dynamic diagrams b. Develop a design model using Class diagrams library management c. Model a view using Object diagram for order management

WEEK IV	**DESIGN OF SYSTEM USING STRUCTURAL DIAGRAMS**
	problem statement: Design and illustrate the static part of the system using the UML structural diagrams (Component and Deployment diagrams). **solutions expected:** a. Demonstrate Components in Component diagram and Components in Deployment diagrams b. Develop a design model using Component and Deployment diagrams with an example c. Model a view using Component and Deployment diagrams for Hospital management system.
WEEK V	**DESIGN OF SYSTEM USING BEHAVIORAL DIAGRAMS**
	problem statement: Design and illustrate the static part of the system using the UML behavioral diagrams (Use Case, Sequential and Collaboration). **solutions expected:** a. Describe modelling techniques of Use case, Sequential and Collaboration diagrams b. Develop a design model using Use case, Sequential and Collaboration diagrams with an example. c. Model a view using Usecase diagrams for a parking lot
WEEK VI	**DESIGN OF SYSTEM USING BEHAVIORAL DIAGRAMS**
	problem statement: Design and illustrate the static part of the system using the UML behavioral diagrams (Activity and State chart). **solutions expected:** a. Describe in detail Activity and State chart diagrams b. Develop a design model using Activity and State chart diagrams with an example c. Model a view using Activity and state chart diagrams for movie ticket booking system.
WEEK VII	**EXAM REGISTRATION SYSTEM**
	Create a UML model for a system to perform the Exam Registration system **problem statement:**Exam Registration system is used in the effective dispatch of registration form to all of the students. This system adopts a comprehensive approach to minimize the manual work and schedule resources, time in a cogent manner. The core of the system is to get the online registration form (with details such as name, reg.no etc.,) filled by the student whose testament is verified for its genuineness by the Exam Registration System with respect to the already existing information in the database. **solutions expected:** a. Demonstrate modelling techniques of Class diagram for Exam Registration b. Develop a design model using Sequence diagrams for Exam Registration System c. Model a view using Collaboration diagram for Exam Registration System

WEEK VIII	**STOCK MAINTENANCE**
	Create a UML model for a system to perform stock maintenance **problem statement:**The stock maintenance system must take care of sales information of the company and must analyze the potential of the trade. It maintains the number of items that are added or removed. The salesperson initiates this Use case. The salesperson is allowed to update information and view the database. **solutions expected:** a. Develop a design model using Usecase diagrams for Stock Maintenance b. Develop a design model using Class diagrams for Stock Maintenance c. Model a view using using Sequence diagram for Stock Maintenanc
WEEK IX	**PASSPORT PROCESS**
	Create a UML model for a system to perform passport process **problem statement:**Passport Automation System is used in the effective dispatch of passport to all of the applicants .This system adopts a comprehensive approach to minimize the manual work and schedule resources, time in a cogent manner. The core of the system is to get the online registration form (with details such as name, address etc.,) filled by the applicants whose testament is verified for its genuineness by the Passport Automation System with respect to the already existing information in the database. **solutions expected:** a. Elaborate modelling techniques of Deployment diagrams b. Design model using Deployment diagrams for Passport Process c. Model a view using Activity diagram for Passport Process
WEEK X	**E-BOOK MANAGEMENT SYSTEM**
	Create a UML model for a system to perform E- book Management **problem statement:** An E, Book lends books and magazines to member, who is registered in the system. Also it handles the purchase of new titles for the Book Bank. Popular titles are brought into multiple copies. Old books and magazines are removed when they are out or date or poor in condition. A member can reserve a book or magazine that is not currently available in the book bank, so that when it is returned or purchased by the book bank, that person is notified. The book bank can easily create, replace and delete information about the tiles, members, loans and reservations from the system **solutions expected:** a. Define modelling techniques of Collaboration diagrams b. Design model using Deployment diagrams for E-book Management system c. Model a view using Use Case diagram for Passport Process

WEEK XI	**RECRUITMENT PROCESS**
	problem statement: The recruitment system allows the job seekers to enroll their names through the process of registration. The employee also can get the list of available candidates and shortlist for their company requirement. Once the applicant enrolls he receives an id, which helps him in further Correspondence. A fees amount is received from the job seekers for enrollment. This system makes the task of the job seeker easier rather than waiting in queue for enrollment. This also reduces the time consumption for both for the job seeker and employee.. **solutions expected:** a. Define modelling techniques of Sequence diagrams b. Design model using Sequence diagrams for Recruitment system process c.Model a view using Use Case diagram for Recruitment system process
WEEK XII	**ATM TRANSACTION**
	Problem Description: ATMs are omnipresent these days, at least in major cities and towns. It is an empowering technology, as one can withdraw or transfer money any time they want. Now the enrolment for bank accounts is on the rise, which will include many illiterate or old people also. Is the current ATM experience good enough for them to use it? How can the experience be enhanced for them? **solutions expected:** a. Demonstrate modelling techniques of Activity diagrams b. Design a model using Activity diagram for ATM Transaction c. Model a view using Use Case diagram for ATM Transaction
WEEK XIII	**CONFERENCE MANAGEMENT SYSTEM**
	Problem Description: The process of the candidates is to login the conference system and submit the paper through online. Then the reviewer reviews the paper and sends the acknowledgement to the candidate either paper selected or rejected. This process of on conference management system are described sequentially through following steps: • The candidate login to the conference management system. • The paper title is submitted. • The paper is been reviewed by the reviewer. • The reviewer sends acknowledgement to the candidate. • Based on the selection, the best candidate is selected. Finally, the candidate registers all details. **solutions expected:** a. Illustrate modelling techniques of Use Case diagrams b. Design a model using Use Case diagram for Conference Management System c. Model a view using using Sequence diagram for library Management System.

WEEK XIV	**PERFORMANCE TESTING**
	Problem Description: : Performance testing tests the non-functional requirements of the system. The different types of performance testing are load testing, stress testing, endurance testing and spike testing. **solutions expected:** 1. A space craft is expected to function for nearly 8 years in space. The orbit control system of the spacecraft is a real-time embedded system. Before the launch, the embedded software is to be tested to ensure that it is capable of working for 8 years in the space. Identify the suitable performance testing category to be carried out to ensure that the space craft will be functioning for 8 years in the space as required. 2. Global Education Centre (GEC) at Infosys Mysore provides the training for fresh entrants. GEC uses an automated tool for conducting objective type test for the trainees. At a time, a maximum of 2000 trainees are expected to take the test. Before the tool is deployed, testing of the tool was carried out to ensure that it is capable of supporting 2000 simultaneous users. Indicate the performance testing category? 3. A university uses its web-based portal for publishing the results of the students. When the results of an examination were announced on the website recently on a preplanned date, the web site crashed. Which type of performance testing should have been done during web-site development to avoid this unpleasant situation? 4. During unexpected terrorist attack, one of the popular websites crashed as many people logged into the web-site in a short span of time to know the consequences of terrorist attack and for immediate guidelines from the security personnel. After analyzing the situation, the maintenance team of that website came to know that it was the consequences of unexpected load on the system which had never happened previously. Which type of performance testing should have been done during web-site development to avoid this unpleasant situation?

TEXTBOOKS

1. Grady Booch, James Rumbaugh, Ivar Jacobson, —The Unified Modeling Language User Guide‖, Pearson Education, 2ndEdition, 2004.

REFERENCE BOOKS:

1. Craig Larman, —Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development‖, Pearson Education, 3rd Edition, 2005.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's
1	Requirement Development	CO 1, CO 2
2	Analysis of Systems Using UML Notations.	CO 1, CO 2
3	Design of system Using Structural Diagrams	CO 2, CO 4
4	Design of system Using Structural Diagrams	CO 2, CO 3

5	Design of System Using Behavioral Diagrams	CO 2, CO 3 CO 4
6	Design of System Using Behavioral Diagrams	CO 2, CO 4
7	Exam Registration System	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
8	Stock Maintenance	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
9	Passport Process	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
10	E-Book Management Systems	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
11	Recruitment Process	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
12	Exam Registration System	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
13	Conference Management System	CO 1, CO 2 ,CO 3 ,CO 4,CO 5
14	Performance Systems	CO 1, CO 2 ,CO 3 ,CO 4,CO 5

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	**Real time Online Transform** for embedded Systems considering non-functional aspects with rate-monotonic analysis.
2	Implementation of **Advanced relationships** and common mechanisms in real time applications.
3	**Reverse engineering:** Encourage students to implement model from a given input of source code.

Signature of Course Coordinator **HOD,CSE(DS)**
Ms .D.Rajani, Assistant Professor