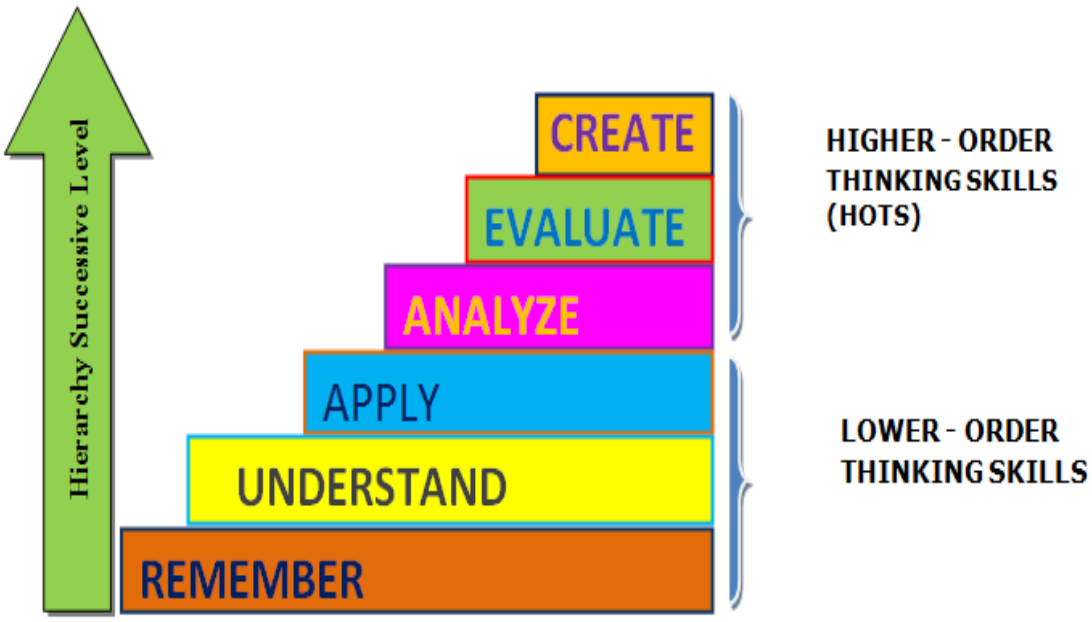
COURSE DESCRIPTOR BOOKLET

B.Tech

ELECTRICAL AND ELECTRONICS ENGINEERING

(Accredited by NBA)

R-16 REGULATIONS



BLOOM'S TAXONOMY OF LEARNING OUTCOMES

.....Moving Towards Perfection in Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Approved by AICTE; Affiliated to JNTUH and Accredited by NAAC with 'A' Grade
Dundigal, Hyderabad - 500 043

I SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER PROGRAMMING**				
Course Code	ACS001				
Programme	B.Tech				
Semester	I	CSE | IT| ECE | EEE			
	II	AE | CE| ME			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	4	2
Chief Coordinator	Dr. K Srinivasa Reddy, Professor & HOD, IT				
Course Faculty	Ms N Jayanthi Dr. G Ramu Dr. J Sirisha Devi Dr. K Suvarchala Ms. B Rekha Ms. B Padmaja Ms. G Geetha Reddy Ms. K Laxmi Narayanamma Mr. R M Norullah				

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
-	-	-	Basic Mathematics and Logical Thinking

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Programming	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 fiveunits 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Assignments
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	Seminars, Viva
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	5 minutes video

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Projects
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	3	Lectures, Assignments
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	1	5 minutes video

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Learn adequate knowledge by problem solving techniques.
II	Understand programming skills using the fundamentals and basics of C Language.
III	Improve problem solving skills using arrays, strings, and functions.
IV	Understand the dynamics of memory by pointers.
V	Study files creation process with access permissions

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACS001.01	CLO 1	Identify and understand the working of key components of a computer system.	PO 1, PO 4	2
ACS001.02	CLO 2	Analyze a given problem and develop an algorithm to solve the problem.	PO 2, PO 3	3
ACS001.03	CLO 3	Describe the fundamental programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.	PO 2, PO 4	2
ACS001.04	CLO 4	Gain knowledge to identify appropriate C language constructs to write basic programs.	PO 1, PO 3	3
ACS001.05	CLO 5	Identify the right data representation formats based on the requirements of the problem.	PO 2,PO 3	3
ACS001.06	CLO 6	Describe the operators, their precedence and associativity while evaluating expressions in program statements..	PO 1, PO 4	2
ACS001.07	CLO 7	Understand branching statements, loop statements and use them in problem solving.	PO 1,PO 4	2
ACS001.08	CLO 8	Learn homogenous derived data types and use them to solve statistical problems.	PO 2, PO 3	3
ACS001.09	CLO 9	Understand procedural oriented programming using functions.	PO 2	3
ACS001.10	CLO 10	Understand how recursion works and write programs using recursion to solve problems.	PO 1, PO 2	3
ACS001.11	CLO 11	Differentiate call by value and call by reference parameter passing mechanisms.	PO 2	3
ACS001.12	CLO 12	Understand pointers conceptually and apply them in C programs.	PO 1	3
ACS001.13	CLO 13	Distinguish homogenous and heterogeneous data types and apply them in solving data processing applications.	PO 3	2
ACS001.14	CLO 14	Explain the concept of file system for handling data storage and apply it for solving problems.	PO 1, PO 3	3
ACS001.15	CLO 15	Differentiate text files and binary files and write the simple C programs using file handling functions. Searching, Sorting.	PO 2	3
ACS001.16	CLO 16	Apply the concepts to solve real-time applications using the features of C language.	PO 2	3
ACS001.17	CLO 17	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 1, PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes POs	Program Specific Outcomes PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3			1										3	
CLO 2		3	2										2		1
CLO 3		3		1									2		
CLO 4	3			1									2		
CLO 5		3	2										2	3	
CLO 6	3			1											1
CLO 7	3			1										3	
CLO 8		3	2										2		
CLO 9		3												3	
CLO 10	3	3											2		1
CLO 11		3												3	
CLO 12	3												2	3	
CLO 13			2										2		
CLO 14	3		2											3	1
CLO 15		3												3	
CLO 16		3												3	
CLO 17	3			1									2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO2, PO 3, PO 4	SEE Exams	PO 1, PO2, PO 3, PO 4	Assignments	PO 2	Seminars	PO 3
Laboratory Practices	PO 1	Student Viva	PO 3	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	INTRODUCTION
Introduction to computers: Computer systems, computing environments, computer languages, creating and running programs, algorithms, flowcharts; Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types; Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions, formatted input and output.	
UNIT-II	**CONTROL STRUCTURES**
Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements; Arrays: Concepts, one dimensional arrays, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays; Strings concepts: String handling functions, array of strings.	
UNIT-III	**ARRAYS AND FUNCTIONS**
Functions: Need for user defined functions, function declaration, function prototype, category of functions, inter function communication, function calls, parameter passing mechanisms, recursion, passing arrays to functions, passing strings to functions, storage classes, preprocessor directives. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers.	
UNIT-IV	**STRUCTURES, UNIONS AND POINTERS**
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields, typedef, enumerations; Dynamic memory allocation: Basic concepts, library functions.	
UNIT-V	**FILE HANDLING AND BASICALGORITHMS**
Files: Streams, basic file operations, file types, file opening modes, file input and output functions, file status functions, file positioning functions, command line arguments.	
Text Books:	
1. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014. 2. B. A. Forouzan, R. F. Gillberg, "C Programming and Data Structures", Cengage Learning, India, 3rd Edition, 2014.	
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. E. Balagurusamy, "Programming in ANSI C", Mc Graw Hill Education, 6th Edition, 2012. 4. Schildt Herbert, "C: The Complete Reference", Tata Mc Graw Hill Education, 4th Edition, 2014. 5. R. S. Bichkar, "Programming with C", Universities Press, 2nd Edition, 2012. 6. Dey Pradeep, Manas Ghosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 – 2	Introduction to Computers: computer systems, computing environments.	CLO 1	T2:1.1-1.2
3 – 4	Computer languages, creating and running programs, program development.	CLO 1	T2:2.1-2.2
5 – 6	Algorithms, flowcharts	CLO 2	T2:1.4-1.5
7 – 8	Introduction to C Language: background, C programs.	CLO 3	T2:2.1-2.2
9 – 10	Identifiers, data types, Input/output, variables, constants, Operators (arithmetic, relational, logical, bitwise etc).	CLO 3	T2: 2.3- 2.6,7
11 – 12	Expressions, precedence and associativity, expression evaluation, type conversions	CLO 6	T2:3.1-3.5
13 – 14	Statements - selection statements (making decisions) – if statement, switch statement.	CLO 7	T2: 5.2-5.3
15 – 16	Repetition statement (loops)-while, dowhile statements, for statements, loop examples	CLO 7	T2: 6.1-6.6
17 – 18	Other statements related to looping – break, continue, go to, simple C program examples.	CLO 7	T2: 6.7
19 – 20	Arrays- Concepts, using arrays in C, declaration and initialization of one dimensional array, C program example. Two dimensional arrays, initialization and accessing, multi dimensional arrays, C program example.	CLO 8	T2: 8.1-8.3,8.7-8.8
21-22	Strings – Strings concepts: String handling functions, array of strings, C program examples.	CLO 8	T2: 11.1-11.5
23-- 24	Functions- Need for user defined functions, function declaration, function prototype. Category of functions, inter function communication, function calls, parameter passing mechanisms.	CLO 9	T2: 4.1-4.5
25	Recursion, passing arrays to functions, passing strings to functions, Storage classes and preprocessor commands.	CLO 10	T1:7 T2:6.9 T2:G.1
26-27	Pointer basics, pointer arithmetic, pointers to pointers, generic pointers. Pointer applications-Arrays and pointers, pointer arithmetic and arrays, passing an array to a function.	CLO 12	T1:1.0
28 – 29	Array of pointers, pointers and arrays, pointers as functions arguments, functions returning pointers	CLO 12	T2:10.3-10.5
30 – 31	Structures – declaration, initialization, accessing structures, operations on structures.	CLO 13	T1:8
32 – 33	Complex structures, structures and functions, passing structures through pointers, self-referential structures.	CLO 13	T2: 12.3-12.4
34 – 35	Unions, C programming examples, Bit fields, typedef, enumerations.	CLO 13	T2:12.4 T2:12.1- 12.2
36 -- 38	Dynamic memory allocation: Basic concepts, library functions	CLO 13	T2:2.1-2.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
39 – 40	Files: Concept of a file, streams, types of files and file opening modes.	CLO 14	R3:12.1-12.3
41 – 42	File input/output functions (standard input/output functions for files).	CLO 14	R3:12.4
43 – 44	File status functions (error handling), positioning functions, C program examples.	CLO 15	R3:12.5
45	Command-line arguments.	CLO 15	R3:12.7

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Updating latest version and new features of the C language	Laboratory Sessions	PO5	PSO2
2	Familiarizing the role of C language in developing system level programs.	Assignments / Industrial visits	PO1,PO2	PSO2
3	Familiarizing different areas where C language can be used.	Seminars	PO12	PSO3
4	Solving different problems and Practicing various debugging strategies to become a good programmer	Extra Lab Sessions, Participating in Coding contests	PO2	PSO3

Prepared by:
N Jayanthi, Assistant Professor

HOD, CSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATION**				
Course Code	AHS002				
Programme	B.Tech				
Semester	I	AE | CSE | IT | ECE | EEE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. P Rajani, Assistant Professor				
Course Faculty	Dr. M Anita, Professor Mr. J Suresh Goud, Assistant Professor Ms. P Srilatha, Assistant Professor Ms. C Rachana, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes Types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Linear Algebra and Ordinary Differential Equations	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	2	Seminar
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	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collabration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of probability on single random variables and probability distributions.
II	Apply the concept of correlation and regression to find covariance.
III	Analyze the given data for appropriate test of hypothesis.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.01	CLO 1	Demonstrate knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix.	PO 1	1
AHS002.02	CLO 2	Finding rank by reducing the matrix to Echelon and Normal forms.	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.03	CLO 3	Determine inverse of the matrix by Gauss Jordon Method.	PO 1	3
AHS002.04	CLO 4	Apply the method of LU Decomposition and solve the simultaneous equations.	PO 2	2
AHS002.05	CLO 5	Use the method of LU factorization real world problems such as circuit designing and solving complex circuits	PO 2	3
AHS002.06	CLO 6	Use the method of LU factorization real world problems such as economize and accumulate sums in double precision Computer Programme.	PO 2	2
AHS002.07	CLO 7	Interpret the Eigen values and Eigen vectors of matrix for a linear transformation and use properties of Eigen values	PO 4	1
AHS002.08	CLO 8	Understand the concept of Eigen values in real world problems of control field where they are pole of closed loop system.	PO 4	1
AHS002.09	CLO 9	Apply the concept of Eigen values in real world problems of mechanical systems where Eigen values are natural frequency and mode shape.	PO4	1
AHS002.10	CLO 10	Use the system of linear equations and matrix to determine the dependency and independency.	PO 2	2
AHS002.11	CLO 11	Determine a modal matrix, and reducing a matrix to diagonal form.	PO 1	3
AHS002.12	CLO 12	Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem.	PO 1	3
AHS002.13	CLO 13	Solving differential equations of first order.	PO 1	3
AHS002.14	CLO 14	Finding orthogonal trajectories of Cartesian and polar equations.	PO 1, PO 2	2
AHS002.15	CLO 15	Apply the first order differential equations in real world problems such as Newton's Law of cooling and Law of natural growth and decay	PO 2	2
AHS002.16	CLO 16	Solving Second and higher order differential equations with constant coefficients.	PO 2	2
AHS002.17	CLO 17	Apply the second order differential equations for real world problems of electrical circuits and simple harmonic motion.	PO 4	1
AHS002.18	CLO 18	Apply the Mean value theorems for the single variable functions.	PO 1, PO 2	2
AHS002.19	CLO 19	Understand the basic concepts of Partial Differential equations.	PO 1, PO 2	2
AHS002.20	CLO 20	Determine Jacobian for the coordinate transformation	PO 1, PO 2	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS002.21	CLO 21	Apply the technique of Jacobian and inverse Jacobian relation to real world problems such as kinematics and inverse kinematic solutions of robot manipulators.	PO 4	1
AHS002.22	CLO 22	Understand the techniques of multidimensional change –of –variables to transform the coordinates by utilizing the Jacobian.	PO 1	3
AHS002.23	CLO 23	Apply maxima and minima for functions of several variable's and Lagrange's method of multipliers	PO 1	3
AHS002.24	CLO 24	Understand the concept and acquire the knowledge for attempting the competitive exams	PO 4	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	1												1		
CLO 2	2												1		
CLO 3	3												1		
CLO 4		2													
CLO 5		3													
CLO 6		2													
CLO 7				1									1		
CLO 8				1											
CLO 9				2									1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	1	2											1		
CLO 15		2													
CLO 16		2													

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 17				1									1		
CLO 18	1	2											1		
CLO 19	1	2											1		
CLO 20	1	2											1		
CLO 21				1											
CLO 22	3														
CLO 23	3														
CLO 24				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2	SEE Exams	PO 1, PO2, PO 4	Assignments	-	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-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, elementary matrix, finding rank of a matrix by reducing to Echelon form and normal form; Finding the inverse of a matrix using elementary row/column transformations: Gauss-Jordan method; Solving of linear system of equations by LU decomposition method.	
Unit-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; Properties of eigen values and eigen vectors of real and complex matrices; Diagonalization of matrix.	
Unit-III	**DIFFERENTIAL EQUATIONS OF FIRST ORDER AND THEIR APPLICATIONS**
Formation of a differential equation; Differential equations of first order and first degree: Exact, non exact, linear equations; Bernoulli equation; Applications of first order differential equations: Orthogonal trajectories; Newton's law of cooling; Law of natural growth and decay.	

Unit-IV	HIGHER ORDINARY LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS
Linear differential equations of second and higher order with constant coefficients, non homogeneous term of the type $f(x)=e^{ax}, \sin ax, \cos ax$ and $f(x)=x^n, e^{ax}v(x), x^n v(x)$; Method of variation of parameters; Applications to electrical circuits and simple harmonic motion.	
Unit-V	**FUNCTIONS OF SINGLE AND SEVERAL VARIABLES**
Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem and generalized mean value theorems-without proofs. Functions of several variables: Functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrang multipliers.	
Text Books:	
1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.	
Reference Books:	
1. RK Jain & SRK Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016. 2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata Mc Graw Hill Education, 1st Edition, 2009. 3. Srimanthapal & Suboth C.Bhunia, "Engineering Mathematics", Oxford Publishers, 3rd Edition, 2015.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Theory of Matrices Introduction of matrices	CLO 1	T1:22.5 R1:2.3
2-3	Real and complex matrices	CLO 2	T1:22.5 R1:2.4
4-6	Find rank by echelon and normal form	CLO 2	T1:22.6 R1:2.6
7	Gauss-Jordan method	CLO 4	T1:22.7 R1:4.4
8	LU decomposition method	CLO 4	T1:22.7 R1:4.10
9-12	Cayley Hamilton theorem	CLO 7	T1:22.8 R1:4.15
13-16	Eigen values and Eigen vectors	CLO 9	T1:22.9 R1:5.4
17-18	Diagonalisation	CLO 9	T1:22.9 R1:5.8
19--22	Differential equations Introduction of first order differential equations	CLO 11	T1:23.10 R1:6.8
23-24	Orthogonal trajectories	CLO 11	T1:23.10 R1:6.13
25-26	Applications	CLO 13	T1:23.9 R1:7.5
27-30	Second and Higher order differential equations with constant coefficients	CLO 11	T1:23.10 R1:7.5
31-34	Method of variation of parameters	CLO 9	T1:23.10 R1:8.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
35-36	Applications of second order differential equations	CLO 14	T1:23.1 R1:9.2
37	Differential Calculus Methods Verification of Rolle's Theorem to the given functions	CLO 14	T1:23.1 R1:9.4
38-39	Verification of Lagrange's Mean value theorem to the given functions	CLO 14	T1:23.1 R1:9.9
40	Verification of Cauchy's mean value theorem to the given functions	CLO 14	T1:23.1 R1:9.10
41	Functional dependence for two and three functions	CLO 14	T2:27.5 R1:10.2
42-43	Maxima and minima of functions of two variables without constraints	CLO 17	T2:27.7 R1:11.3
44-45	Lagranges method of undetermined multipliers	CLO 17	T2:27.8 R1:11.6

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with P0s	Relevance with PSOs
1	To improve standards and analyze the concepts.	Guest lecture	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:
Ms. P Rajani, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTATIONAL MATHEMATICS AND INTEGRAL CALCULUS**				
Course Code	AHS003				
Programme	B.Tech				
Semester	I	CSE | IT| ECE | EEE			
	II	AE| ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. V Subba Laxmi Assistant Professor				
Course Faculty	Dr. S Jagadha, Professor Ms. L Indira, Assistant Professor Mr. Ch Somashekar, Assistant Professor Ms. P Rajani, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of interpolation, curve fitting, numerical solutions of ordinary differential equations, multiple integrals, vector calculus and special functions. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Differentiation, integration and properties of vectors

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computational Mathematics and Integral calculus	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	2	Seminar
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	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of solving algebraic, transcendental and differential equation by numerical methods.
II	Apply multiple integration to evaluate mass, area and volume of the plane
III	Analyze gradient, divergence and curl to evaluate the integration over a vector field.
IV	Understand the Bessel's equation to solve them under special conditions with the help of series solutions.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS003.01	CLO 1	Solve the algebraic and transcendental equations using bisection method, method of false position and Newton-Raphson method.	PO 1	3
AHS003.02	CLO 2	Apply numerical methods to interpolate the functions of values for equal intervals using finite differences.	PO2	3
AHS003.03	CLO 3	Understand the Newton-Raphson method to the real-world problem for a finite barrier quantum well.	PO 4	1
AHS003.04	CLO 4	Evaluate the functional value by using Lagrange's interpolation formula for unequal intervals.	PO2	2
AHS003.05	CLO 5	Understand the Lagrange's interpolation in real-world problem for neural network learning.	PO 4	1
AHS003.06	CLO 6	Apply method of least squares to fit linear and non linear curves.	PO1, PO 2	2
AHS003.07	CLO 7	Solve differential equation using single step method- Taylor"s series.	PO 1	3
AHS003.08	CLO 8	Solve differential equation using multi step methods- Euler's, Modified Euler's and Runge Kutta methods.	PO 2	2
AHS003.09	CLO 9	Understand the multistep methods in real-worl problem for real time Aircraft dynamics.	PO 4	1
AHS003.10	CLO 10	Understand the Runge-Kutta method in real-world problem for embedding the sensor signals into the iterative computation.	PO 4	1
AHS003.11	CLO 11	Evaluate double integral and triple integrals .	PO 1	2
AHS003.12	CLO 12	Utilize the concept of change order of integration to evaluate double integrals.	PO 1,PO2	2
AHS003.13	CLO 13	Determine the area and volume of a given curves using double and triple integration.	PO 2	3
AHS003.14	CLO 14	Understand transformation of co-ordinate system from plane to plane.	PO 1	3
AHS003.15	CLO 15	Analyze scalar and vector fields and compute the gradient, divergence and curl.	PO 2	3
AHS003.16	CLO 16	Understand integration of vector function .	PO 1	2
AHS003.17	CLO 17	Evaluate line, surface and volume integral of vectors.	PO 1	3
AHS003.18	CLO 18	Use Vector integral theorems to facilitate vector integration .	PO 2	2
AHS003.19	CLO 19	Analyze the concept of vector calculus in real-world problem for fluid dynamics.	PO 4	1
AHS003.20	CLO 20	Solve the Differential Equations by series solutions.	PO 1	3
AHS003.21	CLO 21	Understand Gamma function to evaluate improper integrals.	PO 1	2
AHS003.22	CLO 22	Analyze Bessel's function and study its properties	PO 1	3
AHS003.23	CLO 23	Analyze Bessel's function as a Solution to Schrödinger equation in a cylindrical function of the second kind.	PO 4	1
AHS003.24	CLO 24	Understand gamma function to find application diverse areas as quantum physics.	PO 4	1
AHS003.25	CLO 25	Possess the knowledge and skills for	PO 4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		employability and to succeed in national and International level competitive examinations.		

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2		3											1		
CLO 3				1									1		
CLO 4		2													
CLO 5				1											
CLO 6	2	2													
CLO 7	3														
CLO 8	2														
CLO 9				1									1		
CLO 10				1									1		
CLO 11	2														
CLO 12	2	2													
CLO 13		3													
CLO 14	3												1		
CLO 15		3													
CLO 16	2														
CLO 17	3												1		
CLO 18		2											1		
CLO 19				1									1		
CLO 20	3												1		
CLO 21		2													
CLO 22	3														
CLO 23				1											

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 24				1											
CLO 25				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1 PO 2 PO 4	SEE Exams	PO 1 PO 2 PO 4	Assignments	-	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	ROOT FINDING TECHNIQUES AND INTERPOLATION
Root finding techniques: Solving algebraic and transcendental equations by Bisection method, Method of False position, Newton-Raphson method; Interpolation: Finite differences, forward differences, backward differences and central differences; Symbolic relations; Newton's forward interpolation, Newton's backward interpolation; Gauss forward central difference formula, Gauss backward central difference formula; Interpolation of unequal intervals: Lagrange,'s interpolation .	
UNIT-II	**CURVE FITTING AND NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**
Fitting a straight line; Second degree curves; Exponential curve, power curve by method of least squares; Taylor's series method; Step by step methods: Euler's method, modified Euler's method and Runge-Kutta method for first order differential equations .	
UNIT-III	**MULTIPLE INTEGRALS**
Double and triple integrals; Change of order of integration. Transformation of coordinate system; Finding the area of a region using double integration and volume of a region using triple integration.	
UNIT-IV	**VECTOR CALCULUS**
Scalar and vector point functions; Gradient, divergence, curl and their related properties; Solenoidal and irrotational vector point functions; Scalar potential function; Laplacian operator; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.	
UNIT-V	**SPECIAL FUNCTIONS**
Gamma function, properties of gamma function; Ordinary point and regular singular point of differential equations; Series solutions to differential equations around zero, Frobenius method about zero; Bessel"s differential equation: Bessel functions properties, recurrence relations, orthogonality, generating function, trigonometric expansions involving Bessel functions.	
Text Books:	
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012.	

Reference Books:
1. T.K.V Iyengar, B.Krishna Gandhi, "Mathematical methods", S. Chand & Co., 6th Edition, 2014. 2. R K Jain, S R K Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016. 3. S. S. Sastry, "Introduction Methods of Numerical Analysis", Prentice-Hall of India Private Limited, 5th Edition, 2012.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define Algebraic and Transcendental equations	CLO 1	T1:22.5 R1:2.3
2	Explain Bisection method to find the root of an equation.	CLO 1	T1:22.5 R1:2.4
3	Explain Method of False Position to to find root an equation.	CLO 1	T1:22.6 R1:2.6
4	Explain Newton-Raphson method to find root of an equation.	CLO 3	T1:22.7 R1:4.4
5	Define interpolation of the given data.	CLO 2	T1:22.7 R1:4.10
6	Explain symbolic relations the between the operators.	CLO 2	T1:22.8 R1:4.15
7	Define Newton's forward interpolation formula for evenly spaced intervals.	CLO 2	T1:22.9 R1:5.4
8	Define Newton's backward interpolation formula for evenly spaced intervals.	CLO 2	T1:22.9 R1:5.8
9	Define Gauss forward interpolation formula for evenly spaced intervals.	CLO 2	T1:23.10 R1:6.8
10	Define Gauss backward interpolation formula for evenly spaced intervals.	CLO 2	T1:23.10 R1:6.13
11	Demonstrate Lagrange's formula for unequal intervals.	CLO 5	T1:23.9 R1:7.5
12	Describe the best fit of a straight line by method of least squares.	CLO 6	T1:23.10 R1:7.5
13	Describe the best fit of a second degree parabola by method of least squares	CLO 6	T1:23.10 R1:8.1
14	Describe the best fit of an exponential curve by method of least squares.	CLO 6	T1:23.1 R1:9.2
15	Describe the best fit of a power curve by method of least squares	CLO 6	T1:23.1 R1:9.4
16	Solve the ordinary differential equation by Taylors series method.	CLO 6	T1:23.1 R1:9.9
17	Solve the ordinary differential equation by Euler's Method-Euler's modified method.	CLO 8	T1:23.1 R1:9.10
18	Solve the ordinary differential equation by Runge-Kutta Method.	CLO 8	T2:27.5 R1:10.2
19	Evaluate double and triple integrals.	CLO 8	T2:27.7 R1:11.3
20	Use the Change of order of integration cartesian and polar form.	CLO 12	T2:27.8 R1:11.6
21	Explain Transformation of co-ordinate system .	CLO 11	T2:27.12 R1:11.7
22	Use double integration for finding the area.	CLO 14	T2:27.12 R1:11.8
23	Use triple integration for finding the volume.	CLO 14	T2:27.12

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R1:11.9
24	Define vector calculus and vector fields and their properties	CLO 19	T2:27.12 R1:11.10
25	Determine Gradient, divergent and curl of vector fields.	CLO 19	T2:27.14 R1:12.3
26	Solve line integral along smooth path and find work done.	CLO 17	T2:27.1 R1:12.7
27	Evaluate surface integral.	CLO 17	T2:27.17 R1:12.15
28	Use Green's theorem to evaluate line integrals along simple closed contours on the plane.	CLO 17	T2:27.18 R1:12.19
29	Use Stokes' theorem to give a physical interpretation of the curl of a vector field .	CLO 17	T2:27.19 R2:14.4
30	Use the divergence theorem to give a physical interpretation of the divergence of a vector field.	CLO 17	T2:27.19 R2:14.5
31	Explain Gamma function s for improper integrals and gamma properties .	CLO 21	T2:27.19 R2:14.5
32	Define Ordinary and regular point of a differential equation.	CLO 23	T2:27.20 R2:14.5
33	Determine the solution of ordinary differential equations in series form.	CLO 23	T2:27.20 R2:14.5
34	Explain Frobenius Method about zero.	CLO 20	T2:27.19 R2:14.5
35	Define Bessel's Differential equation.	CLO 22	T2:27.19 R2:14.5
36-37	Explain Bessel's differential functions and properties.	CLO 22	T2:27.19 R2:14.5
38-39	Explain Recurrence relations for Bessel's function.	CLO 23	T2:27.19 R2:14.5
40-42	Explain Orthogonality of Bessel's function.	CLO 23	T2:27.20 R2:14.5
43-44	Explain Generating function of Bessel's function.	CLO 23	T2:27.20 R2:14.5
45	Explain trigonometric expansions of Bessel's function.	CLO 23	T2:27.19 R2:14.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Newton Raphson method, Lagranges interpolation, method of least square and Runge-kutta method	Seminars / NPTEL	PO 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 4	PSO 1

Prepared by:
Mr. V Subba Laxmi, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING CHEMISTRY**				
Course Code	AHS005				
Programme	B. Tech				
Semester	I	AE | CIVIL | CSE | ECE | EEE | IT | ME			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	2	1
Chief Coordinator	Ms. V Anitha Rani, Associate Professor				
Course Faculty	Dr. C Mahendar, Professor Mr. M Praveen, Assistant Professor Mr. B Raju, Assistant Professor Ms. M Malathi, Assistant Professor Mr. G Mahesh Kumar, Assistant Professor Ms. T Mallika, Assistant Professor Ms. M Lakshmi Prasanna, Assistant Professor Ms. M Swathi, Assistant Professor				

I. COURSE OVERVIEW:

The primary objective of an Engineering Chemistry course is to introduce the students to the concepts and applications of chemistry in engineering. It should cultivate in them an ability to identify chemistry in each piece of finely engineered products used in households and industry. It aims to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications. It deals with applied and industrially useful topics, such as water technology, engineering materials, electrode potential and cells, fuels, polymers and corrosion. Water and its treatment for various purposes, engineering materials such as plastics, composites, ceramic, abrasives, their preparation, properties and applications, conventional and non-conventional energy sources, nuclear, solar, various batteries, combustion calculations, corrosion and control of metallic materials.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of chemistry

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Chemistry	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Seminar
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.	2	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Apply the electrochemical principles in batteries.
II	Understand the fundamentals of corrosion and development of different techniques in corrosion control.
III	Analysis of water for its various parameters and its significance in industrial, applications.
IV	Improve the fundamental science and engineering principles relevant to materials.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS005.01	CLO 1	Extrapolate the knowledge of electrolytic cell, electrochemical cell, electrode potential and reference electrodes.	PO 1	3
AHS005.02	CLO 2	Use of primary and secondary batteries in various fields such as automobiles, railways, medical devices, aircrafts and day to day life.	PO 1 PO 2	1
AHS005.03	CLO 3	Explain the characteristic factors of a metal and environment influencing the rate of corrosion.	PO 1 PO 7	2
AHS005.04	CLO 4	Use appropriate methods such as protective, metallic and organic coatings to control corrosion in metals.	PO 1 PO 7	2
AHS005.05	CLO 5	Evaluate the quality and utility of suitable water for industrial as well as domestic applications.	PO 1 PO 7	3
AHS005.06	CLO 6	Use innovative methods to improve the quality of soft water for Potable and industrial purpose at cheaper cost.	PO 1 PO 7	2
AHS005.07	CLO 7	Understand the concepts of polymers for viscoelastic nature of polymer materials in real-time application.	PO 1 PO 7	1
AHS005.08	CLO 8	Demonstrate the ability to use polymeric materials for engineering problems in different domains.	PO 1 PO 7	1
AHS005.09	CLO 9	Justify the immense importance of basic constructional material, Portland cement in civil engineering works.	PO 1	1
AHS005.10	CLO 10	Describe various instruments used for measuring various properties of lubricants in industries.	PO 1	3
AHS005.11	CLO 11	Understand refractory use in metallurgical furnaces, kilns and other equipments.	PO 1	2
AHS005.12	CLO 12	Demonstrate comprehensive knowledge of conventional fuel properties on engine performance.	PO 1	2
AHS005.13	CLO 13	Understand the importance of cracking, knocking in IC engines and operations involved in petroleum refining for real-time application.	PO 1 PO 2	2
AHS005.14	CLO 14	Describe the physical and chemical properties of alternate fuels like natural gas, LPG and CNG.	PO 1	1
AHS005.15	CLO 15	Determine efficiency of the fuel in terms of calorific value and combustion reactions of the fuel.	PO 1	2
AHS005.16	CLO 16	Understand the concepts of electro chemistry in solar cell, Fuel cells and batteries for real-time application.	PO 1	2
AHS005.17	CLO 17	Understand the concepts of corrosion control methods in pipeline leaks and ruptures as real-time application.	PO 1 PO 7	2
AHS005.18	CLO 18	Understand the concepts of water technology in applications of image recognition for real-time water level and surface velocity.	PO 1 PO 7	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	2	1											1		
CLO 3	2						2								
CLO 4	2						2								
CLO 5	3						3								
CLO 6	2						2								
CLO 7	2						1						1		
CLO 8	1						1						1		
CLO 9	1														
CLO 10	3														
CLO 11	2														
CLO 12	2												1		
CLO 13	3	1											1		
CLO 14	1														
CLO 15	2												1		
CLO 16	2														
CLO 17	2						2								
CLO 18	2						2								

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 2, PO 7	SEE Exams	PO 1,PO 2 PO 7	Assignments	PO 2	Seminars	PO 1, PO 2
Laboratory Practices	PO 1	Student Viva	-	Mini Project	-	Certificatior	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	ELECTROCHEMISTRY AND BATTERIES
Electrochemistry: Basic concepts of electrochemistry; Conductance: Specific, equivalent and molar conductance and effect of dilution on conductance; Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; Electrochemical series and its applications; Nernst equation; Types of electrodes: Calomel electrode, quinhydrone electrode; Batteries: Classification of batteries, primary cells (dry cells) and secondary cells (lead-acid battery, Ni-Cd cell), applications of batteries, numerical problems.	
Unit-II	**CORROSION AND ITS CONTROL**
Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions.	
Unit-III	**WATER TECHNOLOGY**
Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement. Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.	
Unit-IV	**MATERIALS CHEMISTRY**
Materials chemistry: 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; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples.	
Unit-V	**FUELS AND COMBUSTION**
Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.	
Text Books:	
1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 15th	

Edition, 2015. 2. Shashi Chawla, "Text Book of Engineering Chemistry" Dhanat Rai and Company, 1st Edition 2011
Reference Books:
1.B. Siva Shankar, "Engineering Chemistry", Tata McGraw Hill Publishing Limited, 3rd Edition, 2015. 2. S. S. Dara, Mukkanti, "Text of Engineering Chemistry", S. Chand & Co, New Delhi, 12th Edition, 2006. 3. C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5thEdition, 2013. 4.R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.

XIV.COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understands the concept of electrochemistry. Differentiate the electronic conductors and electrolytes.	CLO 1	T1:5.1,6.3
2	Define the terms specific, equivalence and molar conductance. Explain the dilution effect on these conductance	CLO 1	T1:5.5
3	Understands the concept of specific, equivalence and molar conductance. Define the EMF of the cell. Demonstrate the Daniel cell.	CLO 1	T2:6.1,6.2, 6.3
4	Describe the construction and chemical reactions of different electrodes. Use the Calomel	CLO 1	T2:11,12.2.1
5	Quinhydrone electrodes in calculation of potential of the single electrode.	CLO 1	T1:6.7(4)
6	Derive the relation between cell reaction and emf of the single electrodes.	CLO 1	T2:3.4
7	Use the standard potential values of elements from electrochemical series.	CLO 1	T2:5,5.1
8	Define the battery; differentiate the primary and secondary batteries. Demonstrate the construction of the dry cell.	CLO 2	T2:16,17.1
9	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.3
10	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.4
11	Define corrosion and its disadvantages.	CLO 3	T2:1.1
12	Explain the mechanism of oxidation corrosion when dry gases attack on metal.	CLO 3	T2:2.1
13	Explain the mechanism of hydrogen evolution type and oxygen absorption type corrosion.	CLO 3	T2:2.2
14	Distinguish the types of corrosion.	CLO 3	T2:2.4.5
15	Analyze the effect of different factors on rate of corrosion.	CLO 3	T2:5,5.1,5.2
16	Explain the process of cathodic protection with examples.	CLO 4	T2:6.4
17	Use the methods of application of metallic coatings and Relate the galvanization and tinning	CLO 4	T1:17.1
18	Explain the process of electroplating. Apply the organic coatings for control of corrosion.	CLO 4	T1:8.6 T2:6.3.3
19	List the various sources of water, Differentiate the temporary and permanent hardness and give its units.	CLO 5	T2:3,4,5

Lecture No	Topics to be covered	CLOs	Reference
20	Calculate the total, permanent and temporary hardness of sample hard water by using EDTA	CLO 5	T2:6
21	Calculate the dissolved oxygen in water by Winkler's method	CLO 5	T1:1.14(4)
22-23	Recognize the boiler troubles.	CLO 5	T2:9.2,9.5
24	Discuss the internal treatment methods of boiler feed water. Name the different chemicals used in internal treatment.	CLO 6	T2:12,12.4, 12.2,12.3
25	Explain the process of zeolite and analyze the advantages and disadvantages.	CLO 6	T2:11.2
26	Explain ion-exchange process.	CLO 6	T2:11.3,13
27	Demonstrate the treatment of potable water Purification of potable water. Describe the process of reverse osmosis	CLO 6	T2:13,14 (d)
28	Define monomer and polymer Explain the mechanism of different types of Chain and step growth polymerization.	CLO 7	T2:2,2.2,4,4.1,4.2,4.7
29	Distinguish the thermoplastic and thermo set plasitcs. Illustrate the compounding of plastics.	CLO 7	T1:3.14,3.13.12
30	Identify the preparation, properties and applications of different thermo and thermo set plastics.	CLO 8	T2:2.3,2.7,2.8
31	Identify the preparation, properties and applications of thermo set plastics. Explain about natural rubber.	CLO 8	T2:3,3.1,3.2, 3.3
32	Explain the preparation, properties and applications of synthetic rubbers.	CLO 8	T1:3.24 T2:4.2
33	Explain the preparation, properties and applications of fibers.	CLO 8	T1:3.28 R4:114
34	Generalize the process of setting and hardening reactions of cement	CLO 9	T2:9.3.2, 9.3.3
35	Define the term lubricant and it's classification.	CLO 10	T2:7.4
36	Compare the different types of lubricants based on their properties.	CLO 10	T2:7.5
37	Name the different types of refractories. Discuss the characteristics and applications of refractories.	CLO 11	T2:8.2,8.3
38	Define the fuel with examples. Categorize the different types of fuels.	CLO 12	T2:5.2,5.3
39	Analyze the different types of coals. Explain the significance of proximate analysis of coal.	CLO 12	T2:5.7,5.8,5.8.1
40	Explain the significance of Ultimate analysis of coal.	CLO 12	T2:5.8.2
41	Identify the chemical constituents of petroleum. Describe the refining of petroleum. Define the term cracking. Distinguish the fixed bed and catalytic cracking.	CLO 13	T1:2.18,2.19 2.19(a)
42	Evaluate the octane and cetane rating of the petrol and diesel.	CLO 13	T1:2.23
43	Identify the chemical constituents of the gaseous fuel. Discuss the characteristics of natural gas. Compare the LPG and CNG.	CLO 14	T1:2.28,2.26 T2:5.14.1 R4:247
44	Explain the combustion process of different chemical constituents present in the fuel. Differentiate the HCV and LCV.	CLO 15	T2:5.4,5.5
45	Evaluate the air quantity required for complete combustion of fuel.	CLO 15	T2:5.4.1, 6.5

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Galvanic cell, batteries-lead acid cells, Crevice corrosion, cathodic protection, galvanizing, Electroplating.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
2	Softening techniques, plastics, cement, refining of petroleuim.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
3	Thiokol rubber, EDTA method, Dissolved oxygen, Viscosity, P^H meter.	Assignments / Laboratory Practices	PO 1	PSO 1

Prepared by:
Ms. V Anitha Rani, Associate Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043
ENGINEERING PHYSICS

ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE DESCRIPTOR

Course Title	**ENGINEERING PHYSICS**				
Course Code	AHS006				
Programme	B.Tech				
Semester	I	CSE | IT | ECE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. S Charvani, Assistant Professor				
Course Faculty	Ms. S Charvani, Assistant Professor Ms K Sowmya, Assistant Professor Mr. K Saibaba, Assistant Professor Mr. V S K Prasada Rao, Assistant Professor Mr. A Chandra Prakash., Assistant Professor				

I. COURSE OVERVIEW:

The course matter is divided into five units covering duly-recognized areas of theory and study. This course develops abstract and critical reasoning by studying mathematical and logical proofs and assumptions as applied in basic physics and to make connections between physics and other branches of sciences and technology. The topics covered include nano materials, lasers, dielectric and magnetic properties, principles of quantum mechanics and semiconductors physics. The course helps students to gain knowledge of basic principles and appreciate the diverse applications in technological fields in respective branches and also in their lives.

II. COURSE PRE-REQUISITES:

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

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Physics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are

be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	2	Seminar
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	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills**: Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering**: Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop strong fundamentals of nano materials.
II	Meliorate the knowledge of theoretical and technological aspects of lasers.
III	Correlate principles with applications of the quantum mechanics, dielectric and magnetic materials.
IV	Enrich knowledge in modern engineering materials like semiconductors..

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS010.01	CLO 1	Recall the basic principles of physics.	PO 1 , PO 2	3
AHS010.02	CLO 2	Apply the concepts and principles in solving the problems of physics.	PO 1 , PO 4	3
AHS010.03	CLO 3	Acquire knowledge of basic terms related to dielectric material and different polarization mechanisms.	PO 1 , PO 4	3
AHS010.04	CLO 4	Review the properties of different magnetic materials and magnetization based on orientation of domains.	PO 1 , PO 4	2
AHS010.05	CLO 5	Understand the basic principles involved in the production of Laser light.	PO 1 , PO 2	2
AHS010.06	CLO 6	Describe the construction and working of different types of Laser systems.	PO 1 , PO 2	2
AHS010.07	CLO 7	Explain the basic principles, properties and applications of nanomaterials.	PO 1 , PO 4	1
AHS010.08	CLO 8	Develop knowledge about different techniques of producing nanomaterials.	PO 2 , PO 4	1
AHS010.09	CLO 9	Interpret and verify dual nature of matter wave concept using Davisson & Germer's experiment.	PO 2 , PO 4	2
AHS010.10	CLO 10	Estimate the energy of the particles using Schrödinger's wave equation and apply it to particle in potential box.	PO 1 , PO 2	2
AHS010.11	CLO 11	Recollect the conductivity mechanism involved in semiconductors and calculate carrier concentrations.	PO 1 , PO 4	3
AHS010.12	CLO 12	Discuss about energy gap, direct, indirect band-gap semiconductors and Hall Effect.	PO 1 , PO 2	3
AHS010.13	CLO 13	Correlate different concepts of physics with day to day life applications.	PO 1	3
AHS010.14	CLO 14	Understand the technical importance of dielectric, magnetic and semiconductor materials.	PO 2	2
AHS010.15	CLO 15	Identify the modern engineering devices based on nano materials and Lasers.	PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	3			1									1		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 3	2			2									1		
CLO 4	3	1													
CLO 5	3	2													
CLO 6	3	2											1		
CLO 7	2			1									1		
CLO 8		2		1											
CLO 9		1		2									1		
CLO 10	3	1											1		
CLO 11	3			1											
CLO 12	2	2											1		
CLO 13	2														
CLO 14		2											1		
CLO 15				1											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2,PO4	SEE Exams	PO1,PO 2,PO4	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	PO 1,PO 2,PO4	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	DIELECTRIC AND MAGNETIC PROPERTIES
Dielectric properties: Basic definitions, electronic, ionic and orientation polarizations-qualitative; Internal field in solids; Magnetic properties: Basic definitions, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment,	

domain theory of ferro magnetism on the basis of hysteresis curve.
Unit-II **LASERS**
Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, Einstein's coefficients, ruby laser, He-Ne laser, semiconductor diode laser and applications of lasers.
Unit-III **NANOMATERIAL**
Nanomaterial: Origin of nanomaterial, nano scale, surface to volume ratio, quantum confinement; Properties of nanomaterials: Physical, chemical, electrical, optical, magnetic and mechanical. Bottom-up fabrication: Sol-gel; Top-down fabrication: Chemical vapour deposition; Applications of nanomaterials, characterization by XRD, TEM.
Unit-IV **QUANTUM MECHANICS**
Quantum mechanics: Waves and particles, De Broglie hypothesis, matter waves, Heisenberg's uncertainty principle, Davisson and Germer experiment, Schrodinger's time independent wave equation, physical significance of the wave function, infinite potential well and its extension to three dimensions.
Unit-V **SEMICONDUCTOR PHYSICS**
Semiconductor physics: Fermi level in intrinsic and extrinsic semiconductors, calculation of carrier concentration in intrinsic and extrinsic semiconductors, energy gap, direct and indirect band gap semiconductors, Hall effect.
Text Books:
1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", Chand & Co. New Delhi, 1st Edition, 2010. 2. P. K. Palanisamy, "Engineering Physics", Scitech Publishers, 4th Edition, 2014.
Reference Books:
1 V. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1st Edition, 2010. 2 R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001. 3. A. J. Dekker, "Solid State Physics", Macmillan India ltd, 1st Edition, 2000. 4. Hitendra K. Malik, A. K. Singh, "Engineering Physics", Mc Graw Hill Education, 1st Edition, 2009.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Acquire knowledge of basic terms related to dielectric materials.	CLO 3	T1:13.5 R1:1.3
2	Discuss different polarization mechanisms in dielectrics	CLO 3	T1:13.5 R1:1.3
3	Derive expression for total electric field at a given point inside dielectrics.	CLO 3	T1:13.5 R1:1.3
4	Acquire knowledge of basic terms related to magnetic materials.	CLO 4	T1:14.7 R1:3.4
5	Describe magnetic moment in an atom in terms of Bohr Magneton	CLO 4	T1:15.7 R1:4.10
6	Classify different magnetic materials based on electron theory.	CLO 4	T1:16.8 R1:4.15
7	Examine the spontaneous magnetization in ferro-magnets based on orientation of domains.	CLO 4	T1:16.9 R1:5.4
8	Explain the principle involved in Lasers	CLO 5	T1:17.9 R1:5.8
9	Review basic phenomena's of laser	CLO 5	T1:18.10 R1:6.8
10	Acquire knowledge of basic terms related to lasers	CLO 5	T1:19.10

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R1:6.13
11	Discuss functioning of laser system	CLO 5	T1:19.9 R1:7.5
12	Derive relation between Einstein's Coefficients	CLO 5	T1:23.10 R1:7.5
13	Explain the principle and working of Ruby laser	CLO 5	T1:23.10 R1:8.1
14	Explain the principle and working of Helium-Neon laser	CLO 5	T1:23.1 R1:9.2
15	Explain the principle and working of semiconductor diode laser	CLO 5	T1:23.1 R1:9.4
16	Explain the principle and working of Helium-Neon laser	CLO 5	T1:23.1 R1:9.9
17	Explain the principle and working of semiconductor diode laser	CLO 5	T1:23.1 R1:9.10
18	Discuss the uses of lasers	CLO 5	T2:27.5 R1:10.2
19	Identify the principle of nano technology	CLO 7	T2:27.7 R1:11.3
20	Recall origin of nanomaterials	CLO 7	T2:27.8 R1:11.6
21	Acquire knowledge of basic principle of nanomaterials.	CLO 7	T2:27.12 R1:11.7
22	Analyze nano material with their properties	CLO 7	T2:27.12 R1:11.8
23	Develop nanomaterials in sol gel method	CLO 8	T2:27.12 R1:11.9
24	Develop nanomaterials chemical method	CLO 8	T2:27.12 R1:11.10
25	Discuss applications of nanomaterials	CLO 8	T2:27.14 R1:12.3
26	Analyze nanomaterials by XRD	CLO 8	T2:27.1 R1:12.7
27	Analyze nanomaterials by TEM	CLO 8	T2:27.17 R1:12.15
28	Understand dual nature of radiation	CLO 9	T2:27.18 R1:12.19
29	Correlate dual nature to material particle	CLO 9	T2:27.19 R2:14.4
30	Analyze matter wave concept mathematically	CLO 9	T2:27.20 R2:14.5
31	Describe matter waves and Heisenberg's Uncertainty Principle	CLO 9	T2:30.19 R2:14.5
32-34	Identify existence of matter wave experimentally	CLO 9	T2:30.20 R2:15.5
35-37	Derive wave equation of matter wave	CLO 9	T2:32.19 R2:16.5
38	Correlate wavefunction to probability density.	CLO 10	T2:32.20 R2:16.5
39-41	Derive the solution of wave equation in terms of Potential box	CLO 10	T2:33.1 R2:16.6
42-44	Apply to three dimensions	CLO 10	T2:34.1 R2:17.1
45-48	Explain basic concepts of semiconductors	CLO 11	T2:35.2 R2:17.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
49-55	Derive carrier concentration in intrinsic Semiconductors	CLO 11	T2:36.1 R2:18.1
56-58	Identify Fermi level in semiconductors	CLO 11	T2:39.19 R2:16.5
59	Determine energy gap mathematically	CLO 12	T2:40.19 R2:16.5
60	Compare Direct &Indirect Band Gap semiconductors, Hall Effect	CLO 12	T2:41.19 R2:16.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest Lecture	PO 2	PSO 1

Prepared by:
Ms. S Charvani, Assistant Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING CHEMISTRY**				
Course Code	AHS005				
Programme	B. Tech				
Semester	I	AE | CIVIL | CSE | ECE | EEE | IT | ME			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	2	1
Chief Coordinator	Ms. V Anitha Rani, Associate Professor				
Course Faculty	Dr. C Mahendar, Professor Mr. M Praveen, Assistant Professor Mr. B Raju, Assistant Professor Ms. M Malathi, Assistant Professor Mr. G Mahesh Kumar, Assistant Professor Ms. T Mallika, Assistant Professor Ms. M Lakshmi Prasanna, Assistant Professor Ms. M Swathi, Assistant Professor				

I. COURSE OVERVIEW:

The primary objective of an Engineering Chemistry course is to introduce the students to the concepts and applications of chemistry in engineering. It should cultivate in them an ability to identify chemistry in each piece of finely engineered products used in households and industry. It aims to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications. It deals with applied and industrially useful topics, such as water technology, engineering materials, electrode potential and cells, fuels, polymers and corrosion. Water and its treatment for various purposes, engineering materials such as plastics, composites, ceramic, abrasives, their preparation, properties and applications, conventional and non-conventional energy sources, nuclear, solar, various batteries, combustion calculations, corrosion and control of metallic materials.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of chemistry

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Chemistry	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Seminar
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.	2	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Apply the electrochemical principles in batteries.
II	Understand the fundamentals of corrosion and development of different techniques in corrosion control.
III	Analysis of water for its various parameters and its significance in industrial, applications.
IV	Improve the fundamental science and engineering principles relevant to materials.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS005.01	CLO 1	Extrapolate the knowledge of electrolytic cell, electrochemical cell, electrode potential and reference electrodes.	PO 1	3
AHS005.02	CLO 2	Use of primary and secondary batteries in various fields such as automobiles, railways, medical devices, aircrafts and day to day life.	PO 1 PO 2	1
AHS005.03	CLO 3	Explain the characteristic factors of a metal and environment influencing the rate of corrosion.	PO 1 PO 7	2
AHS005.04	CLO 4	Use appropriate methods such as protective, metallic and organic coatings to control corrosion in metals.	PO 1 PO 7	2
AHS005.05	CLO 5	Evaluate the quality and utility of suitable water for industrial as well as domestic applications.	PO 1 PO 7	3
AHS005.06	CLO 6	Use innovative methods to improve the quality of soft water for Potable and industrial purpose at cheaper cost.	PO 1 PO 7	2
AHS005.07	CLO 7	Understand the concepts of polymers for viscoelastic nature of polymer materials in real-time application.	PO 1 PO 7	1
AHS005.08	CLO 8	Demonstrate the ability to use polymeric materials for engineering problems in different domains.	PO 1 PO 7	1
AHS005.09	CLO 9	Justify the immense importance of basic constructional material, Portland cement in civil engineering works.	PO 1	1
AHS005.10	CLO 10	Describe various instruments used for measuring various properties of lubricants in industries.	PO 1	3
AHS005.11	CLO 11	Understand refractory use in metallurgical furnaces, kilns and other equipments.	PO 1	2
AHS005.12	CLO 12	Demonstrate comprehensive knowledge of conventional fuel properties on engine performance.	PO 1	2
AHS005.13	CLO 13	Understand the importance of cracking, knocking in IC engines and operations involved in petroleum refining for real-time application.	PO 1 PO 2	2
AHS005.14	CLO 14	Describe the physical and chemical properties of alternate fuels like natural gas, LPG and CNG.	PO 1	1
AHS005.15	CLO 15	Determine efficiency of the fuel in terms of calorific value and combustion reactions of the fuel.	PO 1	2
AHS005.16	CLO 16	Understand the concepts of electro chemistry in solar cell, Fuel cells and batteries for real-time application.	PO 1	2
AHS005.17	CLO 17	Understand the concepts of corrosion control methods in pipeline leaks and ruptures as real-time application.	PO 1 PO 7	2
AHS005.18	CLO 18	Understand the concepts of water technology in applications of image recognition for real-time water level and surface velocity.	PO 1 PO 7	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	2	1											1		
CLO 3	2						2								
CLO 4	2						2								
CLO 5	3						3								
CLO 6	2						2								
CLO 7	2						1						1		
CLO 8	1						1						1		
CLO 9	1														
CLO 10	3														
CLO 11	2														
CLO 12	2												1		
CLO 13	3	1											1		
CLO 14	1														
CLO 15	2												1		
CLO 16	2														
CLO 17	2						2								
CLO 18	2						2								

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 2, PO 7	SEE Exams	PO 1,PO 2 PO 7	Assignments	PO 2	Seminars	PO 1, PO 2
Laboratory Practices	PO 1	Student Viva	-	Mini Project	-	Certificatior	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	ELECTROCHEMISTRY AND BATTERIES
Electrochemistry: Basic concepts of electrochemistry; Conductance: Specific, equivalent and molar conductance and effect of dilution on conductance; Electrochemical cells: Galvanic cell (daniel cell); Electrode potential; Electrochemical series and its applications; Nernst equation; Types of electrodes: Calomel electrode, quinhydrone electrode; Batteries: Classification of batteries, primary cells (dry cells) and secondary cells (lead-acid battery, Ni-Cd cell), applications of batteries, numerical problems.	
Unit-II	**CORROSION AND ITS CONTROL**
Corrosion: Introduction, causes and effects of corrosion; Theories of corrosion: Chemical and electrochemical corrosion with mechanism; Factors affecting the rate of corrosion: Nature of the metal and nature of the environment; Types of corrosion: Waterline and crevice corrosion; Corrosion control methods: Cathodic protection- sacrificial anodic protection and impressed current cathodic protection; Surface coatings: Metallic coatings, methods of application of metallic coatings-hot dipping(galvanizing, tinning), electroplating(copper plating); Organic coatings: Paints, its constituents and their functions.	
Unit-III	**WATER TECHNOLOGY**
Water: Sources and impurities of water, hardness of water, expression of hardness-units; Types of hardness: Temporary hardness, permanent hardness and numerical problems; Estimation of temporary and permanent hardness of water by EDTA method; Determination of dissolved oxygen by Winkler's method; Boiler troubles: Priming, foaming, scales, sludges and caustic embrittlement. Treatment of water: Internal treatment of boiler feed water- carbonate, calgon and phosphate conditioning, softening of water by Zeolite process and Ion exchange process; Potable water-its specifications, steps involved in the treatment of potable water, sterilization of potable water by chlorination and ozonization, purification of water by reverse osmosis process.	
Unit-IV	**MATERIALS CHEMISTRY**
Materials chemistry: 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; Rubbers: Natural rubber its process and vulcanization; Elastomers: Buna-s and Thiokol rubber; Fibers: Characteristics of fibers, preparation properties and applications of Dacron; Characteristics of fiber reinforced plastics; Cement: Composition of Portland cement, setting and hardening of Portland cement; Lubricants: Classification with examples; Properties: Viscosity, flash, fire, cloud and pour point; Refractories: Characteristics and classification with examples.	
Unit-V	**FUELS AND COMBUSTION**
Fuel: Definition, classification of fuels and characteristics of a good fuels; Solid fuels: Coal; Analysis of coal: Proximate and ultimate analysis; Liquid fuels: Petroleum and its refining; Cracking: Fixed bed catalytic cracking; Knocking: Octane and cetane numbers; Gaseous fuels: Composition, characteristics and applications of natural gas, LPG and CNG; Combustion: Calorific value: Gross Calorific Value(GCV) and Net Calorific Value(NCV), calculation of air quantity required for complete combustion of fuel, numerical problems.	
Text Books:	
1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 15th	

Edition, 2015. 2. Shashi Chawla, "Text Book of Engineering Chemistry" Dhanat Rai and Company, 1st Edition 2011
Reference Books:
1.B. Siva Shankar, "Engineering Chemistry", Tata McGraw Hill Publishing Limited, 3rd Edition, 2015. 2. S. S. Dara, Mukkanti, "Text of Engineering Chemistry", S. Chand & Co, New Delhi, 12th Edition, 2006. 3. C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5thEdition, 2013. 4.R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.

XIV.COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understands the concept of electrochemistry. Differentiate the electronic conductors and electrolytes.	CLO 1	T1:5.1,6.3
2	Define the terms specific, equivalence and molar conductance. Explain the dilution effect on these conductance	CLO 1	T1:5.5
3	Understands the concept of specific, equivalence and molar conductance. Define the EMF of the cell. Demonstrate the Daniel cell.	CLO 1	T2:6.1,6.2, 6.3
4	Describe the construction and chemical reactions of different electrodes. Use the Calomel	CLO 1	T2:11,12.2.1
5	Quinhydrone electrodes in calculation of potential of the single electrode.	CLO 1	T1:6.7(4)
6	Derive the relation between cell reaction and emf of the single electrodes.	CLO 1	T2:3.4
7	Use the standard potential values of elements from electrochemical series.	CLO 1	T2:5,5.1
8	Define the battery; differentiate the primary and secondary batteries. Demonstrate the construction of the dry cell.	CLO 2	T2:16,17.1
9	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.3
10	Identify the anode, cathode and electrolyte in different types of secondary batteries. Employ the applications of different types of batteries.	CLO 2	T2:17.4
11	Define corrosion and its disadvantages.	CLO 3	T2:1.1
12	Explain the mechanism of oxidation corrosion when dry gases attack on metal.	CLO 3	T2:2.1
13	Explain the mechanism of hydrogen evolution type and oxygen absorption type corrosion.	CLO 3	T2:2.2
14	Distinguish the types of corrosion.	CLO 3	T2:2.4.5
15	Analyze the effect of different factors on rate of corrosion.	CLO 3	T2:5,5.1,5.2
16	Explain the process of cathodic protection with examples.	CLO 4	T2:6.4
17	Use the methods of application of metallic coatings and Relate the galvanization and tinning	CLO 4	T1:17.1
18	Explain the process of electroplating. Apply the organic coatings for control of corrosion.	CLO 4	T1:8.6 T2:6.3.3
19	List the various sources of water, Differentiate the temporary and permanent hardness and give its units.	CLO 5	T2:3,4,5

Lecture No	Topics to be covered	CLOs	Reference
20	Calculate the total, permanent and temporary hardness of sample hard water by using EDTA	CLO 5	T2:6
21	Calculate the dissolved oxygen in water by Winkler's method	CLO 5	T1:1.14(4)
22-23	Recognize the boiler troubles.	CLO 5	T2:9.2,9.5
24	Discuss the internal treatment methods of boiler feed water. Name the different chemicals used in internal treatment.	CLO 6	T2:12,12.4, 12.2,12.3
25	Explain the process of zeolite and analyze the advantages and disadvantages.	CLO 6	T2:11.2
26	Explain ion-exchange process.	CLO 6	T2:11.3,13
27	Demonstrate the treatment of potable water Purification of potable water. Describe the process of reverse osmosis	CLO 6	T2:13,14 (d)
28	Define monomer and polymer Explain the mechanism of different types of Chain and step growth polymerization.	CLO 7	T2:2,2.2,4,4.1,4.2,4.7
29	Distinguish the thermoplastic and thermo set plasitcs. Illustrate the compounding of plastics.	CLO 7	T1:3.14,3.13.12
30	Identify the preparation, properties and applications of different thermo and thermo set plastics.	CLO 8	T2:2.3,2.7,2.8
31	Identify the preparation, properties and applications of thermo set plastics. Explain about natural rubber.	CLO 8	T2:3,3.1,3.2, 3.3
32	Explain the preparation, properties and applications of synthetic rubbers.	CLO 8	T1:3.24 T2:4.2
33	Explain the preparation, properties and applications of fibers.	CLO 8	T1:3.28 R4:114
34	Generalize the process of setting and hardening reactions of cement	CLO 9	T2:9.3.2, 9.3.3
35	Define the term lubricant and it's classification.	CLO 10	T2:7.4
36	Compare the different types of lubricants based on their properties.	CLO 10	T2:7.5
37	Name the different types of refractories. Discuss the characteristics and applications of refractories.	CLO 11	T2:8.2,8.3
38	Define the fuel with examples. Categorize the different types of fuels.	CLO 12	T2:5.2,5.3
39	Analyze the different types of coals. Explain the significance of proximate analysis of coal.	CLO 12	T2:5.7,5.8,5.8.1
40	Explain the significance of Ultimate analysis of coal.	CLO 12	T2:5.8.2
41	Identify the chemical constituents of petroleum. Describe the refining of petroleum. Define the term cracking. Distinguish the fixed bed and catalytic cracking.	CLO 13	T1:2.18,2.19 2.19(a)
42	Evaluate the octane and cetane rating of the petrol and diesel.	CLO 13	T1:2.23
43	Identify the chemical constituents of the gaseous fuel. Discuss the characteristics of natural gas. Compare the LPG and CNG.	CLO 14	T1:2.28,2.26 T2:5.14.1 R4:247
44	Explain the combustion process of different chemical constituents present in the fuel. Differentiate the HCV and LCV.	CLO 15	T2:5.4,5.5
45	Evaluate the air quantity required for complete combustion of fuel.	CLO 15	T2:5.4.1, 6.5

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Galvanic cell, batteries-lead acid cells, Crevice corrosion, cathodic protection, galvanizing, Electroplating.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
2	Softening techniques, plastics, cement, refining of petroleuim.	Seminars / Guest Lectures / NPTEL	PO 1	PSO 1
3	Thiokol rubber, EDTA method, Dissolved oxygen, Viscosity, P^H meter.	Assignments / Laboratory Practices	PO 1	PSO 1

Prepared by:
Ms. V Anitha Rani, Associate Professor

HOD, FRESHMAN ENGINEERING

II SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE DESCRIPTOR

Course Title	**DATA STRUCTURES**				
Course Code	ACS002				
Programme	B.Tech				
Semester	II	CSE | IT | ECE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. B Padmaja, Associate Professor				
Course Faculty	Dr. J Sirisha Devi, Professor Ms. N Jayanthi, Assistant Professor Ms. G Vasavi, Assistant Professor Ms. K Radhika, Assistant Professor Ms. G Geetha, Assistant Professor Ms. B Rekha, Assistant Professor Ms. A Soujanya, Assistant Professor Mr. D Rahul, Assistant Professor				

I. COURSE OVERVIEW:

This course covers some of the general-purpose data structures and algorithms, and software development. It is aimed at helping students understand the reasons for choosing structures or algorithms. Topics covered include managing complexity, analysis, lists, stacks, queues, trees, graphs, balanced search trees 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 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	Credits
UG	ACS001	I	Computer Programming	3

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	Mini Project	✔	Videos
✔	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments/Quiz
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	Assignments/Quiz
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems anddesign 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	Mini Project
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Mini Project
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage independent and life-long learning in the broadest context of technological change.	2	-

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	-
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Assignments
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	1	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Learn the basic techniques of algorithm analysis.
II	Demonstrate searching and sorting algorithms and analyze their time complexities.
III	Implementlinear data structures viz. stack, queue and linked list.
IV	Demonstrate non-linear data structures viz. tree and graph traversal algorithms.
V	Study and choose appropriate data structure to solve problems in real world.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CCS002.01	CLO 1	Understand algorithms and data structures in terms of time and space complexity of basic operations.	PO 1	3
ACS002.02	CLO 2	Analyze a given problem; choose an appropriate data structure and an algorithm to solve the problem.	PO 3,PO4	2
ACS002.03	CLO 3	Choose a suitable algorithm to organize the data in ascending or descending order.	PO 2,PO5	2
ACS002.04	CLO 4	Understand the difference between iterative and recursion approaches to solve problems.	PO 1	3
ACS002.05	CLO 5	Explore an algorithm to find the location of an element in a given list.	PO 2, PO3,PO5	3
ACS002.06	CLO 6	Understand the usage of divide and conquer strategy in searching and sorting applications.	PO 1,PO2	3
ACS002.07	CLO 7	Compare the time complexities of various searching and sorting algorithms.	PO 1,PO5	2
ACS002.08	CLO 8	Understand the working principle of linear data structures and their real time applications.	PO1,PO 2, PO5	3
ACS002.09	CLO 9	Organize the data in various linked representation format.	PO1,PO 2, PO5	3
ACS002.10	CLO 10	Design and implement abstract data types for linear and non-linear data structures.	PO1,PO 2	3
ACS002.11	CLO 11	Describe the concept of non-linear data structures viz. trees and graphs and their applications.	PO 1,PO2	2
ACS002.12	CLO 12	Compare and Contrast the operations of binary search trees and AVL trees.	PO 1	3
ACS002.13	CLO 13	Understand the concept of M-way search trees, operations and applications.	PO1,PO 2, PO5	3
ACS002.14	CLO 14	List out different tree and graph traversal techniques.	PO1,PO 2,PO5	2
ACS002.15	CLO 15	Understand the implementation of hashing using hash table and hash function.	PO1,PO 2, PO5	3
ACS002.16	CLO 16	Describethe concept of collision and its resolving methodsin applications.	PO1,PO 2, PO5	2
ACS002.17	CLO 17	Strengthen the knowledge of data structures and algorithms for employability.	PO1,PO 2, PO5	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3													2	
CLO 2		3	2												
CLO 3		3			2									3	
CLO 4	3												2		
CLO 5		3	3		2									2	
CLO 6	3	3													
CLO 7	3				2										
CLO 8	3	3	2											3	
CLO 9	2	3			2										
CLO 10	3	3												2	
CLO 11	3	3												3	
CLO 12	3														2
CLO 13	3	3			2								1		
CLO 14	2	3			2									3	
CLO 15	3	3			2								1		
CLO 16	2	3			2							2		3	
CLO 17	2	3			2							3		3	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2,PO3, PO5	SEE Exams	PO 1	Assignments	PO 1	Seminars	PO 2
Laboratory Practices	PO 1	Student Viva	PO 1	Mini Project	PO 1	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING
Basic concepts: Introduction to data structures, classification of data structures, operations on data structures, abstract data type, algorithms, different approaches to design an algorithm, recursive algorithms; Searching techniques: Linear search, binary search and Fibonacci search; Sorting techniques: Bubble sort, selection sort, insertion sort, quick sort, merge sort, and comparison of sorting algorithms.	
UNIT-II	**LINEAR DATA STRUCTURES**
Stacks: Primitive operations, implementation of stacks using Arrays, 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).	
UNIT-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.	
UNIT-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 implementation, graph traversals, Application of graphs, Priority Queue.	
UNIT-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.	
Text Books:	
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. 3. Y Daniel Liang, "Introduction to Programming using Python", Pearson. 4. Martin Jones, "Python for Complete Beginners", 2015. 5. Zed A. Shaw, "Learn Python the Hard Way: a very simple introduction to the terrifyingly beautiful world of computers and code", 3e, Addison-Wesley, 2014. 6. Hemant Jain, "Problem Solving in Data Structures and Algorithms using Python: programming interview guide", 2016.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 – 2	Basic concepts: Introduction to Data Structures.	CLO 1	T1:1.1.3 R2 : 1.2
3 – 4	Classification of data structures, operations on data Structures.	CLO 2	T1:1.1.3 R2 : 1.4
5 – 6	Abstract data type, Algorithms, Different approaches to design an Algorithm.	CLO 2	T1:1.2
7 – 8	Recursive algorithms ,Searching techniques: Linear search, binary search	CLO 4	T1:5.1
9 – 10	Fibonacci search	CLO 4	R1:14.5

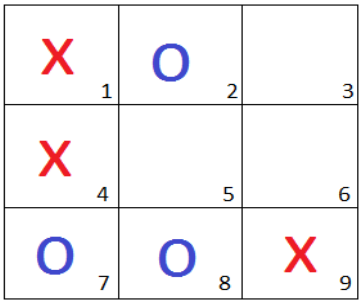
Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
11 – 14	Sorting techniques: Bubble sort, selection sort, insertion sort, and quick sort; merge sort, and comparison of sorting algorithms.	CLO 7	T1:5.2 R2 : 10.2
15 – 16	Stacks: Primitive operations, implementation of stacks using Arrays.	CLO 9	T1:7.1
17 – 20	Applications of stacks arithmetic expression conversion and evaluation.	CLO 9	T1:7.2
21 – 22	Queues: Primitive operations; Implementation of queues using Array.	CLO 11	T1:8.1
23 – 24	Applications of linear queue circular queue.	CLO 11	T1:8.4
25 – 26	Double ended queue (deque).	CLO 13	R2 : 5.4
27 – 28	Linked lists: Introduction, singly linked list, representation of a linked list in memory.	CLO 11	T1:9.1
29– 30	Operations on a single linked list, Applications of linked lists: Polynomial representation, Circular linked lists, doubly linked lists;	CLO 9	T1:9.2
31 - 32	Sparse matrix manipulation.	CLO 14	T2:9.2
33 – 35	Linked list representation and operations of Stack, Linked list representation and operations of queue.	CLO 14	T1:9
36 – 38	Trees: Basic concept, binary tree, binary tree representation, array and linked representations	CLO 14	T1:13.1-13.2
39 – 40	Binary tree traversal, binary tree variants, application of trees.	CLO 14	T1:13.2.3
41 – 43	Graphs: Basic concept, graph terminology, graph implementation.	CLO 14	R2 : 8.2
44 – 46	Graph traversals, Application of graphs,	CLO 17	T2:6.2
47 – 50	Priority Queue.	CLO 17	T1:6.1 T2:5.6
51 – 52	Binary search trees, properties and operations.	CLO 19	T1:14.1
53 – 55	Balanced search trees: AVL trees, Introduction to M-Way search trees, B trees.	CLO 19	T1:14.3
56 – 58	Hashing and collision: Introduction, hash tables, hash functions,	CLO 20	R2 : 6.4
59 - 60	Collisions, applications of hashing.	CLO 20	R2 : 6.4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Updating latest version and new features of the Python language	Laboratory Sessions	PO5	PSO2
2	Familiarizing the role of Python language in developing application level programs.	Assignments/ Industrial visits	PO1,PO2	PSO2
3	Familiarizing different areas where Python language can be used.	Seminars	PO12	PSO3
4	Solving different problems and Practicing various debugging strategies to become a good programmer	Extra Lab Sessions, Participating in Coding contests.	PO2	PSO3

XVI. DESIGN BASED PROBLEMS (DP) / OPEN ENDED PROBLEM:

1. **Check a Single Linked List is Palindrome or not**: Given a singly linked list of integers, the task is to complete the function **is Palindrome** which returns true if the given list is palindrome, else returns false. The first line of input contains an integer T denoting the no of test cases. Then T test cases follow. Each test case contains 2 line the first line of each test case contains an integer N denoting the size of the linked list. The next line contains N space separated integers denoting the values of the nodes of the linked list.
2. **Tic-Tac-Toe Game**: The game of Tic-Tac-Toe is being played between two players and it is in below state after six moves.



Answer the following questions?

a. Who will win the game, O or X?
b. Which was the sixth mark and at which position?

Assume that both the players are intelligent enough.

3. **Lowest Common Ancestor in a Binary Tree:** Given a Binary Tree and 2 nodes value n1 and n2. The task is to find the lowest common ancestor of the two nodes. You are required to complete the function LCA. You should not read any input from stdin/console. There are multiple test cases. For each test case, this method will be called individually.
   The task is to complete the method LCA which takes 3 arguments, root of the Tree and two nodes value n1 and n2. The struct node has a data part which stores the data, pointer to left child and pointer to right child. There are multiple test cases. For each test case, this method will be called individually. The function should return the node which is the least common ancestor of the two nodes n1 and n2.

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL CIRCUITS**				
Course Code	**AEE002**				
Programme	B.Tech				
	II	EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	**Ms. S Swathi, Assistant Professor, EEE**				
Course Faculty	**Dr. D Shobha Rani, Professor, EEE** **Mr. T Anil Kumar, Assistant Professor, EEE** **Mr. K Raju, Associate Professor, EEE** **Mr. T Vigneysh, Assistant Professor, EEE** **Ms. S Swathi, Assistant Professor, EEE** **Mr. G Hari krishna, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course deals with fundamentals of electrical circuit analysis, basic parameters like resistor, inductor and capacitor, formation of circuit and network, nature of sources to feed the networks, different network reduction techniques to study behavior of networks, single phase AC circuits and their analysis and network theorems for reducing complexity of networks and for easy simplifications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra and Ordinary Differential Equations	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electrical Circuits	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✔	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	3	Seminar
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	Project Work / Tutorial

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Assignment and Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	--	--
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	--	--

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic parameters, formation of circuit and network.
II	Apply different network reduction techniques to solve complex electrical networks..
III	Use network topology technique to solve complex electrical networks.
IV	Analyze single phase AC circuits and their behavior.
V	Summarize the conditions for electrical resonance.
VI	Explain the importance of magnetic circuits and their behavior in electrical engineering.
VII	Examine complex electrical networks using network theorems.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAEE002.01	CLO 1	Define the various nomenclature used to study the characteristics of DC networks.	PO1	3
CAEE002.02	CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.	PO1	3
CAEE002.03	CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.	PO1, PO2, PSO1	3
CAEE002.04	CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit	PO1, PO2, PSO1	3
CAEE002.05	CLO 5	Define the various nomenclature related with network topology and give the importance of dual network.	PO1, PO2	3
CAEE002.06	CLO 6	Formulate incidence, tie-set and cut-set matrix which are used to solve the behavior of complex electrical circuits.	PO1, PO2, PSO1	3
CAEE002.07	CLO 7	Identify the alternating quantities with it instantaneous, average and root mean square values.	PO1, PO2	3
CAEE002.08	CLO 8	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuits.	PO1, PO2	3
CAEE002.09	CLO 9	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	PO1, PO2,PSO1	3
CAEE002.10	CLO 10	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.	PO1, PO2, PSO1	3
CAEE002.11	CLO 11	State the faraday's laws of electromagnetic induction used in construction of magnetic circuit.	PO1, PO2, PSO1	3
CAEE002.12	CLO 12	Determine magnetic flux, reluctance, self and mutual inductance in the single coil and coupled coils magnetic circuits.	PO1, PO2 PSO1	3
CAEE002.13	CLO 13	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitations.	PO1, P02,PO3 PSO1	3
CAEE002.14	CLO 14	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.	PO1, P02,PO3, PSO1	3
CAEE002.15	CLO 15	Explain the steps of compensation, zero current and voltage shift theorem to predict constraints of electrical networks.	PO1, P02, PSO1	3
CAEE002.16	CLO 16	Apply the network reduction techniques , concept of graph theory, resonance and faraday's laws to solve real constraints of electrical and magnetic circuits.	PO1, P02,PSO1	3
CAEE002.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1, P02 PSO1	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	3														
CLO 3	3	3											3		
CLO 4	3	3											3		
CLO 5	3	2													
CLO 6	3	2											2		
CLO 7	3	2													
CLO 8	3	2													
CLO 9	3	3											3		
CLO 10	3	3											3		
CLO 11	3	3											3		
CLO 12	3	2											2		
CLO 13	3	3	3										3		
CLO 14	3	3	3										3		
CLO 15	3	3											3		
CLO 16	3	3											3		
CLO 17	3	3											3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1, PO2, PO3, PSO1	SEE Exams	PO1, PO2, PO3, PSO1	Assignments	PO1	Seminars	PO1
Laboratory Practices	PO1	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	INTRODUCTION OF ELECTRICAL CIRCUITS
Circuit concept: Basic definitions, Ohm's law at constant temperature, classifications of elements, R, L, C parameters, independent and dependent sources, voltage and current relationships for passive elements (for different input signals like square, ramp, saw tooth, triangular and complex), temperature dependence of resistance, tolerance, source transformation, Kirchhoff's laws, equivalent resistance of series, parallel and series parallel networks.	
Unit-II	**ANALYSIS OF ELECTRICAL CIRCUITS**
Circuit analysis: Star to delta and delta to star transformation, mesh analysis and nodal analysis by Kirchhoff's laws, inspection method, super mesh, super node analysis; Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.	
Unit-III	**SINGLE PHASE AC CIRCUITS**
Single phase AC circuits: Representation of alternating quantities, instantaneous, peak, RMS, average, form factor and peak factor for different periodic wave forms, phase and phase difference, 'j' notation, concept of reactance, impedance, susceptance and admittance, rectangular and polar form, concept of power, real, reactive and complex power, power factor. Steady state analysis: steady state analysis of RL, RC and RLC circuits (in series, parallel and series parallel combinations) sinusoidal excitation.	
Unit-IV	**RESONANCE AND MAGNETIC CIRCUITS**
Resonance: Series and parallel resonance, concept of band width and Q factor. Magnetic circuits: Faraday's laws of electromagnetic induction, analysis of series and parallel magnetic circuits, composite magnetic circuits, coupled coils, concept of self and mutual inductance, dot convention, coefficient of coupling, multi winding analysis.	
Unit-V	**NETWORK THEOREMS (DC and AC)**
Theorems: Zero current theorem, Tellegen's, superposition, reciprocity, voltage shift theorem, Thevinin's, Norton's, maximum power transfer, Milliman's and compensation theorems for DC and AC excitations.	
Text Books:	
1. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010. 2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010 3. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014. 4. Rudrapratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1st Edition, 1999.	
Reference Books:	
1. John Bird, "Electrical Circuit Theory and technology", Newnes, 2nd Edition, 2003 2. C L Wadhwa, "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2nd Edition, 2009. 3. David A Bell, "Electric Circuits", Oxford University Press, 7th Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define the voltage, current, power and energy.	CLO1	T1:1.1-1.5
2	Define resistance, inductance and capacitance and their V-I characteristics.	CLO1	T1:1.1-1.5
3	Understand different elements in power systems and sources to drive the network.	CLO2	T1:1.6-1.8
4	Understand the behavior of RLC for different input signals.	CLO2	T2:1.7
5	Understand application of kirchoff's laws for electrical networks.	CLO3	T1:1.9-1.13
6	Apply the RLC parameters in series and parallel combinations to form electrical network.	CLO3	T1:1.9-1.13
7	Apply the solution for the network using network reduction technique.	CLO3	T1:2.15
8	Apply the network reduction techniques using mesh analysis to determine current, voltage and power in each and every element and of the network.	CLO4	T1:2.9-2.11
9	Apply the network reduction techniques using using nodal analysis to determine current, voltage and power in each and every element and of the network.	CLO4	T1:2.12 2.14
10	Apply the network reduction techniques using of power systems networks using above reduction techniques.	CLO4	T1:2.12-2.14
11-13	Apply the network reduction techniques for different complex problems.	CLO4	T1:2.12-2.14
14	Define the various nomenclature related with network topology.	CLO5	T1:2.1-2.3
15	Formulate incident matrix from which characteristics of electrical circuits can be studied.	CLO6	T1:2.4-2.5
16	Formulate incident matrix from which current flowing through each element can be determined.	CLO6	T1:2.7
17	Formulate incident matrix from which voltage across each element can be determined.	CLO6	T1:2.8
18	Formulate incident matrix from which voltage across each element can be determined.	CLO6	T1:2.7-2.8
19	Formulate complex network into simple network without changing results.	CLO6	T1:3.8
20	Define the various nomenclature related with network topology and give the importance of dual network.	CLO7	T1:3.8
21-23	Define the various nomenclature related with network topology and give the importance of dual network	CLO7	T1:3.9-315
24	Identify the representing alternating quantity with sine wave.	CLO7	T1:4.1
25	Understand the characteristics of sine wave in alternating quantity	CLO7	T1:4.2-4.4
26	Understand behavior of series circuits with sine input	CLO7	T1:12.5-12.7
27	Understand behavior of parallel circuits with sine input	CLO7	T1:12.5-12.7
28	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit.	CLO8	T1:5.1-5.4
29	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:5.1-5.4
30	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:6.1-6.5
31	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:6.1-6.5

33	Understand behavior of different AC circuits that come across in power systems(finding alternating current, alternating Voltage, complex power).	CLO8	T1T2
34	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation	CLO9	T2:4.5
35	Steady state analysis: steady state analysis C circuits with sinusoidal excitation.	CLO9	T2:4.5
36	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO9	T2:4.6
37	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO9	T2:4.7
38	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
39	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
40 - 42	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
43	Understand the basic formation of magnetic circuit.	CLO10	T1:10.11
44	State the faraday's laws of electromagnetic induction used in construction of magnetic circuit	CLO11	T1:10.11
45 - 47	Determine magnetic flux, reluctance, self and mutual inductance in the single coil and coupled coils magnetic circuits.	CLO12	T1:10.4-10.5
48	Remember different types magnetic circuits	CLO11	T1:10.15
49 -55	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitations.	CLO13	T1:3.9-3.10
56 - 60	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.	CLO14	T1:3.9-3.10

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Mathematical modelling of electrical network using MATLAB.	Guest Lectures / NPTEL	PO1, PO2,PO5	PSO3
2	Design of electrical circuit using graph theory in PC.	Matlab Demos / NPTEL	PO1, PO2,PO5	PSO3

Prepared by:

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HOD, EEE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGLISH FOR COMMUNICATION**				
Course Code	AHS001				
Programme	B.Tech				
Semester	I	AE | ME | CE			
	II	CSE | IT | ECE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	2	1
Chief Coordinator	Ms B Anand Lakshmi, Associate Professor				
Course Faculty	Dr Prudhvi Raju, Associate Professor Ms P B Esther Rani, Assistant Professor Ms Jayshree Naidu, Assistant Professor Ms Shirisha Deshpande, Assistant Professor Mr. Sudhakar Medi, Assistant Professor Mr Kondal, Assistant Professor				

I. COURSE OVERVIEW:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, this Engineering English has been designed to develop linguistic and communicative competence of the students. In the classroom the focus should be on the skills of reading, writing, listening and speaking. The teacher can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/ essays etc.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Standard applicability of grammar and vocabulary

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
English for Communication	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
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	Term paper
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	Seminar Listening Test Speaking Test Presentation (Technical / Review: Movie/Book)
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.	2	Five minutes video

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	1	Written Test – Verbal Aptitude for Placement and Higher studies
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Communicate in an intelligible English accent and pronunciation.
II	Use the four language skills i.e., Listening, Speaking, Reading and Writing effectively.
III	Develop the art of writing simple English with correct spelling, grammar and punctuation.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS001.01	CLO 1	Understand the value of English as an international language and try to improve the knowledge regarding language skills and elements to be perfect in their usage.	PO 10	1
AHS001.02	CLO 2	Develop the ability to listen effectively in order to analyze the language used in descriptions and narrations.	PO 9	2
AHS001.03	CLO 3	Paraphrase listening skills for different purposes with special emphasis on intensive listening.	PO 9	2
AHS001.04	CLO 4	Interpret how to contextualize the use of language for different purposes.	PO 9 PO 10	2
AHS001.05	CLO 5	Ability to comprehend speaking skills for different purposes with special emphasis on intensive listening	PO 9, PO 10, PO 11	3
AHS001.06	CLO 6	Express fluently without any grammatical mistakes and also give presentations with proper modulation.	PO 10	3
AHS001.07	CLO 7	Translate the importance of critical reading to get information from the context with the help of root words and contextual clues.	PO 10	3
AHS001.08	CLO 8	Grasp the importance of reading skills for focused and selective information at various levels of professional career.	PO 10	3
AHS00.09	CLO 9	Summarize the topic to write different types of argumentative, narrative, descriptive and persuasive paragraphs and essays.	PO 9, PO 10	3
AHS001.10	CLO 10	Infer the use of language for developing behavioral skills.	PO 9, PO 10, PO 11, PSO 3	2
AHS001.11	CLO 11	Translate the importance of reading techniques and applying it to literary texts.	PO 11	3
AHS001.12	CLO 12	Ability to learn and understand techniques of grammar to apply in the functions of English language	PO 10	2
AHS001.13	CLO 13	Remember to use the knowledge of grammar and vocabulary in writing more meaningfully.	PO 10	3
AHS001.14	CLO 14	Infer the importance of language and applying to learn to be sensitive according to the needs of the society.	PO 9, PO 10, PO 11, PSO 3	2
AHS001.15	CLO 15	Develop writing skills in order to apply in day to day life.	PO 9, PO 10	3
AHS001.16	CLO 16	Understand the importance of written communication for the future correspondence throw out the career of the students.	PO 9, PO 10	3
AHS001.17	CLO 17	Develop the ability to analyze the results of experiments and be competent in writing reports, work in teams in real time situations	PO 9, PO 10	3
AHS001.18	CLO 18	Understand the value of writing skills to be a responsive, attentive and empathetic writer in order to face the real-world situations	PO 9, PO 10	3
AHS001.19	CLO 19	Infer the importance of vocabulary and writing as an essential ability in the real-time situations for those who desire to advance their career.	PO 11, PSO 3	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1										1					
CLO 2									2						
CLO 3									2						
CLO 4									2	1					
CLO 5									3	3	1				
CLO 6										3					
CLO 7										3					
CLO 8										3					
CLO 9									3	3					
CLO 10									2	3	2			1	
CLO 11											3				
CLO 12										2					
CLO 13										3					
CLO 14									1	1	3			1	
CLO 15									3	3					
CLO 16									3	3					
CLO 17									3	3					
CLO 18									3	3					
CLO 19											2			2	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 9, PO 10, PO11, PSO 3	SEE Exams	PO 9, PO 10, PO11, PSO 3	Assignments	-	Seminars	PO 10
Laboratory Practices	PO 9, PO 10, PO11, PSO 3	Student Viva	PO 10	Mini Project	-	Certification	-
Term Paper	PO 9						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	LISTENING SKILLS
Significance, essentials, barriers and effectiveness of listening; Listening to dialogues, conversation, discussions, monologues; Listening to sounds, silent letters, stressed syllables in English; Listening for the gist of the text, for identifying the topic, general meaning and specific information; Listening for multiple choice questions, positive and negative comments for interpretation. Note: instructions in theory and practice in the lab.	
Unit-II	**SPEAKING SKILLS**
Significance, essentials, barriers and effectiveness of speaking; Simple oral or casual interaction, dialogue, conversation; Debates: Differences between disagreeing and being disagreeable; Brief presentations; Role plays; Generating talks based on visual or written prompts; Addressing a small group or a large formal gathering; Speaking about present, past experiences and future plans; Arguing out a topic without verbal fights; Paper presentation. Note: instructions in theory and practice in the lab.	
Unit-III	**READING SKILLS**
Techniques of reading: Skimming, scanning, intensive and extensive reading; Reading comprehension: Exercises for multiple choice questions and contextual meaning- values in Dr. Kalam. Vocabulary enrichment and grammar exercises based on selective readings: Power of dreams- vision to mission- prose passage for intellectual and emotional comments; Reading for the gist of a text, for specific information, for information transfer and interpretation.	
Unit-IV	**WRITING SKILLS**
Significance, essentials and effectiveness of writing; Writing emails; Writing paragraphs: Comparing, contrasting, presentations with an introduction, body and conclusion; Writing formal and informal letters: Letter of invitation, accepting, declining, requesting, cover letter enclosing a CV.	
Unit-V	**GRAMMAR AND VOCABULARY**
Punctuation, parts of speech, articles, prepositions, tenses, concords, phrasal verbs; Forms of verbs: Regular and irregular, direct and indirect speech, change of voice; prefixes, suffixes, Synonyms, antonyms, one word substitutes, idioms and phrases, technical vocabulary.	
Text Books:	
1. Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles Practices", Oxford University Press, New Delhi, 3rd Edition , 2015.	
Reference Books:	
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 5. Dr. N V Sudershan, "President Kalam's Call to the Nation", Bala Bharathi Publications, Secunderabad, 1st Edition, 2003.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Explain the importance of English Language as a tool for global communication and emphasis to acquire communicative competence	CLO 1	T1:1.1
2	Recognize the importance of English as the global language.	CLO 1	T1:1.1
3	Identify the learning levels and their competencies	CLO 1	T1:1.1-1.5
4-7	Recall the functions of punctuation and practice exercises	CLO 6, CLO12	R3:5
8	Develop the ability to understand that speaking skills are essential to be a responsive, attentive and empathetic speaker in order to face the real-world situations.	CLO 5, CLO 14	R2:1.1
9-11	Apply the knowledge of preparation for oral presentation	CLO 6	R4:2.21
12	Identify common errors in the language through the concept of word formation	CLO 13, CLO 19	R4:60.1
13-15	Prepare the students to be aware of the importance of commonly used technical vocabulary	CLO 19	R4:1.1-2.1
16	Infer the concept of grammatical ambiguity & sentence construction	CLO 6, CLO 12	R4:4.2
17	Recognize the concept of "Subject-Verb agreement", to familiarize the students with the usage of "Concord"	CLO 6	R3:1.3
18-22	Identify and understand conventional signs, prefixes, suffixes, Synonyms, antonyms, one word substitutes used by writers to make their meaning clear to the reader	CLO 13	R4:47.1
23	Appraise the students in order to acquire the knowledge of sentence structure	CLO 6	R4:42.1
24-25	Learn to use the vocabulary in writing more meaningfully	CLO 13	R3:4.4
26-27	Infer the difference between phrases and idioms & learn to use them in sentences	CLO 13	R3:4.2
28	To make the students learn and identify commonly used technical vocabulary.	CLO 13	R4:1.3
29	Understand the significance, essentials, and effectiveness of reading	CLO 7, CLO 8	T1:2.4
30	Interpret derivatives, and standard abbreviations in English through reading skills	CLO 11	T1:27.2
31-33	Infer the gist of the text, for identifying the topic through reading skills	CLO 11	R4:5.8
34	Apply the general meaning and specific information through writing skills	CLO 16	T1:2.7
35	Analyze and Interpret multiple choice questions, positive and negative comments through comprehension passages	CLO 17	T1:2.6
36	Identify passage for intellectual and emotional comments; reading for the gist of a text.	CLO 11	T1:4.15
37	Associate the students to identify their common errors in the language	CLO 9	R2:3
38	Understand the importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents to foster the writing skills of the students	CLO 17	R2:3
39	Evaluate Letter writing-formal and Informal writing and E-mail writing.	CLO 19	T1:4.13
40	To make learners aware of the selection of language to make presentations and prepare the students for an effective presentation giving them necessary inputs	CLO 18	T1:4.13
41	Distinguish writing skills such as describing, defining,	CLO 17	T1:4.13

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	classifying, writing introduction and conclusion.		
42-43	Evaluate writing skills through creating coherence, organizing principles of paragraphs in documents.	CLO 9	T1:3.10
44-45	Understand the importance of vocabulary enrichment and grammar exercises to foster the writing skill of the students.	CLO 19	T1:4.13

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Construct basic and intermediate skills in English language.	Seminars	PO 10	PSO 2
2	Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work.	Seminars / NPTEL	PO 9	PSO 2
3	To build confidence for communicating in English and create interest for the life-long learning of English language.	Guest lecture	PO 10	PSO 2

Prepared by:
Ms. B Anand Lakshmi, Associate Professor

HOD, FRESHMAN ENGINEERING

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	AHS009				
Programme	B.Tech				
Semester	II	AE | CSE | IT | ECE | EEE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms. M Lakshmi Prasanna, Assistant Professor				
Course Faculty	Dr. C Mahendar, Professor Ms. V Anitha Rani, Associate Professor Mr. B Raju, Assistant Professor Ms. M Praveen, Assistant Professor Ms. M Malathi, Assistant Professor Mr. G Mahesh Kumar, Assistant Professor Ms. T Mallika, Assistant Professor Ms. M Swathi, Assistant Professor				

I. COURSE OVERVIEW:

Environmental study is interconnected interrelated and interdependent subject. Hence, it is multidisciplinary in nature. The present course is framed by expert committee of UGC under the direction of honorable supreme court to be as a core module syllabus for all branches of higher education and to be implemented in all universities over India. The course is designed to create environmental awareness and consciousness among the present generation to become environmental responsible citizens. The course description is multidisciplinary nature of environmental studies, natural resources Renewable and non-renewable resources Ecosystems Biodiversity and its conservation Environmental pollution Social issues and the environment Human population and the environment Pollution control acts and field work. The course is divided into five chapters for convenience of academic teaching followed by field visits.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic Principles of Environmental Studies

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Environmental Studies	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz/AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th 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 25 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 centre. 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 section XI.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminar
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	Seminar
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.	1	Real-time applications
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	Real-time applications

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyze the interrelationship between living organism and environment
II	Understand the importance of environment by assessing its impact on the human world
III	Enrich the knowledge on themes of biodiversity, natural resources, pollution control and waste management
IV	Understand the constitutional protection given for environment

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS009.01	CLO 1	Understand and realize the importance of multi-disciplinary nature of the environment in day to day life	PO 1, PO 3	2
AHS009.02	CLO 2	Describe various types of ecosystems its components and inter-relationship between man and environment	PO 1, PO 3	2
AHS009.03	CLO 3	Examine how pollutants move through various levels in an ecosystem in our daily life	PO 1, PO 3, PO 7	2
AHS009.04	CLO 4	Explain the pathways of relevant chemical elements through the components of the biosphere in real world applications	PO 1, PO 3, PO 7	2
AHS009.05	CLO 5	Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard.	PO 1, PO 3, PO 5, PO 7	2
AHS009.06	CLO 6	Develop an understanding of the natural resources problems and ethical issues facing humans and the environment	PO 1, PO 3, PO 7	2
AHS009.07	CLO 7	Correlate the exploitation and utilization of conventional and non-conventional resources.	PO 1, PO 3, PO 5,PO 7	2
AHS009.08	CLO 8	Demonstrate the level of chemical usage in agricultural development and its impact in our daily life	PO 1, PO 5, PO 7	2
AHS009.09	CLO 9	Understand the concept of growing energy needs in the world in terms of consumption of energy	PO 1, PO 7	2
AHS009.10	CLO 10	Establish knowledge and existence of endemic, extinct, endangered and threatened species, types and values of biodiversity	PO 1, PO 5, PO 7	2
AHS009.11	CLO 11	Describe our country as mega biodiversity nation in terms of hotspots	PO 1, PO 7	2
AHS009.12	CLO 12	Explain on threats and innovative methods for conservation of biodiversity.	PO 1, PO 3, PO 7	2
AHS009.13	CLO 13	Establish a foundation on different pollutants and pollutions in the environment.	PO 1, PO 3, PO 5, PO 7	2
AHS009.14	CLO 14	Ability to use methods, and strategies to investigate and interpret the pollution problems	PO 3, PO 5, PO 7	2
AHS009.15	CLO 15	Use innovative methods to control the level of water pollution in our day to day life.	PO 3, PO 5, PO 7	2
AHS009.16	CLO 16	Acquire Knowledge on global effects and how to interpret with global environmental problem in our daily life	PO 1, PO 7	2
AHS009.17	CLO 17	Acquire knowledge and skills about health and safety protocols when working with polluted environment in day to day life	PO 1, PO 7	2

AHS009.18	CLO 18	Describe the role of government and legal aspects in environmental protection.	PO 7	1
AHS009.19	CLO 19	Knowledge of proper decontamination techniques for solid waste management.	PO 3, PO 7	2
AHS009.20	CLO 20	Understand the importance of EIA for developmental activities to have minimum negative impacts on people	PO 1, PO 7	2
AHS009.21	CLO 21	Prepare entry level for future generations to meet sustainable development.	PO 7	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	3		1													
CLO 2	3		1													
CLO 3	2		2				1									
CLO 4	2		2				1									
CLO 5	3		1		1		1									
CLO 6	2		2				1									
CLO 7	3		1		1		1									
CLO 8	2				1		1									
CLO 9	3						1									
CLO 10	3				1		1									
CLO 11	2						1									
CLO 12	2		2				1									
CLO 13	3		2		2		2									
CLO 14			2		1		1						1			
CLO 15			2		1		1						1			
CLO 16	2						1									
CLO 17	2						1									
CLO 18							1									
CLO 19			1				2									
CLO 20	1						1									
CLO 21							2									

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO3 PO5,PO7	SEE Exams	PO1,PO3 PO5,PO7	Assignments	PO1	Seminars	PO1 PO3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

Unit-I	ENVIRONMENT AND ECOSYSTEMS
Environment: Definition, scope and importance of environment, need for public awareness; Ecosystem: Definition, scope and importance of ecosystem, classification, structure and function of an ecosystem, food chains, food web and ecological pyramids, flow of energy; Biogeochemical cycles; Biomagnifications	
Unit-II	**NATURAL RESOURCES**
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; Mineral resources: Use and exploitation; Land resources; Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.	
Unit-III	**BIODIVERSITY AND BIOTIC RESOURCES**
Biodiversity and biotic resources: Introduction, definition, genetic, species and ecosystem diversity; Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and optional values; India as a mega diversity nation; Hot spots of biodiversity Threats to biodiversity: Habitat loss, poaching of wildlife, human-wildlife conflicts; Conservation of biodiversity: In situ and ex situ conservation; National biodiversity act.	
Unit-IV	**ENVIRONMENTAL POLLUTION, POLLUTION CONTROL TECHNOLOGIES AND GLOBAL ENVIRONMENTAL PROBLEMS**
Environmental pollution: Definition, causes and effects of air pollution, water pollution, soil pollution, noise pollution; Solid waste: Municipal solid waste management, composition and characteristics of e-waste and its management; Pollution control technologies: Waste water treatment methods, primary, secondary and tertiary; Concepts of bioremediation; Global environmental problems and global efforts: Climate change, ozone depletion, ozone depleting substances, deforestation and desertification; International conventions / protocols: Earth summit, Kyoto protocol and Montreal protocol.	
Unit-V	**ENVIRONMENTAL LEGISLATIONS AND SUSTAINABLE DEVELOPMENT**
Environmental legislations: Environmental protection act, air act1981, water act, forest act, wild life act, municipal solid waste management and handling rules, biomedical waste management and handling rules2016, hazardous waste management and handling rules, Environmental impact assessment(EIA); Towards sustainable future: Concept of sustainable development, population and its explosion, crazy consumerism, environmental education, urban sprawl, concept of green building.	
Text Books:	
1. Benny Joseph (2005)., Environmental Studies, New Delhi, Tata McGraw Hill Publishing co. Ltd 2. Erach Bharucha (2005)., Textbook of Environmental Studies for Undergraduate Courses, Hyderabad, Universities Press.	
Reference Books:	
1. Anji Reddy .M (2007), Textbook of Environmental Sciences and Technology, Hyderabad, BS Publications.	

2. Anjaneyulu.(2004), Introduction to Environmental Sciences, BS Publications
3. Anubha Kaushik(2006).,Perspectives in Environmental Science, 3rd Edition, New Delhi, New age international.
4. Tyler Miller, Scott Spoolman, "Environmental Science", Cengage Learning, 14th Edition, 2012.

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1	Summarize about environment and its importance.	CLO 1	T2: 1.1.1, 1.1.2,1.1.3, 1.2.1,1.2.2 R3:1.1-1.3
2	Discuss environment and importance of ecosystems	CLO 1	R1: 1.1,1.2 R3:1.1-1.3
3	Provides the information regarding ecosystem and applicability.	CLO 1	T2:3.2 R1:1.6.1,1.6.2 R3:1.6,1.7
4	Provides the information regarding ecosystem and applicability	CLO 1	T2:3.2 R1:1.6.1,1.6.2 R3:1.6,1.7
5	Acquire knowledge of how all the animals are competing with their food requirements and also understand the various trophic levels in the food chain.	CLO 2	T2:3.6.1-3.6.3 R1:1.7.1,1.7.2, 1.7.3 R3:1.7.1,1.7.2
6	Describe the flow of energy through the various components of ecosystem	CLO 2	T2:3.4 R1:1.8 R3:1.7.5
7	Examine the importance a of nutrients and flow of nutrients in ecosystem	CLO 3	T2:3.4.1-3.4.4 R1:1.9,1.10 R3:1.7.6
8	Examine the importance a of nutrients and flow of nutrients in ecosystem	CLO 3	T2:3.4.1-3.4.4 R2:1.9,1.10 R3:1.7.6
9	Summarize about the toxicity of heavy metals on the biotic and a biotic components.	CLO 4	R1:1.11 R3:1.7.3
10	Distinguish about different types of natural resources and their applicability and illustrate the utility of renewable resources efficiency	CLO 5	R1:2.1 R3:2.1
11	Describe the impact of over utilization of underground and surface water	CLO 5	R1:2.3,2.4.1, 2.4.2,2.4.3 R3:2.2
12	Discuss the disaster manage mental plans	CLO 6	R1:2.4.4 R3:2.2.4,2.2.5
13	Describe the benefits and property dams	CLO 6	R1:2.4.5 R3:2.3
14	Illustrate the uses of mineral resources	CLO 2 CLO 6	R1:2.5 R3:2.4
15	Enumerate the application of the solar energy in modern days	CLO 6	R1:3.1 R3:2.5
16	Enumerate the application of the wind energy in modern days	CLO 6	R1:3.3.1.5 R3:2.5
17	Illustrate the definition and importance of biodiversity	CLO 6	T2:4.1 R1:4.1 R3:3.1

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
18	Acquire the genetic diversity, species and ecosystem diversity	CLO 7	T2:4.1.1,4.1.2, 4.1.3 R1:4.2 R3:3.2
19	Describe the ecological values and consumptive use of ecosystem	CLO 7	T2:4.3 R1:4.3 R3:3.3
20	Recall India is mega diversity nation	CLO 7	T2:4.5 R3:3.4
21	Discuss the hot spot center in and around	CLO 7	T2:4.6 R1:4.6 R3:3.4
22	Analyze the information regarding different causes for loss of biodiversity	CLO 7	T2:4.7 R1:4.4 R3:3.5
23	Analyze various reasons for conflict of species	CLO 7	T2:4.7 R3:3.5.3
24	Illustrate different methods to protect the biodiversity	CLO 7	T2:4.9 R1:4.5 R3:3.7
25	Correlate national biodiversity act	CLO 8	T2:4.9 R1:4.5 R3:3.7
26	Explain the meaning of environmental pollution and classification.	CLO 9	T2:5.1 R1:5.1 R3:4.1
27	Analyze the important pollutants in air pollutants	CLO 9	T2:5.2.1 R1:5.3 R3:4.2
28	Enumerate the sources types and effects of water pollution	CLO 9	T2:5.2.2 R1:5.4 R3:4.6
29	Correlate the sources types and effects of soil pollution	CLO 9	T2:5.2.3 R1:5.5 R3:4.8
30	Analyze the noise quality and permissible levels	CLO 9	T2:5.2.5 R1:5.7 R3:4.13
31	Describe the various methods commonly employed for the disposal of solid waste.	CLO 9	T2:5.3 R1:7.7
32	Identify To understand the recent trends in e- waste management practices.	CLO 10	R1:5.10.6 R3:4.16.3
33	Understand concept of climate change and impacts.	CLO 10	T2:6.6.1 R1:6.5 R3:5.5
34	Summarize the remedial measures of ozone depletion	CLO 10	T2:6.6.4 R1:6.6 R3:5.6,5.7
35	Evolve strategies to environmental issues	CLO 10	R1:6.8 R3:5.10
36	Describe the role of government and legal aspects in environmental protection	CLO 10	T2:6.9-6.14 R1:7.2,7.3,7.4, R3:7.3,7.4,7.5, 7.6,7.7
37	Discuss the silent features of the hazardous waste management	CLO 11	R1:7.9 R3:7.10
38	Understand the importance of EIA for developmental activities	CLO 12	T2:6.14 R3:6.3,6.4

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
39	Understand the importance of EIA for developmental activities	CLO 12	T2:6.14 R1:10.1 R3:6.3,6.4
40	State the aim and objectives of sustainable development	CLO 12	T2:6.1 R1:10.5 R3:8.3
41	State the aim and objectives of sustainable development	CLO 13	T2:6.1 R1:10.5 R3:8.3
42	Enumerate population and its explosion	CLO 15	T2:7.2 R1:10.3 R3:8.2
43	State the aim and objectives of sustainable development	CLO 19	T2:7.2.2.2 R1:10.8 R3:8.6
44	Acquire knowledge of environmental education	CLO 18	T2:7.3 R1:10.6 R3:8.4
45	Summarize the environmental ethics and objectives of green buildings	CLO 21	T2:6.5 R1:10.10,10.12 R3:8.10,8.12

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Types of ecosystem, Energy flow, Biomagnification	Seminars / Field visit	PO 1	-
2	Dams ,Mining Activities, Alternative energy resources	Seminars / NPTEL	PO 3	PSO 1
3	Sources of pollution EIA Methodology, Green building	Guest Lecture	PO 7	-

Prepared by:
Ms. M Lakshmi Prasanna, Assistant Professor

HOD, FRESHMAN ENGINEERING

TITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**MATHEMATICAL TRANSFORM TECHNIQUES**				
Course Code	AHS011				
Programme	B.Tech				
Semester	II	EEE			
	III	AE | ECE			
	IV	ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. M.Nagender, Assistant Professor				
Course Faculty	Dr. S Jagadha, Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced engineering mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes types of matrices, difference calculus methods and differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of integration

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Mathematical Transform Techniques	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	2	Seminar
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	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Problem-Solving Skills:** To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Epress non periodic function to periodic function using Fourier series and Fourier transforms.
II	Apply Laplace transforms and Z-transforms to solve differential equations.
III	Formulate and solve partial differential equations.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS011.01	CLO 1	Ability to compute the Fourier series of the function with one variable.	PO 1	3
AHS011.02	CLO 2	Understand the nature of the Fourier series that represent even and odd functions.	PO 1	3
AHS011.03	CLO 3	Determine Half- range Fourier sine and cosine expansions.	PO 1	2
AHS011.04	CLO 4	Understand the concept of Fourier series to the real-world problems of signal processing	PO 2	1
AHS011.05	CLO 5	Understand the nature of the Fourier integral.	PO 2	2
AHS011.06	CLO 6	Ability to compute the Fourier transforms of the function.	PO 2	2
AHS011.07	CLO 7	Evaluate finite and infinite Fourier transforms.	PO 4	1
AHS011.08	CLO 8	Understand the concept of Fourier transforms to the real-world problems of circuit analysis, control system design	PO 2	3
AHS011.09	CLO 9	Solving Laplace transforms using integrals.	PO 2	1
AHS01110	CLO 10	Evaluate inverse of Laplace transforms by the method of convolution.	PO 2	2
AHS011.11	CLO 11	Solving the linear differential equations using Laplace transform.	PO 1	3
AHS011.12	CLO 12	summarize the concept of Laplace transforms to the real-world problems of electrical circuits, harmonic oscillators, optical devices, and mechanical systems	PO 1	3
AHS011.13	CLO 13	Apply Z-transforms for discrete functions.	PO 1	3
AHS011.14	CLO 14	Evaluate inverse of Z-transforms using the methods of partial fractions and convolution method.	PO 1, PO 2	3
AHS011.15	CLO 15	Apply Z-transforms to solve the difference equations.	PO 2	3
AHS011.16	CLO 16	Understand the concept of Z-transforms to the real-world problems of automatic controls in telecommunication.	PO 2	2
AHS011.17	CLO 17	Understand partial differential equation for solving linear equations by Lagrange method.	PO 1, PO 2	3
AHS011.18	CLO 18	Apply the partial differential equation for solving non-linear equations by Charpit's method.	PO 1, PO 2	3
AHS011.19	CLO 19	Solving the heat equation and wave equation in subject to boundary conditions.	PO 1, PO 2	3
AHS011.20	CLO 20	Summarize the concept of partial differential equations to the real-world problems of electromagnetic and fluid dynamics	PO 1, PO 2	3
AHS011.21	CLO 21	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 1	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	2												1		
CLO 4		1													
CLO 5		2													
CLO 6		2													
CLO 7				1											
CLO 8				3											
CLO 9		1											1		
CLO 10		2											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	3	2											1		
CLO 15		3													
CLO 16		2													
CLO 17	3	3											1		
CLO 18	3	3											1		
CLO 19	2	3											1		
CLO 20	3	2											1		
CLO 21	3														

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 4	SEE Exams	PO 1, PO 2, PO 4	Assignments	PO 1, PO 2, PO 4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	**FOURIER SERIES**
Definition of periodic function, determination of Fourier coefficients; 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; Half- range Fourier sine and cosine expansions.	
UNIT-II	**FOURIER TRANSFORMS**
Fourier integral theorem, Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transform, properties, inverse transforms, finite Fourier transforms.	
UNIT-III	**LAPLACE TRANSFORMS**
Definition of Laplace transform, linearity property, piecewise continuous function, existence of Laplace transform, function of exponential order, first and second shifting theorems, change of scale property, Laplace transforms of derivatives and integrals, multiplied by t, divided by t, Laplace transform of periodic functions. Inverse Laplace transform: Definition of Inverse Laplace transform, linearity property, first and second shifting theorems, change of scale property, multiplied by s, divided by s; Convolution theorem and applications.	
UNIT-IV	**Z –TRANSFORMS**
Z-transforms: Elementary properties, inverse Z-transform, convolution theorem, formation and solution of difference equations.	
UNIT-V	**PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equation by Lagrange method; Charpit's method; method of separation of variables; One dimensional heat and wave equations under initial and boundary conditions.	
TEXT BOOKS:	
1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2010. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.	
REFERENCES:	
1. G. Shanker Rao, "Mathematical Methods", I. K. International Publications, 1st Edition, 2009. 2. G. Shanker Rao, "Engineering Mathematics-1", I. K. International Publications, 1st Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define periodic function	CLO 1	T1:22.5 R1:2.3
2	Solve Fourier coefficients	CLO 2	T1:22.5 R1:2.4
3	Apply Fourier series for $(0, 2\pi)$	CLO 2	T1:22.6 R1:2.6
4-5	Determine even and odd function	CLO 4	T1:22.7 R1:4.4
6-7	Determine Fourier series in $(0,2l)$, $(-l,l)$ and also half range series in $(0, l)$	CLO 4	T1:22.7 R1:4.10
8-9	Determine half range series in $(0, \pi)$	CLO 7	T1:22.8 R1:4.15
10	Apply Fourier integral theorem to find integrals	CLO 9	T1:22.9 R1:5.4
11	Apply Fourier sine and cosine integrals to find integrals	CLO 9	T1:22.9 R1:5.8
12-13	Define and apply Fourier transforms	CLO 11	T1:23.10 R1:6.8
14	Use properties to solve the given functions	CLO 11	T1:23.10 R1:6.13
15-16	Define and apply Inverse transforms	CLO 13	T1:23.9 R1:7.5
17	Define and apply Finite Fourier transforms	CLO 11	T1:23.10 R1:7.5
18	Define Laplace transform and its property	CLO 9	T1:23.10 R1:8.1
19	Define piecewise continuous function	CLO 14	T1:23.1 R1:9.2
20	Define and apply shifting theorem, change of scale property	CLO 14	T1:23.1 R1:9.4
21	Solve derivatives and integrals, multiplied by t, divided by t	CLO 14	T1:23.1 R1:9.9
22-23	Define periodic functions	CLO 14	T1:23.1 R1:9.10
24-25	Solve Inverse Laplace transform	CLO 14	T2:27.5 R1:10.2
26	Define and apply shifting theorem, change of scale property	CLO 17	T2:27.7 R1:11.3
27	Solve multiplied by s, divided by s	CLO 17	T2:27.8 R1:11.6
28-30	Define and apply Convolution theorem	CLO 19	T2:27.12 R1:11.7
31-32	Define Z-transforms, Elementary properties	CLO 19	T2:27.12 R1:11.8
33-34	Define inverse Z-transform	CLO 20	T2:27.12 R1:11.9
35-36	Define and apply convolution theorem	CLO 20	T2:27.12 R1:11.10
37-38	Formulate partial differential equations	CLO 21	T2:27.14 R1:12.3
39	Solve by lagrange's method	CLO 22	T2:27.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R1:12.7
40-41	Solve by Charpit's method	CLO 23	T2:27.17 R1:12.15
42	Apply method of separation of variables	CLO 23	T2:18.2 R1:13.1
43-45	Solve heat and wave equations	CLO 23	T2:18.3-18.5 R1:13.2, 13.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S no	Description	Proposed Actions	Relevance with Pos	Relevance with Psos
1	Problem deduction, Initial and Boundary value problems	Seminars	PO 1	PSO 1
2	Fourier Integral Transforms, Convolution theorem in Fourier Transforms, Higher order difference equations	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to identify the type of transform involved in industry	NPTEL	PO 2	PSO 1

Prepared by:
Ms. M.Nagender, Assistant Professor, FE

HOD,EEE

III SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRONIC DEVICES AND CIRCUITS**				
Course Code	AEC001				
Programme	B.Tech				
Semester	III	ECE | EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. V R Seshagiri Rao, Professor				
Course Faculty	Mr. S Rambabu, Assistant Professor Mr. B Naresh, Assistant Professor				

I. COURSE OVERVIEW:

This course provides the basic knowledge over the construction and functionality of the basic electronic devices such as diodes and transistors. It also provides the information about the uncontrollable and controllable electronic switches and the flow of current through these switches in different biasing conditions. This course is intended to describe the different configurations and modes of controllable switches and how these electronic devices can be configured to work as rectifiers, clippers, clampers, oscillators and amplifiers.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS006	I	Engineering Physics	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electronic Devices and Circuits	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Quiz
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	Assignments
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	Assignments
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	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving Skills**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Seminars and Assignments
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Quiz and Assignments
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Acquire knowledge of electrical characteristics of ideal and practical diodes under forward and reverse bias to analyze and design diode application circuits such as rectifiers and voltage regulators.
II	Utilize operational principles of bipolar junction transistors and field effect transistors to derive appropriate small-signal models and use them for the analysis of basic amplifier circuits.

The course should enable the students to:	
III	Perform DC analysis (algebraically and graphically using current voltage curves with super imposed load line) and design of CB, CE and CC transistor circuits.
IV	Compare and contrast different biasing and compensation techniques and functioning as amplifier.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC001.01	CLO 1	Understand and analyze diodes operation and their characteristics in order to design basic form circuits.	PO 1	3
AEC001.02	CLO 2	Explain the operation of Zener diode and its usage in voltage regulating application.	PO 1	2
AEC001.03	CLO 3	Explain the operational characteristics of various special purpose diodes such as zener diode, Tunnel diode, varactor diode and photo diode.	PO 1	2
AEC001.04	CLO 4	Understand the principle of operation and characteristics of silicon controlled rectifier and its application in power supply protection circuit.	PO 1 PO 4	2
AEC001.05	CLO 5	Explain half wave rectifier without and with different filters for the given specifications.	PO 1 PO 2	3
AEC001.06	CLO 6	Design full wave rectifier without filter and different filters for the given specifications.	PO 3	3
AEC001.07	CLO 7	Design and selection of appropriate filter to meet the requirements of voltage regulation and ripple factor	PO 3	3
AEC001.08	CLO 8	Write Use of diodes in typical circuits: rectifiers, regulated power supplies, limiting circuits.	PO 1	2
AEC001.09	CLO 9	Understand the different parameters of transistors such as depletion width and channel width for understanding the functioning and design of this component.	PO 1 PO 2	2
AEC001.10	CLO 10	Estimate the performance of BJT and UJT on the basis of their operation and working.	PO 1 PO 2	2
AEC001.11	CLO 11	Analyze various transistor configurations and asses merits and demerits for different applications.	PO 1	2
AEC001.12	CLO 12	Discuss the construction of MOSFET and steady the VI characteristics, as it is the prime component in VLSI technology.	PO 1	3
AEC001.13	CLO 13	Distinguish the constructional features and operation of FET and MOSFET and their applications.	PO 1	2
AEC001.14	CLO 14	Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.	PO 3	2
AEC001.15	CLO 15	Identify the various transistor biasing circuits and its usage in applications like	PO 1	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		amplifiers.		
AEC001.16	CLO 16	Explain basic circuits like dc and biasing circuits, small-signal ac circuits with emphasis on single-stage amplifiers.	PO 1	2
AEC001.17	CLO 17	Explain the role of temperature variations on the performance of the BJT, FET and MOSFET inorder to take necessary measures in design for stabilization.	PO 3 PO 4	3
AEC001.18	CLO 18	Discuss and Design small signal amplifier circuits applying the various biasing techniques.	PO 3	3
AEC001.19	CLO 19	Apply small-signal models to transistors and determine the voltage gain and input and output impedances.	PO 2 PO 3	3
AEC001.20	CLO 20	Analyze the performance of FETs on the basis of their operation and working.	PO 3	3
AEC001.21	CLO 21	Apply the concept of electronic devices and circuits to understand and analyze real time applications.	PO 4	2
AEC001.22	CLO 22	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												3		
CLO 2	2												1	3	
CLO 3	2												2		
CLO 4	2			2										3	
CLO 5	3	3												3	
CLO 6			3											2	
CLO 7			3											2	
CLO 8	2												3		
CLO 9	2	2											1		
CLO 10	2	2												3	
CLO 11	2												2		

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 12	3													2	
CLO 13	2													2	
CLO 14			2										2		
CLO 15	3												3		
CLO 16	2												2		
CLO 17			3	3										2	
CLO 18			3											1	
CLO 19		3	3											1	
CLO 20			3										2		
CLO 21				2									1		
CLO 22				2											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4	SEE Exams	PO 1, PO 2 PO 3, PO 4	Assignments	PO 2 PO 3	Seminars	PO 4
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS :

UNIT – I : SEMICONDUCTOR DIODES
P-N Junction Diode: Qualitative Theory of P-N Junction, P-N Junction as a Diode, Diode Equation, Volt-Ampere Characteristics, Temperature dependence of VI characteristic, Ideal versus Practical – Resistance levels (Static and Dynamic), Transition and Diffusion Capacitances, Diode Equivalent Circuits, Load Line Analysis, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode Characteristics, Zener diode as a voltage regulator.
UNIT – II : SPECIAL ELECTRONIC DEVICES AND RECTIFIERS
Special purpose electronic devices: Principles of operation and characteristics of Silicon controlled rectifier, tunnel diode, varavtor diode, Photo diode; Half wave Rectifier, Full wave Rectifier, general

filter considerations, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L-Section Filters,multiplt of L-C section , RC filter, Comparison of Filters.
UNIT – III : TRANSISTORS
Bipolar Junction Transistor and UJT: Transistor Construction, BJT Operation, minority carrier distribution and current components, Configurations, Characteristics, BJT specifications; Appications; Amplifier, switch. Field effect transistors: Types of FET, FET construction, symbol, principle of operation, V-I characteristics, FET parameters, FET as voltage variable resistor, comparison of BJT and FET; MOSFET construction and operation; Uni Junction Transistor: Symbol, Principle of operation, UJT Characteristics and applications.
UNIT – IV : BIASING AND COMPENSATION TECHNIQUES
Biasing and Compensation techniques: Operating Point, The DC and AC Load lines, types of biasing circuits, Bias Stability, Stabilization Factors, Stabilization against variations in VBE and β, Bias Compensation techniques, Thermal Runaway, Thermal Stability, biasing the FET and MOSFET.
UNIT – V : BJT AND FET AMPLIFIERS
BJT small signal analysis, BJT hybrid model, determination of h-parameters from transistor characteristics, Transistor amplifier, analysis using h-parameters; FET small signal model, FET as common source amplifier, , FET as common drain amplifier, , FET as common gate amplifier, generalized FET amplifier.
Textbooks:
1. J. Millman, C.C.Halkias and Satyabrata Jit, "Millman's Electronic Devices and Circuits", 2nd Edition, 1998, Tata McGraw Hill Publications. 2. J. Millman and Christos C. Halkias, "Integrated Electronics", International Student Edition , 2008, Tata McGraw Hill Publications. 3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press.
Reference Books:
1. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits", 9th Edition, 2006, PEI/PHI. 2. B.P.Singh, Rekha Singh, "Electronic Devices and Circuits", 2nd Edition, 2013, Pearson Publisher. 3. K. Lal Kishore, "Electronic Devices and Circuits", 2nd Edition, 2005,BS Publisher. 4. Anil K. Maini and Varsha Agarwal, "Electronic Devices and Circuits", 1stEdition, 2009, Wiley India Pvt. Ltd. 5. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, 2011, Tata McGraw Hill Publications.

XIV. COURSE PLAN:

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

Lecture No.	Topics to be covered	CLOs	Reference
1-2	Understand thefunctioning of diode	CLO 1	T1: 5.1
3-4	Examine the P-N junction diode under different biasing conditions	CLO 8	T1: 5.2
5	Derive the current equation	CLO 1	T1: 5.3
6-7	Examine the P-N junctiondiode under temperature conditions	CLO 1	T1: 5.6-5.7
8	Understand diode ideal and practical conditions	CLO 1	T1: 5.6 – 5.7
9	Understand diode load line	CLO 1	R5: 1.7
10-11	Solve the diode capacitance equations	CLO 1	T1: 5.8 -5.10

Lecture No.	Topics to be covered	CLOs	Reference
12	Understand breakdown mechanism	CLO 1	T1: 5.12 R5: 1.15
13	Model Zener diode as voltage regulator	CLO 2	T1: 6.15
14	Understand the operation Of tunnel diode.	CLO 3	T1:5.13-5.14 R5: 8.2
15	Understand the operationof SCR	CLO 4	R5: 8.5-8.6
16	Understand semiconductorPhoto diode.	CLO 3	R5: 8.5-8.6
17	Understand and analyzeP-N diode as rectifier	CLO 5	T1: 6.1-6.2
18-20	Understand and analyzeP-N diode as half wave rectifier.	CLO 5	T1: 6.1-6.2
21-23	Understand and analyzeP-N diode as full wave rectifier	CLO 6	T1: 6.3
24	Understand and analyze filters	CLO 6	T1: 6.7-6.8 T1: 6.10-6.13
25	Understand and analyze L section filters	CLO 7	T1: 6.10-6.13
26	Understand and analyze Pi section filters	CLO 6	T1: 6.10-6.13
27	Understand and analyze RC filters	CLO 7	T1: 6.7-6.8
28	Understand the constructionof bipolar transistor	CLO 9	T1: 7.1, 7.4
29	Understand the bipolar transistor	CLO 10	T1: 7.1
30	Understand the current componentsof bipolar transistor	CLO 9	T1: 7.2-7.3
31	Analyze CB characteristics	CLO 11	T1:7.7
32	Examine CE characteristics	CLO 11	T1: 7.8-7.10
33	Examine CC characteristics	CLO 11	T1: 7.12
34	Examine the BJT, BJT Applications	CLO 10	T1: 7.12
35	Understand the operationof FET transistor	CLO 13	R5:7.1-7.3
36	Understand FET construction	CLO 13	R5:7.4
37	Understand FET application	CLO 13	R5:7.7
38-39	Understand MOSFET operation	CLO 12	R5:7.9-7.16
40-41	Understand the operationof UJT.	CLO 10	T1: 12.12
42-43	Understand the Transistor biasing	CLO 16	T1: 8.1
44	Analyze load lines	CLO 14	R5: 4.2
45	Understand fixedbias	CLO 15	T1: 8.4
46	Understand emitter feedback circuit	CLO 15	T1:8.5

Lecture No.	Topics to be covered	CLOs	Reference
47-48	Analyze and design proper Voltage divide bias	CLO 15	T1:8.6
49-50	Understand bias stability	CLO 14	T1: 8.2 R5: 4.4
51	Understand compensation technique.	CLO 15	T1: 8.9
52	Examine thermal stability	CLO 17	T1: 8.12-8.13
53-54	Distinguish Hybrid model of BJT	CLO 16	T1: 10.6
55-56	Understand the operationof FET	CLO 20	T1: 12.1
57	Understand FET CD amplifier	CLO 20	T1: 12.2
58	Model the FET circuits	CLO 21	T1: 12.11
59	Understand application of FET	CLO 20	T1: 12.12
60	Understand comparison of transistors	CLO 21	T1: 12.12

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Design of AC to DC Converters	Seminars / NPTEL	PO 1, PO 2, PO 3	PSO 1
2	Design of amplifiers circuits	Seminars / Guest Lectures / NPTEL	PO 2,PO 3, PO 5	PSO 1
3	Design of electronic circuits on PCB boards.	Laboratory Practices	PO 1, PO 3,PO12	PSO 1

Prepared by:
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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**POWER GENERATION SYSTEMS**				
Course Code	AEE003				
Programme	B.Tech				
Semester	III	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. T Mahesh , Assistant Professor, EEE				
Course Faculty	Mr. T Mahesh , Assistant Professor, EEE				

I. COURSE OVERVIEW:

This course deals with conventional energy systems like thermal and nuclear power stations. This course also introduces non conventional energy systems like solar energy (radiation, collection, storage, and application), Hydro and Wind Energy.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS006	I	Engineering Physics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Power Generation Systems	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 weight age 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz 05/Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz/AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th 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/ATT
Two Quiz exams shall be online examination consisting of 25 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.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Discussion and seminars
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	Discussion and seminars
PO3	**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	Discussion and seminars
PO4	**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	Discussion and seminars
PO6	**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	Discussion and seminars
PO7	**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.	2	Discussion and seminars
PO12	**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	Discussion and seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO2	Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally	2	Discussion and seminars
PSO3	The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Demonstrate thermal power generation systems including major subsystems.
II	Illustrate hydroelectric power generation systems along with pumped storage plants.
III	Understand basic working principles of nuclear power generation systems.
IV	Apply knowledge of solar and wind power generation systems in design and implementation to obtain clean energy.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE003.01	CLO 1	Demonstrate the layout and working principle of thermal power plant.	PO1,PO3,PO6,PO7	2
AEE003.02	CLO 2	Analyze the principle and operation of different energy conversion systems.	PO1,PO6,PO7,PO12, PSO2	1
AEE003.03	CLO 3	Classify the various types of renewable energy sources.	PO6,PO7,PO12	1
AEE003.04	CLO 4	Compare the various hybrid energy systems in electrical system.	PO1,PO4, PO7, PO12,PSO2	4
AEE003.05	CLO 5	Use the renewable energy sources to meet the constraints in electrical and electronics engineering field.	PO1, PSO2	2
AEE003.06	CLO 6	Explain the working of hydro power plant and its importance in the power system	PO1, PO2, PO7, PO12	2
AEE003.07	CLO 7	Discuss the principles and operations of photovoltaic effect.	PO1, PO7, PO12	1
AEE003.08	CLO 8	Describe the layout and working of solar power plant in electrical systems.	PO1, PO2, PO7	2
AEE003.09	CLO 9	Build the flow chart of maximum power point tracking system.	PO1,PO2, PO3, PO4	2
AEE003.10	CLO 10	Illustrate the principle of various types of solar concentrators.	PO1, PO3	1
AEE003.11	CLO 11	Demonstrate the construction and working principle of wind energy systems.	PO1, PO2, PO3	2
AEE003.12	CLO 12	Discuss the principle and operation of induction generator in wind energy system.	PO1, PO3	2
AEE003.13	CLO 13	Demonstrate the importance of wind energy system and types of turbines.	PO1, PO2, PO7	2
AEE003.14	CLO 14	Generalize the construction and working of nuclear power plant in power systems.	PO1, PO3, PO6, PO7	2
AEE003.15	CLO 15	Illustrate the effect of non-renewable energy sources on the environment.	PO3, PO7	2
AEE003.16	CLO 16	Apply the concepts of renewable energy sources to solve real-world applications.	PO1, PO3, PO6, PO7	1
AEE003.17	CLO 17	Possess the knowledge and skills for employability and to succeed national and international level competitive examination.		

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	1		2			2	1								
CLO 2	1					1	2					1		1	
CLO 3												1			
CLO 4	1			2			2							2	
CLO 5	1													2	
CLO 6	1						3					1			
CLO 7	1						1					1			
CLO 8	1	2					1								
CLO 9	1	2		3										2	
CLO 10	1														
CLO 11	1	2	1												
CLO 12	1		2												
CLO 13	1	1					2								
CLO 14	1		2			2	1								
CLO 15			1				2								
CLO 16	1		1			1	2								
CLO 17															

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4, PO6, PO7, PO12	SEE Exams	PO1, PO2, PO4, PO6, PO7, PO12	Assignments	PO4	Seminars	PO2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT -I	THERMAL POWER STATIONS
Thermal Power Stations: Line diagram of thermal power station, paths of coal, steam, water, air, ash and flue gasses, description of thermal power station components, economizers, boilers, super heaters, turbines, condensers, chimney and cooling towers.	
UNIT -II	**HYDROELECTRIC POWER STATIONS**
Hydroelectric Power Stations: Elements, types, concept of pumped storage plants, storage requirements, mass curve and estimation of power developed from a given catchment area, heads and efficiencies, simple problems.	
UNIT-III	**SOLAR ENERGY AND PHOTOVOLTAIC SYSTEMS**
Solar Energy: environmental impact of solar power, physics of the sun, solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation, solar radiation data, solar concentrators, collectors, thermal applications, design of standalone solar systems, simple problems. Photovoltaic systems: Photovoltaic effect, semiconducting materials, band gap theory, photo emission of electrons, cell configuration, types of solar cells, cell properties, device physics, electrostatic field across the depletion layer, voltage developed, I-V characteristics, module structure and fabrication, output power and efficiency, fill factor, maximum power point tracking (MPPT), solar grid connected inverters, simple Problems	
UNIT-IV	**WIND ENERGY**
Wind Energy: sources and potential, power from wind, betz criterion, components of wind energy conversion system, types of turbines, horizontal and vertical axis wind turbines, aerodynamics, momentum theory (actuator disk concept), operational characteristics, blade element theory, types of generating systems for wind energy, permanent magnet generators, dc generators, induction generators, doubly fed induction generators, applications of wind energy, safety and environmental aspects, simple problems	
UNIT–V	**NUCLEAR POWER STATIONS**
Nuclear Power Stations: nuclear fission and chain reaction, nuclear fuels, principle of operation of nuclear reactor and components, types of nuclear reactors, pressurized water reactor, boiling water reactor and fast breeder reactor, radiation hazards, shielding and safety precautions, applications	
Text Books:	
1. C L Wadhawa,"Generation, Distribution and Utilization of Electrical Energy", New Age International Limited, New Delhi, 3rd Edition, 2010. 2. V.K Mehata, Rohit Mehta, "Principles Of Power Systems", 4th Edition, 2014. 3. G D Rai, "Non-Conventional Energy Sources", Khanna Publishers, 1st Edition, 2011. 4. G N Tiwari, M K Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publications, New Delhi, 1st Edition, 2007. 5. B.H Khan, "Non-conventional energy sources", Tata Mecgraw-hili, 2rd Edition, 2013. 6. Geoff Stapleton and Susan Neill"Grid Connected Solar Electric System", Earth Scan Expert series, 1st Edition,2014.	
Reference Books:	
1. J B Gupta, "A Course in Electrical Power", S K Kataria and Sons, New Delhi, 15th Edition, 2013. 2. M V Deshpande, "Elements of Power Station design", Prentice Hall India Learning Private Limited, New Delhi, 1st Edition, 1992. 3. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 1st Edition, 1999.	

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Explain Thermal power station line diagram	CLO 1	T2 :10-13
3	Describe the function of economizer in a thermal power plant	CLO 1	T2:15
4	Compare the types of different boilers	CLO 2	T2:14
5-6	Describe the Functions of super heater and condenser	CLO 3	T2:14-15
7-8	Differentiate the Types of steam turbine with neat diagram	CLO 2	T2:12
9-11	Illustrate the operation of chimney and cooling tower	CLO 3	T2:15
12	Explain the operation of Hydroelectric Power Stations	CLO 4	T2:18-23
13-14	Identify the types of pumped storage plants	CLO 4	T2:18-22
15	Explain the importance of mass curve	CLO 4	T2:18-22
16-17	Estimate the power developed from a given catchment area	CLO 4	T2:18-22
18	Calculate the power developed in hydro power station	CLO 5	T2:23-27
19-21	Explain the importance of Different heads in hydro power station	CLO 6	T2:21-23
22	Estimate the efficiency of hydro power station	CLO 5	T2:18-25
23	List out the Various hydro power stations in India	CLO 7	T2:18-25
24	Tabulate the effects hydro power station on environment.	CLO 7	T2:18-25
25	Choose the solar energy as a renewable source	CLO 7	T3:47
26	Explain the Role and potential of Solar energy	CLO 7	T3:47
27-28	Illustrate the effect environmental impact of solar power	CLO 9	T3:47
29	Discuss the physics of the sun	CLO 9	T3:73
30-31	Understand the solar constant, extra- terrestrial and terrestrial solar radiation	CLO 9	T3:47
32	Describe the solar radiations	CLO 8	T3:49-64
33-34	Understand instruments used for measuring solar radiation and sun shine	CLO 10	T3:60-64
35	List different types of collectors	CLO 10	T3:73-123
36	Classify different concentrating collectors	CLO 11	T3:102
37	Understand the orientation and thermal analysis	CLO 11	T3:94
38-39	Discuss about the advanced collectors	CLO 10	T3:111

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
40-43	Illustrate the methods of solar energy storage	CLO 12	T3:123-146
44	Understand the solar ponds	CLO 12	T3:138-145
45	Understand the Photovoltaic cell output power and efficiency and Fill factor.	CLO 12	T3:146-224
46	Discuss the solar heating/cooling technique	CLO 13	T5:182
47	Explain maximum solar radiation dragging by using maximum power point tracking (MPPT).	CLO 13	T5:182
48	Understand the photovoltaic energy conversion	CLO 13	T3:146-224
49	Explain how to connect solar system to power grid.	CLO 14	T6:217
50	Understand Potential of wind energy sources	CLO 14	T3:227
51	Classify the types of windmills	CLO 14	T3:262
52	Interpret the performance characteristics	CLO 14	T3:287
53	Understand the Betz criteria	CLO 14	T3:287
54-55	Illustrate the different schemes of electric generation and control	CLO 15	T3:292

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with Pos	Relevance with PSOs
1	Design of modern boilers to reduce pollution in view of environment.	Seminars / NPTEL	PO1,PO7,PO3,P08	PSO1
2	Hybrid energy conversion systems to improve overall efficiency of power stations.	Term Paper / NPTEL	PO1, PO2	PSO1,PSO2
3	Interfacing the solar system to the grid and its operation.	NPTEL / Laboratory Practices	PO1, PO2, PO5	PSO2

Prepared by:
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INSTITUTE OF AERONAUTICAL ENGINEERING

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**DC MACHINES AND TRANSFORMERS**				
Course Code	**AEE004**				
Programme	B.Tech				
Semester	III	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. P Mabuhussain, Assistant Professor				
Course Faculty	Dr. P Sridhar, Professor Mr. P Mabuhussain, Assistant Professor Mr. K Devender Reddy, Assistant Professor				

I. COURSE OVERVIEW:

This course examines the basic theory, construction, operation, performance characteristics and application of electromechanical energy conversion devices such as DC generators and motors. It also gives an in-depth knowledge on the operation of single phase and three phase transformers and it's testing. It also focus on the auto transformers, on-load, off-load tap changers which are widely used in real time applications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS006	I	Engineering Physics	4
UG	AEE002	II	Electrical Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
DC Machines and Transformers	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical and application skills of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	seminars
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	Assignments
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	Laboratory Practice

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO 2	**Professional Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	2	METE Projects, Open ended experiments

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Illustrate the theory of electromechanical energy conversion and the concept of co energy.
II	Demonstrate the working principle of different types of dc machines and transformers.
III	Analyze the losses in dc machines to improve the efficiency by conducting various tests
IV	Outline the principle of operation, construction and testing of single phase transformers

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE004.01	CLO 1	Solve simple and complex problems related to electromagnetic circuits.	PO 1, PO 2	2
AEE004.02	CLO 2	Describe the basic electromagnetic energy conversion process, energy storage and energy balance.	PO 1	3
AEE004.03	CLO 3	Derive the force and torque produced in singly excited, multi excited magnetic systems.	PO 2	3
AEE004.04	CLO 4	Outline the construction, operation and the windings used in DC machines.	PO 1, PO 2	3
AEE004.05	CLO 5	Illustrate the concept of armature reaction, commutation and study the characteristics and applications of DC generators.	PO 1, PO 2	3
AEE004.06	CLO 6	Examine the parallel operation of DC generators, importance of equalizer bars and load sharing.	PO 1, PO 2	2
AEE004.07	CLO 7	Study the operation, significance of back EMF, characteristics and speed control methods of DC motors.	PO 1, PO 4	3
AEE004.08	CLO 8	Classify the different types of losses occurred in DC machines.	PO 1	2
AEE004.09	CLO 9	Determine the efficiency of DC machines by conducting direct and indirect tests.	PO 2, PO 4	3
AEE004.10	CLO 10	Discuss the principles of operation, construction and EMF equation of single phase transformers.	PO 1, PO 2	2
AEE004.11	CLO 11	Explain the operation of single phase transformer under no-load and on-load along with its phasor diagrams.	PO 1,PO 2	2
AEE004.12	CLO 12	Calculate the efficiency and regulation of single phase transformers by conducting different tests.	PO 2, PO 4	2
AEE004.13	CLO 13	Examine the parallel operation of single phase transformers and analyze the load sharing.	PO 1, PO 2	3
AEE004.14	CLO 14	Summarize the different types of connections of three phase transformers.	PO 1, PO 2	2
AEE004.15	CLO 15	Demonstrate the operation of open delta connection and Scott connection with two single phase transformers.	PO 2, PO 4	3
AEE004.16	CLO 16	Explain the functioning of autotransformers, tap changing transformers and off-load, on-load tap changers.	PO 1, PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2	2													
CLO 2	3														
CLO 3		3													
CLO 4	3	3													
CLO 5	3	3													
CLO 6	2	2													
CLO 7	3			3											2
CLO 8	2														
CLO 9		3		3											2
CLO 10	2	2													
CLO 11	2	2													
CLO 12		3		3											2
CLO 13	2	3													2
CLO 14	2	3													
CLO 15		3		3											2
CLO 16	2	3													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4, PSO3	SEE Exams	PO1, PO2, PO4, PSO3	Assignments	PO1, PO2	Seminars	PO 2
Laboratory Practices	PO3, PO4	Student Viva	PO 4	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	ELECTROMECHANICAL ENERGY CONVERSION
Electromechanical energy conversion: Forces and torque in magnetic systems, energy balance, energy and force in a singly excited and multi excited magnetic field systems, determination of magnetic force, coenergy.	
UNIT-II	**DC GENERATORS**
Principle of operation, construction, armature windings, lap and wave windings, simplex and multiplex windings, use of laminated armature, commutator, emf equation, types of DC generators, voltage buildup, critical field resistance and critical speed, causes for failure to self excite and remedial measures; Armature reaction: Cross magnetization and demagnetization, ampere turns per pole, compensating winding, commutation, reactance voltage, methods of improving commutation; Characteristics: Principle of parallel operation load sharing, use of equalizer bars and cross connection of field windings problems	
UNIT-III	**DC MOTORS AND TESTING**
Principle of operation, back EMF, torque equation, condition for maximum power developed, types of DC motors, armature reaction and commutation, characteristics, methods of speed control, types of starters, numerical problems; Losses and efficiency: Types of losses, calculation of efficiency, condition for maximum efficiency Testing of DC machines: Swinburne's test, brake test, regenerative testing, Hopkinson's test, field's test, retardation test and separation of stray losses, problems.	
UNIT-IV	**SINGLE PHASE TRANSFORMERS**
Single phase transformers: Principle of operation, construction, types of transformers, EMF equation, concept of leakage flux and leakage reactance, operation of transformer under no load and on load, phasor diagrams, equivalent circuit, efficiency, regulation and all day efficiency; Testing of transformer: objective of testing, polarity test, measurement of resistance, OC and SC tests, back to back test, heat run test, parallel operation, problems.	
UNIT-V	**POLY PHASE TRANSFORMERS**
Three phase transformer: Principle of operation, star to star, delta to delta, star to delta, delta to star, three phase to six phase, open delta connection, scott connection; Auto transformers: Principles of operation, equivalent circuit, merits and demerits, no load and on load tap changers, harmonic reduction in phase voltages, problems.	
Text Books:	
1. J B Gupta, "Theory and Performance of Electrical Machines", S K Kataria & Sons publications, 14th edition, 2010. 2. P S Bimbra, "Electrical Machines", Khanna publications, 2nd edition, 2008. 3. I J Nagrath, D P Kothari, "Electrical Machines", Tata Mc Graw Hill publications, 3rd Edition, 2010. 4. Abhijit Chakrabarti, Sudipta Debnath, " Electrical Machines", McGrawhill education (India) private limited, 1st edition, 2015	
Reference Books:	
1. Ian McKenzie Smith, Edward Hughes, "Electrical Technology", Prentice Hall, 10th edition, 2015. 2. M G Say, E O Taylor, "Direct current Machines", Longman higher education, 1st edition, 1985. 3. M V Deshpande, "Electrical Machines", PHI learning private limited, 3rd edition, 2011.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understand the concepts of electromechanical energy systems	CLO 1	T1: 2.1
2	Analyze the forces and torques produced in magnetic field systems	CLO 3	T1:2.4
3	Solve the different problems related to magnetic field systems	CLO 1	T1:2.4
4	Solve different analytical problems related to energy balance	CLO 2	T1:2.5
5	Understand the concept of energy and force in singly excited systems	CLO 3	T1:2.7.1 - 2.7.4
6	Understand the concept of energy and force in multi excited systems	CLO 3	T1:2.10
7	Solve different analytical problems related to multi excited systems	CLO 3	T1:2.10
8	Understand the concept of magnetic force and coenergy	CLO3	T1:2.10
9	Understand principle of operation of DC generator	CLO 4	T1:4.1-4.2
10	Know the different parts in a DC machine and Understand the functioning of each component.	CLO 4	T1:4.3
11	Know the different types of windings used in DC generators	CLO 4	T1:4.4-4.9
12	Understand why the core of a DC machine is laminated and functioning of commutator	CLO 4	T1:4.3
13	Derive the equation of EMF induced in a DC generator and solve the simple problems	CLO 4	T1:4.10
14	Distinguish the different types of DC generators and know how the voltage is buildup in DC generators	CLO 4	T1:6.1-6.2
15	Understand the concept of critical field resistance and critical speed	CLO 5	T1:6.7-6.12
16	Understand the different causes for the failure of excitation in DC generators and know the remedies to solve the problem	CLO 5	T1:6.13-6.14
17	Understand the concept of armature reaction in DC generator	CLO 5	T1:5.1-5.2
18	Understand the concept of cross magnetization and demagnetization in DC generator	CLO 5	T1:5.3
19	Solve the problems on armature reaction	CLO 5	T1:5.7
20	Understand the concept of commutation, and know different methods used for improving the commutation	CLO 5	T1:5.4-5.6
21	Draw the different types of characteristics for DC generator	CLO 5	T1:6.5-6.11
22	Understand the basic principle of operating the generators in parallel	CLO 6	T1:7.1 -7.4
23	Understand the function of equalizer bar and its usage	CLO 6	T1:7.2
24	Solve the different types of numerical problems related to DC generators.	CLO 6	T1:4.1-7.4
25	Understand the basic principle of dc motor and its function	CLO 7	T1:8.2
26	Understand how the back EMF is induced in DC motor and derive the torque equation	CLO 7	T1:8.4-8.6 & T1: 8.12-8.15
27	Know different types of motors and solve simple problems	CLO 7	T1:8.7.1-8.7.5

Lecture No	Topics to be covered	CLOs	Reference
28	Understand the occurrence of armature reaction and study the commutation techniques	CLO 5	T1:8.16
29	Draw the performance characteristics of DC motors	CLO 7	T1:8.18-8.23
30	Understand the methods of speed control	CLO 7	T1:9.1-9.3
31	Know why starters are used and different types of starters	CLO 7	T1:9.4-97
32	Understand the differ types of losses that are occurred in a DC motor.	CLO 8	T1:10.1-10.4
33	Solve different numerical problems related to efficiency of DC motor	CLO 8	T1:10.1-10.4
34	Conduct the Swinburne's test and Brake test on DC motor and compare the two methods.	CLO 9	T1:10.7
35	Conduct the regenerative test, Hopkinson's test and determine the efficiency of DC motor	CLO 9	T1:10.8
36	Conduct the field's test on DC series motor, and retardation test on DC shunt motor.	CLO 9	T1:10.9-10.10
37	Summarize the different types of losses and separate the each loss from total losses.	CLO 9	T4:10.10
38	Solve the different types of numerical problems related to DC motors testing	CLO 9	T1:8.2-10.10
39	Explain the operation, construction and types of single phase transformer.	CLO 10	T1:1.1-1.4 & T1:1.24
40	Derive the equation of EMF induced in transformer and understand the concept of leakage flux and reactance.	CLO 10	T1:1.5-1.6
41	Discuss the operation of transformer under no load and on load with the phasor diagrams	CLO 11	T1:1.8-1.12
42	Draw the equivalent circuit of single phase transformer and study the concept of regulation and all day efficiency	CLO 11	T1:1.13-1.18
43	Solve the Numerical problems on EMF equation and draw the phasor diagrams	CLO 10	T1:1.1-1.18
44	Understand the objectives of testing, and kwon how to conduct polarity test and how to measure resistance.	CLO 12	T1:1.19.1-1.19.2
45	Conduct OC and SC tests on transformer and determine the efficiency and regulation at different loads.	CLO 12	T1:1.193-1.195
46	Conduct back to back test / heat run test and determine the efficiency and regulation.	CLO 12	T1:1.19.6
47	Solve the problems on transformer testing	CLO 12	T1:1.19.1-1.19.6
48	Understand the necessity and importance of parallel connection of transformers.	CLO 13	T1:2.11.1-2.11.4
49	Understand how the load is shared between two transformers connected in parallel.	CLO 13	T1:2.11.1-2.11.4
50	Solve the different types of numerical problems related to single phase transformers.	CLO 13	T1:1.1-2.11
51	Understand the principle of operation of three phase transformers	CLO 14	T1:2.1-2.2
52	Analyze the different connections of three phase transformers.	CLO 14	T1:2.3.1-2.3.2
53	Solve the problems on three phase transformer connections	CLO 14	T1:2.1-2.3.2
54	Analyze how a transformer can work on open delta connection.	CLO 15	T1:2.4.1-2.4.2
55	Describe how scott connection is performed to convert three phase supply to two phase and vice versa.	CLO 15	T1:2.5

Lecture No	Topics to be covered	CLOs	Reference
56	Understand the principle of operation auto transformers.	CLO 16	T1:2.12
57	Draw the equivalent circuit and explain the merits and demerits of auto transformers	CLO 16	T1: 2.12.2
58	Solve the problems on Autotransformers	CLO 16	T1: 2.12.2
59	Understand the operation of no load and on load tap changers.	CLO 16	T1:1.17.1-2.17.2
60	Know how to reduce the harmonics in phase voltages	CLO 16	T1:2.62

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Effect of magnetic inrush current on the performance of transformers	MOOC courses / Laboratory Practices	PO 1, PO 2	PSO 1
2	Types of windings and section of windings in transformers	NPTEL / Industrial visits	PO 1, PO 2	PSO 1
3	Cooling methods and maintenance of transformers	NPTEL / R&D Centres, Industrial visits	PO 1, PO 4	PSO 2

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**NETWORK ANALYSIS**				
Course Code	**AEE005**				
Programme	B.Tech				
	III	EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	**Ms. S Swathi, Assistant Professor, EEE**				
Course Faculty	**Dr. D Shobha Rani, Professor, EEE** **Ms. S Swathi, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course introduces the basic concepts of net work theory which is the foundation for all subjects of the electrical engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes three phase circuits, transient analysis of DC and AC circuits, network functions, and two port net work parameters, Fourier analysis of AC circuits, design and analysis of filters.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra and Ordinary Differential Equations	4
UG	AHS011	II	Mathematical Transform Techniques	4
UG	AEE002	II	Electrical Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Network Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✔	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	3	Seminar
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	Presentation on real-world problems
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	Project Work / Tutorial

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Assignment and Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	---	---
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	2	Project Work / Tutorial

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyse three phase star and delta connected circuits to calculate the active and reactive power.
II	Understand the transient response of series and parallel RL, RC and RLC circuits for DC and AC excitations.
III	Discuss the concepts of locus diagram, network functions and to calculate the two port network parameters.
IV	Design different types of filters and perform the digital simulation of electric circuits.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAEE005.01	CLO 1	Analyze three phase star and delta circuits with different configuration.	PO1, PO2, PSO1	3
CAEE005.02	CLO 2	Understand the concept of Phasor diagram for three phase systems.	PO1	3
CAEE005.03	CLO 3	Discuss the active, reactive and apparent power and power factor in three phase circuits.	PO1, PO2, PSO1	3
CAEE005.04	CLO 4	Estimate the transient response of series and parallel circuits with AC and DC excitation.	PO1, PO2	3
CAEE005.05	CLO 5	Evaluate the transient response of first and second order electric circuits using differential equation approach.	PO1, PO2	3
CAEE005.06	CLO 6	Determine the transient response of first and second order electric circuits using Laplace transform technique.	PO1, PO2, PSO1	3
CAEE005.07	CLO 7	Explain the concept of locus diagram for series and parallel circuits.	PO1, PO2	3
CAEE005.08	CLO 8	Generalize the concept of network functions for one port and two port networks.	PO1	3
CAEE005.09	CLO 9	Examine the electric networks in time domain and frequency domain.	PO1, PO2	3
CAEE005.10	CLO 10	Calculate Z, Y, ABCD, H and image parameters of two port network.	PO1, PO2, PSO1	3
CAEE005.11	CLO 11	Inter relationships between various two port networks them.	PO1, PO2, PSO1	3
CAEE005.12	CLO 12	Outline the concepts of interconnections of two port networks.	PO1, PSO1	3
CAEE005.13	CLO 13	Design of low pass, high pass, band pass, band elimination, Active filters and their characteristics.	PO1, P02, PO3, PO5, PSO1	3
CAEE005.14	CLO 14	Summarize the characteristics of electric circuit using Matlab.	PO1, P02 , PO5, PSO3	3
CAEE005.15	CLO 15	Use the technique of Fourier transforms to solve the electric circuit problems.	PO1, P02, PSO3	3
CAEE005.16	CLO 16	Apply the concept of network theorems, switching transient to solve real time world applications.	PO1, P02,PO5, PSO1	3
CAEE005.17	CLO 17	Process the knowledge and skills for employability and to succeed national and international level competitive examinations.	PO1, P02,PO5, PSO1, PSO3	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2	3											2		
CLO 2	3														
CLO 3	2	3											2		
CLO 4	3	3													
CLO 5	3	3													
CLO 6	3	3											2		
CLO 7	3	2													
CLO 8	3														
CLO 9	2	3													
CLO 10	2	3											3		
CLO 11	3	2											3		
CLO 12	3												3		
CLO 13	2	3	2		2								3		
CLO 14	2	3			2										3
CLO 15	3	3													2
CLO 16	2	3			2								2		
CLO 17	2	3			2								3		2

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1, PO2, PO3, PO5, PSO1	SEE Exams	PO1, PO2, PO3, PO5, PSO1	Assignments	PO1	Seminars	PO1
Laboratory Practices	PO1	Student Viva	-	Mini Project	PSO3	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	THREE PHASE CIRCUITS
Three Phase Circuits: Star and delta connections, phase sequence, relation between line and phase voltages and currents in balanced star and delta circuits, three phase three wire and three phase four wire systems, shifting of neutral point, analysis of balanced and unbalanced three phase circuits, measurement of active and reactive power.	
Unit-II	**DC AND AC TRANSIENT ANALYSIS**
Transient response: Initial conditions, transient response of RL, RC and RLC series and parallel circuits with DC and AC excitations, differential equation and Laplace transform approach.	
Unit-III	**LOCUS DIAGRAMS AND NETWORKS FUNCTIONS**
Locus Diagrams: Elementary treatment of locus diagrams of RL, RC and RLC circuits (series and parallel combinations). Network Functions: The concept of complex frequency, physical interpretation, transform impedance, series and parallel combination of elements, terminal ports, network functions for one port and two port networks, poles and zeros of network functions, significance of poles and zeros, properties of driving point functions and transfer functions, necessary conditions for driving point functions and transfer functions, time domain response from pole-zero plot.	
Unit-IV	**TWO PORT NETWORK PARAMETERS**
Two Port Network Parameters: Z, Y, ABCD, hybrid and inverse hybrid parameters, conditions for symmetry and reciprocity, inter relationships of different parameters, interconnection (series, parallel and cascade) of two port networks, image parameters.	
Unit-V	**FILTERS AND DIGITAL SIMULATION OF CIRCUITS**
Filters: Low pass, high pass, band pass, band elimination filters, introduction to active filter, filter design. Digital Simulation: MATLAB simulation and mathematical modeling of R, RL, RC and RLC circuits with DC and AC excitations: steady state and transient analysis, time and frequency domain analysis, frequency and phase spectra by Fourier analysis; basic test signals representation, filter design.	
Text Books:	
1. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010. 2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010 3. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014. 4. Rudrapratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1st Edition, 1999.	
Reference Books:	
1. John Bird, "Electrical Circuit Theory and technology", Newnes, 2nd Edition, 2003 2. C L Wadhwa, "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2nd Edition, 2009. 3. David A Bell, "Electric Circuits", Oxford University Press, 7th Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Interpret three phase circuits, its generation and connections.	CLO1	T2:9.3 R1:19.1
2	Discriminate three phase circuits when connected in star and delta.	CLO1	T2: 9.6 R2:19.4
3	Analyze the three phase loads	CLO2	T2: 9.7 R2:19.5
4-5	Discuss voltage and current of three phase unbalanced loads.	CLO2	T2: 9.10 R2:19.6
6-7	Determine the active power in a three phase circuit and the effect of power factor on Wattmeter readings.	CLO3	T2: 9.11 R2:19.8
8-9	Determine the reactive power in a three phase circuit	CLO3	T2: 9.11 R2:19.8
10-12	Tutorial Problems	CLO3	T2, 9.12 R2:19.9
13-14	Observe the Transient behavior of R, L and C elements in a circuit.	CLO5	T2 - 11.1 R2 :17.1
15-16	Compute initial conditions and time response for current and voltage in first order R-L and R-C circuits	CLO4	T2 :11.2 R2 :17.3
17-18	Analyze and solve problems on complicated RC and RL circuits	CLO5	T2 :11.2 R2:17.12
19-20	Describe the AC Transient analysis of a series RC, RL circuits	CLO5	T2:11.5 R2:17.5
21-22	Analyze Transient behavior of a series RLC circuits to AC excitation	CLO5	T2 - 11.7 R2:17.6
23-24	Analyze the Transients using Laplace transform method	CLO6	T2 :11.7 R2:17.10
25-27	Tutorial Problems	CLO6	T1:9.1 R2:17.12
28-29	Discuss the concepts of locus diagram	CLO7	T2 – 8.13 R2:15.12
30	Learn about complex frequency	CLO8	T2 – 15.1 R2:15.1
31-32	Design Transform Impedance and Transform Circuits	CLO8	T2 – 15.3 R2:15.1
33-34	Learn terminal pairs or ports	CLO8	T2 – 15.5 R2:15.1
35	Study the significance of poles and zeros	CLO8	T2 – 15.8 R2:15.1
36	Understand the properties of Transfer functions, Necessary conditions for driving point functions	CLO8	T2 :15.14 R2:15.1
37	Study the Necessary conditions for transfer functions, time domain response from pole zero plot	CLO8	T2 :15.14 R2:15.1
38-41	Tutorial Problems	CLO9	T2:15.15 R2:16.2
42	Discuss about network parameters	CLO10	T1 :13.6 R2:16.3
43-44	Obtain Z parameters and Y parameters	CLO10	T1 :13.6 R2:16.4
45-52	Analyze problems on Z and Y parameters	CLO10	T1 :13.9 R2:16.5
45, 46	Design h parameters and ABCD parameters	CLO10	T1 :13.6

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R2:16.6
47	Analyze problems on h and ABCD parameters	CLO10	T1 :13.6 R2:16.7
48	Interrelate Z, Y, H & T parameters	CLO11	T1 :13.7 R2:16.8
49	Study the Cascade, series, parallel connection of Networks	CLO12	T1 :13.14 R2:16.9
50-51	Tutorial Problems	CLO10	T1:14.13R2 :16.12
52	Understand the Low Pass filter characteristics and design	CLO13	T1: 18.6 R2:19.12
53	Design the High Pass filter and study its characteristics	CLO13	T1 :18.8 R2:19.2
54	Analyze and Design Band Pass filter	CLO13	T1 :18.8 R2:19.3
55	Understand the characteristics of Band Elimination filter	CLO13	T1 :18.14 R2:19.4
56	Tutorial Problems	CLO13	T1: 18.16 R2:19.5
57	Design of Active filters	CLO13	T1 :18.17 R2:19.3
58	Observe the simulation of RL,RC,RLC circuits	CLO14	T2 :11.7 R2:14.3
59	Demonstrate different properties of Fourier transforms	CLO15	T2 :12.1 R2:14.5
60	Tutorial Problems	CLO15	T2:12.3 R2:14.6

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Designing of Filters	Guest Lectures / NPTEL	PO1,PO2, PO5	PSO 1
2	Digital Simulation of Electric Circuits.	Matlab Demos / NPTEL	PO1, PO3, PO5	PSO 1
3	Significance of Poles and Zeros.	NPTEL / Term Paper	PO1, PO2	PSO 1

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRO MAGNETIC FIELD THEORY**				
Course Code	AEE006				
Programme	B.Tech				
Semester	III	EEE			
Course Type	Professional Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. T. Anil Kumar, Assistant Professor, EEE				
Course Faculty	Mr. T. Anil Kumar, Assistant Professor, EEE Mr. B. Muralidhar Nayak, Assistant Professor. EEE				

I. COURSE OVERVIEW:

Electromagnetic theory field deals with principles and basic laws of electrostatics, characteristics and properties of conductors and dielectrics, behavior of static magnetic field and application of ampere law, determination of force in magnetic field and magnetic potential, concept of time varying fields and application of numerical methods to electrostatic and magnetic fields.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS003	I	Computational Mathematics and Integral Calculus	4
UG	AHS006	I	Engineering Physics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electromagnetic Field Theory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignment And Seminars
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	Assignment And Seminars
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	Assignment And Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Assignment And Seminars
PSO2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Demonstrate the concept of electrostatic field intensity and electric potential.
II	Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in an electric field.
III	Understand the concept of field intensity and flux density in magnetic fields.
IV	Discuss forces in magnetic fields and laws of electromagnetic induction
V	Summarize the concept of time varying field and apply numerical methods to electro-statics and magnetic fields.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
AEE006.01	CLO 1	Analyze the force and electric field intensity in the electrostatic field.	PO1,PO2	3

AEE006.02	CLO 2	Identify the characteristics of electrostatic fields in terms of definitions.	PO1	3
AEE006.03	CLO 3	State different laws which defines characteristics of electrostatic fields.	PO1	2
AEE006.04	CLO 4	Illustrate polarization of dielectrics and the behavior of conductors and dielectrics in electric field.	PO1	3
AEE006.05	CLO 5	Demonstrate the electric dipole and its effect on electric field.	PO1	2
AEE006.06	CLO 6	Estimate the capacitance of parallel plates, spherical and coaxial capacitors with composite dielectrics.	PO1,PO2,PO3,	2
AEE006.07	CLO 7	Summarize the concept of magneto static and interrelate the terms of magnetic fields.	PO1	2
AEE006.08	CLO 8	Interpret the magnetic field intensity due to circular, square and solenoid current carrying wire.	PO1,PO2,PO3,	2
AEE006.09	CLO 9	Use Ampere circuital law to determine magnetic field intensity due to an infinite sheet of current, a long current carrying filament and its applications.	PO1,PO2,PO3,	2
AEE006.10	CLO 10	Predict the force due to moving charge in the magnetic field for different configuration of current carrying conductor.	PO1,PO2	3
AEE006.11	CLO 11	Demonstrate the magnetic dipole and its effect on magnetic field.	PO1	2
AEE006.12	CLO 12	Calculate the self inductance and mutual inductance for different configurations of wires and applications of permanent magnet.	PO1,PO2	3
AEE006.13	CLO 13	State the Faraday's laws of electromagnetic induction and nature of voltage induced in the coil.	PO1	3
AEE006.14	CLO 14	Derive and explain the differential and integral form of Maxwell's equation in time varying fields and fields varying harmonically with time.	PO1	3
AEE006.15	CLO 15	Discuss the different numerical methods to calculate the electrostatic and magneto static fields.	PO1,PO2, PO3	3
AEE006.16	CLO 16	Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.	PO1,PO2, PO3	3
AEE006.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1,PO2, PO5, PO12	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											2		
CLO 2	3												2		
CLO 3	2												3		
CLO 4	3												3		
CLO 5	2												2		
CLO 6	2	2	3										3		

CLO 7	2												2		
CLO 8	2	3	2										3		
CLO 9	2	3	2										2		
CLO 10	2	3											2		
CLO 11	2														
CLO 12	2	3											3		
CLO 13	3												3		
CLO 14	3												2		
CLO 15	2	3	3										3		
CLO 16	3	3	2										3		
CLO 17	3	3			2							2	2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2, PO3	SEE Exams	PO1,PO2, PO3	Assignments	PO1,PO2, PO3	Seminars	PO1,PO2, PO3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	**ELECTROSTATICS**
Coulomb's law, electric field intensity due to line and surface charges, work done in moving a point charge in an electrostatic field, electric potential, properties of potential function, potential gradient, Gauss's law, application of Gauss's law, Maxwell's first law, Laplace's and Poisson's equations, solution of Laplace's equation in one variable.	
Unit-II	**CONDUCTORS AND DIELECTRICS**
Dipole moment, potential and electric field intensity due to an electric dipole, torque on an electric dipole in an electric field, behavior of conductors in an electric field, electric field inside a dielectric material, polarization, conductor and dielectric, dielectric boundary conditions, capacitance of parallel plate and spherical and coaxial capacitors with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form, equation of continuity.	
Unit-III	**MAGNETOSTATICS**

Biot-Savart's law, magnetic field intensity, magnetic field intensity due to a straight current carrying filament, magnetic field intensity due to circular, square and solenoid current carrying wire, relation between magnetic flux, magnetic flux density and magnetic field intensity, Maxwell's second equation, div(B)=0.

Magnetic field intensity due to an infinite sheet of current and a long current carrying filament, point form of Ampere's circuital law, Maxwell's third equation, Curl (H)=Jc, field due to a circular loop, rectangular and square loops.

Unit-IV	**FORCE IN MAGNETIC FIELD AND MAGNETIC POTENTIAL**

Moving charges in a magnetic field, Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, a differential current loop as a magnetic dipole, torque on a current loop placed in a magnetic field;

Vector magnetic potential and its properties, vector magnetic potential due to simple configurations, Poisson's equations, self and mutual inductance, Neumann's formula, determination of self-inductance of a solenoid, toroid and determination of mutual inductance between a straight long wire and a square loop of wire in the same plane, energy stored and density in a magnetic field, characteristics and applications of permanent magnets.

Unit-V	**TIME VARYING FIELDS AND FINITE ELEMENT METHOD**

Faraday's laws of electromagnetic induction, integral and point forms, Maxwell's fourth equation, curl (E)=∂B/∂t, statically and dynamically induced EMFs, modification of Maxwell's equations for time varying fields, displacement current; Numerical methods: Finite difference method (FDM), finite element method (FEM), charge simulation method (CSM), boundary element method, application of finite element method to calculate electrostatic and magneto static fields.

Text Books:

1 K.B. Madhu Sahu, " Eelectromagnetic Fields", Scitech Ltd., 2nd Edition.

2 David J Griffiths, "Introduction to Electrodynamics" Pearson Education Ltd., 4th Edition, 2014.

3 Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, 1st Edition, 2012.

4 E Kuffel, W S Zaengl, J Kuffel, "High Voltage Engineering Fundamentals", Newnes, 2nd Edition, 2000.

Reference Books:

1 Matthew N O Sadiku, S V Kulkarni, "Principles of Electromagnetics", Oxford University Press, 6th Edition, 2015.

2 AS Mahajan , AA Rangwala "Electricity And Magnetism", McGraw Hill Publications, 1st Edition, 2000.

3 MS Naidu , V Kamaraju "High Voltage Engineering", McGraw Hill Publications, 3rd Edition, 2013.

4 William H Hayt, John A Buck, "Problems and Solutions in Electromagnetics", McGraw Hill Publications, 1st Edition, 2010.

XIV. COURSE PLAN:

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

Lecture No.	Topics to be covered	CLOS	Reference
1	Introduction to electro static fields and coulomb's law.	CLO3	T1: 2.1-2.3, R:2.3
2	Calculation Of Electric field intensity due to line and surface charges.	CLO1	T1:2.4-2.5 R:3.2
3	Derive the work done in moving a point charge in an electrostatic field.	CLO1	T1:2.15 R:2.9
4-6	Define electric potential, properties of potential function, potential gradient.	CLO2	T1:2.16-2.17 R:2.9-2.10

Lecture No.	Topics to be covered	CLOS	Reference
7	State Gauss's law and application of Gauss's law.	CLO3	T1:2.13-2.14 R:2.11
8	Deduce Maxwell's first law.	CLO3	T1:2.20 R:2.11
9	Derive the Laplace's and Poisson's equations.	CLO1	T1:2.21 R:3.5
10	Determine the solution of Laplace's equation in one variable.	CLO1	T1:2.21 R:3.5
11	Introduction to Dipole moment.	CLO5	T1:3.1 R:3.7
12	Write the expression for potential and electric field intensity due to an electric dipole.	CLO5	T1:3.2-3.3 R3.7
13	Find torque on an electric dipole in an electric field.	CLO5	T1:3.4 R:3.7
14	Study behavior of conductors in an electric field.	CLO4	T1:4.1-4.2 R:4.1
15	Understand electric field inside a dielectric material.	CLO4	T1:4.3,4.5 R:5.1
16	Discuss on polarization, conductor and dielectric.	CLO4	T1:4.3.2,4.3.3 R:5.2
17	Derive dielectric boundary conditions.	CLO4	T1:4.6 R:5.4
18	Calculate capacitance of parallel plate and spherical and coaxial capacitors with composite dielectrics.	CLO6	T1:3.5.2-3.5.5 R:4.3-4.4
19	Estimate capacitance of parallel plate and spherical and coaxial capacitors with composite dielectrics.	CLO6	T1:3.5.2-3.5.51 R:4.3-4.4
20	Derive the expressions for energy stored and energy density in a static electric field.	CLO6	T1:3.5.7-3.5.8 R:4.5
21	Define current density, conduction and convection current densities.	CLO6	T1:4.7-4.8 R:6.1
22	Deduce Ohm's law in point form, equation of continuity.	CLO6	T1:4.9-4.10 R:6.2
23	Introduction to static magnetic fields.	CLO7	T1:5.1-5.2 R:7.1-7.2
24	State Biot-Savart's law and magnetic field intensity.	CLO8	T1:5.3-5.4 R:7.4
25	Determine magnetic field intensity due to a straight current carrying filament.	CLO8	T1:5.4-5.7 R:7.4
26	Determine magnetic field intensity due to circular.	CLO8	T1:5.4-5.7 R:7.4
27	Find magnetic field for square and solenoid current carrying wire.	CLO8	T1:5.4-5.7 R:7.4
28	Relation between magnetic flux, magnetic flux density and magnetic field intensity.	CLO7	T1:5.2.7 R:7.3
29	Deduce Maxwell's second equation, div (B)=0.	CLO8	T1:5.8 R:7.3
30	Determine magnetic field intensity due to an infinite sheet of current and a long current carrying filament.	CLO8	T1:6.3-6.4
31	Find magnetic field intensity due to an infinite sheet of current and a long current carrying filament.	CLO8	T1:6.3-6.4 R:7.4
32	State point form of Ampere's circuital law.	CLO9	T1:6.1 R:7.7
33	Deduce Maxwell's third equation, Curl (H)=Jc	CLO9	T1:6.2 R:6.3
34	Estimate field due to a circular loop, rectangular and square loops.	CLO9	T1:6.3-6.4 R:7.8
35	Determine field due to a circular loop, rectangular and square loops.	CLO9	T1:6.3-6.4 R:7.8
36	Expression for force due to Moving charges in a magnetic field, Lorentz force equation.	CLO10	T1:7.1-7.4 R:8.1

Lecture No.	Topics to be covered	CLOS	Reference
37-38	Expression for force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a	CLO10	T1:7.3,7.5-7.7 R:8.6
39	Find force between two straight long and parallel current carrying conductors.	CLO10	T1:7.5-7.7 R:8.6
40	Explain magnetic dipole and dipole moment, a differential current loop as a magnetic dipole.	CLO11	T1:7.8 R:8.6
41	Derive torque on a current loop placed in a magnetic field.	CLO11	T1:7.9 R:8.7
42	Define vector magnetic potential and its properties.	CLO11	T1:8.2 R:7.12-7.13
43	Define vector magnetic potential due to simple configurations.	CLO11	T1:8.2 R:7.12-7.13
44	Explain Poisson's equations, self and mutual inductance.	CLO12	T1:8.3-8.4 R:9.4-9.5
45	Derive Neumann's formula, determination of self-inductance of a solenoid, toroid.	CLO12	T1:8.5,8.3-8.4 R:7.11
46	Determination of mutual inductance between a straight long wire and a square loop of wire in the same plane.	CLO12	T1:8.6 R:7.11
47	Calculate energy stored and density in a magnetic field.	CLO12	T1:8.7-8.8 R:7.11
48	Study characteristics and applications of permanent. magnets.	CLO12	T1:8.1
49	State Faraday's laws of electromagnetic induction.	CLO 13	T1:9.2,9.4 R:9.1
50	Deduce integral and point forms.	CLO14	T1:9.3 R:9.2
51	Derive Maxwell's fourth equation.	CLO14	T1:9.6 R:9.2
52	Derive Curl (E)=∂B/∂t, statically and dynamically induced emf.	CLO14	T1:9.4 R:12.2
53	Modification of Maxwell's equations for time varying fields.	CLO14	T1:9.8 R:12.2
54	Define displacement current.	CLO14	T1:9.5 R:12.1
55	Discuss Finite difference method (FDM).	CLO15	T1:4.4.1 R:1.6
56	Discuss Finite element method (FEM).	CLO15	T1:4.4.2 R:1.6
57	Discuss Charge simulation method (CSM).	CLO15	T1:4.4.3 R:1.6
58	Discuss Boundary element method.	CLO15	T1:4.4.4 R:1.6
59	Application of finite element method to calculate electrostatic and magneto static fields.	CLO15	T1:4.4 R:1.6

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Complete behavior of dielectrics.	Seminars / NPTEL	PO1, PO2	PSO1
2	Analytical calculations of magnetic field in air gap.	NPTEL	PO1, PO2	PSO1

Prepared by:
Mr. T. Anil Kumar, Assistant Professor

HOD, EEE

IV SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL AND PULSE CIRCUITS**				
Course Code	AEC019				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	4	-	3	-	-
Chief Coordinator	Dr. Vijay Vallabhuni, Associate Professor, ECE				
Course Faculty	Mrs. V. Bindusree, Assistant Professor, ECE				

I. COURSE OVERVIEW:

The course will make them learn the basic theory of switching circuits and their applications in detail. Starting from a problem statement they will learn to design circuits of logic gates that have a specified relationship between signals at the input and output terminals. They will be able to design combinational and sequential circuits. They will learn to design counters, adders, sequence detectors. This course provides a platform for advanced courses like Computer architecture, Microprocessors & Microcontrollers and VLSI design. Greater Emphasis is placed on the use of programmable logic devices and State machines.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC001	III	Electronic Devices and Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital and Pulse Circuits	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz / Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	**CIE Exam**	**Quiz / AAT**	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Lectures, Assignments, 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.	2	Seminars, Lab related 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.	1	Assignments
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	Five minute videos

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	3	Lectures and Assignments
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	1	Seminars
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	2	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of probability on single random variables and probability distributions and apply the concept of correlation and regression to find covariance.
II	Analyze the given data for appropriate test of hypothesis and discuss the concept of sequential circuits and analyze sequential systems.
III	Interpret the concept of feedback and classify various types of feedback amplifiers and understand the principle of oscillation and design different types of oscillators.
IV	Design and analyze single stage and multi stage Amplifiers.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
CAEC019.01	CLO 1	Understand number systems, binary addition and subtraction, 2's complement Representation and operations with this representation and understand the different binary codes.	PO 1 PO 2	2
CAEC019.02	CLO 2	Illustrate the switching algebra theorems and apply them for reduction of Boolean function.	PO 1 PO 2	2
CAEC019.03	CLO 3	Identify the importance of SOP and POS canonical forms in the minimization or other optimization of Boolean formulas in general and digital circuits.	PO 2	2
CAEC019.04	CLO 4	Discuss about digital logic gates and their properties, and implement logic gates using universal gates.	PO 2	2
CAEC019.05	CLO 5	Evaluate functions using various types of minimizing algorithms like Boolean algebra.	PO 1 PO 2	2
CAEC019.06	CLO 6	Evaluate functions using various types of minimizing algorithms like Karnaugh map or tabulation method.	PO 2 PO 4	1
CAEC019.07	CLO 7	Design Gate level minimization using K-Maps and realize the Boolean function using logic gates.	PO 4	1
CAEC019.08	CLO 8	Analyze the design procedures of Combinational logic circuits like adder, binary adder, carry look ahead adder.	PO 3	1
CAEC019.09	CLO 9	Understand bi-stable elements like latches, flip-flop and illustrate the excitation tables of different flip flops.	PO 3	1
CAEC019.10	CLO 10	Analyze and apply the design procedures of small sequential circuits to build the gated latches.	PO 2 PSO 2	2
CAEC019.11	CLO 11	Understand the concept of Shift Registers and implement the bidirectional and universal shift registers.	PO 3	1
CAEC019.12	CLO 12	Implement the synchronous counters using design procedure of sequential circuit and excitation tables of flip – flops.	PO 3	1
CAEC019.13	CLO 13	Implement the Asynchronous counters using design procedure of sequential circuit and excitation tables of flip – flops.	PO 3	1
CAEC019.14	CLO 14	Understand the design analysis of feedback amplifiers & types of feedback circuits.	PO 2	2
CAEC019.15	CLO 15	Design various sinusoidal Oscillators like RC Phase shift, Wien bridge, Hartley and Colpitts oscillator for various frequency ranges.	PO 3	1
CAEC019.16	CLO 16	Analyze the design of BJT as single stage and multistage amplifier circuits.	PO 2	2
CAEC019.17	CLO 17	Implement the design analysis of coupling amplifiers and types of coupling circuits.	PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CAEC019.01	3	2												1	
CAEC019.02	3	2												1	
CAEC019.03		2												1	
CAEC019.04		2											3		
CAEC019.05	3	2												1	
CAEC019.06		2		1										1	
CAEC019.07				1										1	
CAEC019.08			1												
CAEC019.09			1												
CAEC019.10		2												1	
CAEC019.11			1											1	
CAEC019.12			1											1	
CAEC019.13			1										3		
CAEC019.14		2												1	
CAEC019.15			1												2
CAEC019.16		2													2
CAEC019.17		2												1	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4	SEE Exams	PO 1, PO 2 PO 3, PO 4	Assignments	PO 1	Seminars	PO 2
Laboratory Practices	–	Student Viva	–	Mini Project	–	Certification	–
Term Paper	–						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Assessment of Course Outcomes (By Feedback, Once)	✔	Student Feedback on Faculty (Twice)
✘	Assessment of Mini Projects By Experts		

XIII. SYLLABUS

Unit-I	BOOLEAN ALGEBRA AND SWITCHING FUNCTIONS:
Introduction of binary numbers: Complements of numbers, codes, binary codes, binary code decimal code and its properties, unit distance codes, alpha numeric codes, error detecting and correcting codes;	

Boolean algebra: Basic theorems and properties, switching functions, canonical and standard form.	
Unit-II	**MINIMIZATION TECHNIQUES AND DESIGN OF MSI:**
Minimization with theorem: Karnaugh map method, five variable map, prime and essential implications, don't care map entries, tabular method, partially specified expressions; combination all design: Arithmetic circuits, comparator, multiplexers, code converters, hazards and hazard free relations.	
Unit-III	**SEQUENTIAL CIRCUITS DESIGN:**
Basic differences between combinational and sequential logic circuits, binary cell, fundamentals of sequential machine operation, D Flip Flop, T Flip Flop, J K Flip Flop, design procedure for conversion of Flip Flops, conversion from one type of Flip-Flop to another, timing and triggering consideration, clock skew. Counters: Design of single mode counter, ripple counter, ring counter, shift register, shift register sequences, ring counter using shift register.	
Unit-IV	**FEEDBACK AMPLIFIERS AND OSCILLATORS:**
Feedback Amplifiers: Concepts of feedback, classification of feedback amplifiers, general characteristics of negative feedback amplifiers, effect of feedback on amplifier characteristics, voltage series, voltage shunt; Current series; Current shunt feedback configurations, illustrative examples; Oscillators: Classification of oscillators, condition for oscillations, RC phase shift oscillators; Generalized analysis of LC oscillators: Hartley and Colpitts oscillators, Wien Bridge and crystal oscillators, stability of oscillators.	
Unit-V	**SINGLE STAGE AMPLIFIERS AND MULTISTAGE AMPLIFIERS**
Single Stage Amplifiers: Classification of amplifiers, distortion in amplifiers, analysis of CE, CC and CB configurations with simplified hybrid model, analysis of CE amplifier with emitter resistance and emitter follower, Miller's theorem and its dual design of single stage RC coupled amplifier using BJT; Multistage amplifiers: Analysis of cascaded RC coupled BJT amplifiers, cascade amplifier, darlington pair, different coupling schemes used in amplifiers RC coupled amplifiers, transformer coupled amplifier, direct coupled amplifier.	
Text Books:	
1. M Morris Mano, Michael D Ciletti, "Digital Design", Pearson Education / PHI, 3rd Edition, 2008. 2. Fletcher W I, "An Engineering Approach to Digital Design", Prentice Hall India Learning Private Limited, 1990. 3. Zvi Kohavi, "Switching and Finite Automata Theory", Tata McGraw-Hill, 3rd Edition, 2004. 4. John M Yarbrough, "Digital logic applications and design", Thomson publications, 1st Edition, 2006. 5. J Millman, C C Halkias, "Integrated Electronics", Tata McGraw -Hill, 2008.	
Reference Books:	
1. Fredriac J Hill, Gerald R Peterson, "Introduction to Switching Theory and Logic Design", 3rd Edition, 2008. 2. Thomas L Floyd, "Digital Fundamentals", Pearson Publications, 10th Edition, 2013. 3. Roth, "Fundamentals of Logic Design", Thomson Publications,7th Edition, 2004 4. Comer, "Digital Logic and State Machine Design", Oxford Publications, 3rd Edition, 2013. 5. Rashid, "Electronic Circuit Analysis", Cengage Publishers, 12th Edition,2013 . 6. Robert L Boylestad, Louis Nashelsky, "Electronic Devices and Circuits Theory", PHI, 9th Edition, 2008.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-5	Number systems, base conversion methods.	CLO 1	T1:1.1 to 1.5 R1: 3.1 to 3.5
6-8	Complements of numbers, codes- binary codes, BCD code and its	CLO 2	T1:1.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	properties.		R1: 3.7 to 3.9
9-11	Unit distance code, alphanumeric codes, and error detecting and correcting codes.	CLO 2	T1:1.7 R1: 4.1 to 4.2
12-15	Basic theorems and its properties, switching functions, canonical and standard form.	CLO 4	T1:2.1 to 2.6 R2: 2.8 to 3.5
16-18	Algebraic simplification of digital logic gates, properties of XOR gates.	CLO 4	T1:2.8 R2: 3.3 to 3.7
19-21	Universal gates, Multilevel NAND/NOR realizations.	CLO 7	T1:3.7 to 3.8 R3: 2.7 to 2.9
22-24	Tabular method.	CLO 9	T1:3.5 to 3.9 R3: 3.8 to 3.9
25-32	Combinational design, arithmetic circuits- adders, subtractors.	CLO 9	T1:4.1 to 4.9 R4: 2.1 to 2.4
33-35	Serial adder, 1's complement subtractor, 2's complement subtractor.	CLO 11	T1:5.1 to 5.2 R4: 3.1 to 3.5
36-38	Combinational and sequential circuits, the binary cell, the fundamentals of sequential machine operation.	CLO 11	T1:5.3 to 5.5 R4: 5.1 to 5.8
39-42	Flip-flop, D-Latch Flip-flop, "Clocked T" Flip-flop, "Clocked JK "flip-flop.	CLO 13	T1:5.3 to 5.5 R4: 6.1 to 6.6
43-45	Design of a clocked flip-flop conversion from one type of flip-flop to another.	CLO 11	T1:5.3 to 5.5 R4: 6.7 to 7.9
46-48	Registers and counters	CLO 9	T1: 6.1 to 6.5 R4: 7.1 to 7.7
49-51	Feedback Amplifiers: Concepts of feedback, design of different feedback Amplifiers.	CLO 14	T3:12.1to12.4 R5: 4.1 to 4.8
52-54	Oscillators & design of types of oscillators	CLO 14	T3:15.2.1 to 15.2.2 R5: 7.1 to 7.4
55-58	Single stage & multi stage Amplifiers design of types	CLO 14	T3:8.4 R6: 6.1 to 6.6
59-60	Cascade & cascade amplifiers	CLO 14	T3:4.9.1 to 4.9.2 R6: 8.1 to 8.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Gate level Minimization.	Seminars / NPTEL	PO 1, PO 2, PO 4	PSO 1
2	Design of combinational circuits using universal gates.	Seminars / Guest Lectures / NPTEL	PO 2, PO 3, PO 4	PSO 1
3	Verilog programming for combinational and sequential circuits.	Laboratory Practices	PO 1, PO 3, PO 4	PSO 3

Prepared by:
Dr. Vijay Vallabhuni, Associate Professor, ECE

HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**AC MACHINES**				
Course Code	AEE007				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. K Devender Reddy, Assistant Professor				
Course Faculty	Mr. K Devender Reddy, Assistant Professor Mr. P Mabu Hussain, Assistant Professor				

I. COURSE OVERVIEW:

This course deals with the construction, principle, classification, starting methods and different types of testing methods on AC machines including single phase, three phase induction motors and synchronous motors, this course also enlightens the students with the construction, principle, classification and different testing methods of synchronous generator.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AEE004	III	DC Machines and transformers

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA	Total Marks
AC Machines	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of assessment	CIE Exam	Quiz / AAT	
CIA marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**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	Seminars
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	Term paper
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	Laboratory experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem-Solving Skills:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Seminars
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test, and maintain power system and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Discuss the construction, working and characteristics of three phase induction motor and synchronous motor.
II	Illustrate the equivalent circuit and speed control methods of three phase induction motors.
III	Outline the working and parallel operation of alternators.
IV	Evaluate synchronous impedance and voltage regulation of synchronous machine.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE007.01	CLO 1	Understand the principle of operation and constructional features of three phase induction motor	PO1	3
CAEE007.02	CLO 2	Understand production of torque and modes of three phase induction motor operation	PO2	2
CAEE007.03	CLO 3	Understand the different types of torques, various losses, efficiency and torque- slip characteristics of three phase induction motor operation	PO2	2
CAEE007.04	CLO 4	Describe no -load and blocked rotor test of three phase induction motor for calculating the equivalent circuit parameters.	PO1,PO2, PO4	3
CAEE007.05	CLO 5	Describe circle diagram of three phase induction motor and concept of induction generator	PO1,PO2, PO4	3
CAEE007.06	CLO 6	Understand the starting and speed control methods of three phase induction motor	PO2,PO4	2
CAEE007.07	CLO 7	Understand the principle of operation and constructional features and different types of armature windings of synchronous alternator	PO1	3
CAEE007.08	CLO 8	Understand the phasor diagrams of alternator on no-load, load and analyze the harmonics and its suppression methods.	PO2	2
CAEE007.09	CLO 9	Describe the different methods for calculating the voltage regulation	PO2	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE007.10	CLO 10	Understand the concept of parallel operation and slip test	PO1, PO2	2
CAEE007.11	CLO 11	Understand the principle of operation, constructional features and starting methods of synchronous motor	PO1	3
CAEE007.12	CLO 12	Describe the importance of power, excitation circles and effect of varying different parameters on synchronous motor performance	PO2	3
CAEE007.13	CLO 13	Understand the concept of constructing V, inverted V curves and synchronous condenser	PO2,PO4, PSO2	2
CAEE007.14	CLO 14	Understand the principle of operation and constructional features of single phase induction motor and starting methods for single phase induction motor	PO1, PO2	2
CAEE007.15	CLO 15	Describe the torque-speed characteristics of single phase induction motor and equivalent circuit.	PO2	2
CAEE007.16	CLO 16	Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.	PO1,PO2	3
CAEE007.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2		3													
CLO 3		2													
CLO 4	3	2		3											
CLO 5		2		3											
CLO 6	3	2		3										2	
CLO 7	3														
CLO 8		2													
CLO 9		2		3											
CLO 10	3	2		3										2	
CLO 11	2														
CLO 12		3												2	
CLO 13	2			3										2	
CLO 14	2			3											
CLO 15		2													
CLO 16	2	2													
CLO 17						2									

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4	SEE Exams	PO1, PO2, PO4	Assignments	PO1, PO2, PO4	Seminars	PO1
Laboratory Practices	PO4	Student Viva	PO1, PO2, PO4	Mini Project	-	Certification	-
Term Paper	PO2						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT - I	THREE PHASE INDUCTION MOTORS

Three phase induction motors: Introduction, construction, types of induction motors, slip and frequency of rotor currents, rotor MMF and production of torque, equivalent circuit, power across air gap, torque and power output, torque slip characteristics, generating and braking modes, maximum (breakdown) torque, starting torque, maximum power output, problems.

UNIT - II	TESTING AND SPEED CONTROL OF INDUCTION MOTORS

Equivalent circuit model: No load test and blocked rotor test, circuit model, starting methods, speed control of induction motors, induction generator, principle of operation, isolated induction generator, circle diagram, determination of induction motor parameters from circle diagram, problems.

UNIT - III	ALTERNATORS

Synchronous generators: Introduction, principle of operation, constructional features, armature windings, integral slot and fractional slot windings, distributed and concentrated windings, winding factors, basic synchronous machine model, circuit model of a synchronous machine, phasor diagrams, determination of synchronous impedance, short circuit ratio, armature reaction ampere turns and leakage reactance.

Voltage regulation: Calculation of regulation by synchronous impedance method, MMF, ZPF and ASA methods, slip test, parallel operation of alternators, synchronization of alternators, problems.

UNIT - IV	SYNCHRONOUS MOTORS

Synchronous motors: Principle of operation, power developed, synchronous motor with different excitations, effect of increased load with constant excitation, effect of change in excitation with constant load, effect of excitation on armature current and power factor, construction of "V" and inverted "V" curves, power and excitation circles, starting methods, salient pole synchronous motor, phasor diagrams and analysis, synchronous condenser.

UNIT - V	SINGLE PHASE INDUCTION MOTOR

Single phase induction motor: Principle of operation, two reaction theory, equivalent circuit analysis, split phase motor, construction, principle of operation, capacitor start motor, shaded pole motor, torque speed characteristics.

Text books

1. P S Bimbra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008.
2. Kothari, "Electrical Machines", TMH publication, 3rd Edition, 2010.
3. B. L Thereja, A.K Thereja Charles Kingsley JR., Stephen D U mans, "Electric Machinery", McGraw-Hill, 6th Edition, 1985.

References

1. J B Gupta, "Theory and Performance of Electrical Machines",S K Kataria & Sons Publication, 14th Edition, 2010
2. M G Say, "Alternating Current Machines", Pitman Publishing Ltd, 4th Edition, 1976.
3. S K Bhattacharya, "Electrical Machines", TMH publication, 2nd Edition, 2006.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understand the principle of operation and constructional features of three phase induction motor	CLO 1	T1: 6.2 R1:7.1-7.2
2	Discuss the types of induction motor based on rotor structure like caged and wound rotor type and concept of slip	CLO 1	T1: 6.3 R1:7.35
3-4	Describe the frequency of rotor currents, rotor MMF, power and numerical problems on rotor EMF, current and power	CLO 1	T1: 6.4-6.5 R1:7.4-7.9
5	Discuss the types of torques under different slip conditions and derive torque derivation, starting torque and condition for maximum torque	CLO 2	T1: 6.6 R1:7.1- 7.9
6-7	Understand the relation between rotor input, losses and power developed and numerical problems on rotor losses and power developed	CLO 3	T1: 6.9 R1:7.22
8	Describe equivalent circuit of three phase induction motor	CLO 4	T1: 6.8 R1:7.28
9-10	Understand the torque slip characteristics and numerical problems on equivalent circuit and torque – slip	CLO 3	T1: 6.9.1 R1:7.11
11-12	Understand no load and blocked rotor test of three phase induction motor and numerical problems on no load and blocked rotor test	CLO 4	T1:6.11 R1:7.31
13-15	Explain the procedure for drawing circle diagram and numerical problems on circle diagram	CLO 5	T1:6.12 R1:8.1-8.3
16-17	Understand starting methods of three phase induction motor and numerical problems on starting methods of three phase induction motor	CLO 6	T1:6.14 R19.1
18-19	Explain speed control methods of three phase induction motor and numerical problems on speed control methods of three phase induction motor	CLO 6	T1:6.15 R1:3.1-3.2
20	Discuss the induction generator principle of operation, isolated induction generator	CLO 6	T1:6.16.1 R1:6.16
21	Explain the working principle of synchronous generators	CLO 7	T1: 5.2 R1:3.5
22	Understand constructional details like stator, rotor and types of synchronous generators	CLO 7	T1: 5.1 R1:3.5
23	Discuss the types of armature windings like single layer, double layer, short pitch, full pitch windings	CLO 8	T1: 5.1 R13.6-3.7
24	Derive the equation for distribution, pitch , winding factors and EMF equation	CLO 8	T1: 7.7 R1:3.12
25-26	Describe armature reaction, leakage reactance, synchronous impedance and numerical problems on windings and EMF equation	CLO 8	T1: 5.2 R1:3.13-3.15
27	Discuss the experimental determination of synchronous reactance and impedance	CLO 8	T1: 5.2.1 R1:3.14
28-29	Explain load characteristics of synchronous generator and numerical problems on efficiency	CLO 8	T1: 5.7 R1:3.17
30	Describe harmonics in generated EMF and suppression methods	CLO 8	T1: 5.3.1 R1:3.17
31	Explain the procedure of calculating the voltage regulation by synchronous impedance method	CLO 9	T1: 5.4.1 R1:3.17
32	Use EMF method for solving numerical problems on voltage regulation	CLO 9	T1: 5.4.1 R1:3.18
33	Explain the procedure for calculating the regulation by MMF method	CLO 9	T1: 5.4.2 R1:3.18
34-35	Use MMF method for solving numerical problems on voltage regulation	CLO 9	T1: 5.4.2 R1:3.19-3.20
36	Explain the procedure for calculating the regulation by Zero power factor method	CLO 9	T1: 5.4.3 R1:3.21
37-38	Use Zero power factor method for solving numerical problems on voltage regulation	CLO 9	T1: 5.4.3 R1:6.1-6.2

Lecture No	Topics to be covered	CLOs	Reference
39	Explain the procedure for calculating the regulation by American standard association method	CLO 9	T1: 5.4.4 R1:6.4-6.6
40	Use American standard association method for solving numerical problems on voltage regulation	CLO 9	T1: 5.4.4 R1:6.13
41	Discuss two reaction analysis and experimental determination of X_d and X_q(slip test), phasor diagram	CLO 10	T1: 5.16 R1:6.7
42	Explain the regulation of salient pole alternators	CLO 10	T1: 5.12 R1:6.13
43	Discuss the parallel operation and necessary conditions for parallel operation	CLO 10	R1:3.22
44	Explain different types of parallel operation methods like dark lamp and bright lamp methods and numerical problems on	CLO 10	R1:6.13
45-46	Understand load shearing of alternators and numerical problems on load shearing	CLO 10	R1:5.3 R1:5.8
47	Explain synchronous motor principle of opertion and constructional features	CLO 11	T1: 5.12 R1:5.5
48	Discuss the starting methods of synchronous motor and hunting effect	CLO 11	T1: 5.20 R1:5.5
49	Describe the effect of increased load with constant excitation on armature current, power factor and voltage	CLO 12	T1: 5.14 R1:5.8-5.9
50	Understand excitation and power circles	CLO 12	T1: 5.14.1 R1:5.14-5.15
51-53	Derive formula for power developed by synchronous motor and numerical problems on power developed	CLO 12	T1: 5.116 R1:5.10
54	Discuss the operation of synchronous condenser and numerical problems	CLO 13	T1: 5.419 R1:5.10
55	Explain constructional features and principle of operation of single phase induction motor	CLO 14	T3:36.2 R1:5.11
56	Discuss double revolving and cross field theory	CLO 14	T3:36.3 R1:10.2
57-58	Explain single phase induction motor starting methods like split phase, capacitor start, capacitor run, shaded pole induction motor and numerical problems on starting methods of single phase induction motor	CLO 14	T3:36.8 R1:10.3- 10.5
59-60	Understand the equivalent circuit and its parameters and numerical problems on equivalent circuit of single phase induction motor.	CLO 15	T3:36.2 R1:10.6-10.10

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Cascaded connection of induction motor	Guest lecture	PO1, PO2	-
2	Stepper motor	Seminars	PO1, PO2	-
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 1	-

Prepared by:

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL MEASUREMENTS AND INSTRUMENTATION**				
Course Code	**AEE008**				
Programme	B.Tech				
Semester	IV	E EE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. P Shivakumar, Assistant Professor				
Course Faculty	Mr. P Shivakumar, Assistant Professor Ms. Lekha chandran, Assistant Professor				

I. COURSE OVERVIEW:

This course deals with measuring instruments mainly indicating instruments and the associated torques, instrument transformers, power factor meter, frequency meter, synchro scopes, wattmeter, energy meter, potentiometer, resistance measuring methods, ac bridges, ballistic galvanometer, flux meter, extension range of indicating instruments.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHS006	I	Engineering Physics
UG	AEE002	II	Electrical Circuits

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electrical measurements and Instrumentation	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminars
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	Term Paper
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

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work..	-	-
PSO 2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications	3	seminars

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Demonstrate the construction, working and characteristics of electrical measurement instruments.
II	Illustrate the principles of energy measurement in electrical loads.
III	Outline the use of cathode ray oscilloscope.
IV	Evaluate various transducers for electrical measurement

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAEE008.01	CLO 1	Explain the various effects on measuring instruments used to measure electrical quantity.	PO 1,PO2	3
CAEE008.02	CLO 2	Understand PMMC and MI instruments in view of construction, extension range and various errors.	PO 1,PO2	2

CAEE008.03	CLO 3	Explain the instruments works on electrostatic effect principle.	PO2,PO4	2
CAEE008.04	CLO 4	Understand the working of potentiometer to measure the small voltages and discuss the importance of standardization in instruments.	PO 4	2
CAEE008.05	CLO 5	Explain Potentiometer applications in measurement of voltage, current, resistance and power.	PO 4	2
CAEE008.06	CLO 6	Distinguish between current transformer and potential transformer.	PO 4	2
CAEE008.07	CLO 7	Summarize ratio error and phase angle error in instrument transformers.	PO1,PO2	2
CAEE008.08	CLO 8	Understand the construction and operation of single phase wattmeter and three phase wattmeter.	PO 4	2
CAEE008.09	CLO 9	Identify the best method for the measurement of active and reactive powers in balanced, unbalanced system.	PO 1	3
CAEE008.10	CLO 10	Explain the importance of induction effect in the working of energy meter and also describe the energy meter calibration.	PO1,PO2	3
CAEE008.11	CLO 11	Find the unknown resistance using various DC bridges.	PO 1	3
CAEE008.12	CLO 12	Solve for unknown inductance and its quality factor using different types of AC bridges.	PO1,PO2	3
CAEE008.13	CLO 13	Estimate the capacitance between two conducting surfaces using various AC bridges.	PO 1	3
CAEE008.14	CLO 14	Explain transducers and classify the transducers based on measurement of electrical quantities.	PO4	2
CAEE008.15	CLO 15	Understand transducer used for the measurement of displacement, pressure, resistances, capacitance, speed and position.	PO2, PO4	2
CAEE008.16	CLO 16	Summarize the features, application and various working models of cathode ray oscilloscope.	PO1, PO2	3
CAEE008.17	CLO 17	Explain the measurement of phase angle and frequency of various electrical quantities.	PO 1, PO 2	3
CAEE008.18	CLO 18	Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.	PO 1, PO 2	3
CAEE008.19	CLO 19	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO 1, PO 2	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2													
CLO 2	3	2													
CLO 3		2		2											
CLO 4				2											
CLO 5				2											
CLO 6				2											
CLO 7	3	2													
CLO 8				2											
CLO 9	3														
CLO 10	3	2													
CLO 11	3	2													
CLO 12	3	2													
CLO 13				2											
CLO 14				2											3
CLO 15		2		2											3
CLO 16	3	2													3
CLO 17	3	2													3
CLO 18	3	2													
CLO 19	3	2													3

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4	SEE Exams	PO1, PO2, PO4	Assignments	PO1, PO2, PO4	Seminars	PO1, PO2
Laboratory Practices	PO4	Student Viva	PO1, PO2, PO4	Mini Project	-	Certification	-
Term Paper	PO2						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	INTRODUCTION TO MEASURING INSTRUMENTS
Introduction: Classification of measuring instruments, deflecting, damping and control torques, types of errors, ammeter and voltmeter: PMMC, MI instruments, expression for deflection and control torque, errors and compensation, extension of range using shunts and series resistances; Electro static voltmeter, electro dynamic type, attracted type, disc type, extension of range of ES voltmeters..	
Unit-II	**POTENTIOMETERS AND INSTRUMENT TRANSFORMERS**
DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, measurement of unknown resistance, current, voltage; AC potentiometers: polar and coordinate type, standardization, applications; Instrument transformers: CT and PT, ratio and phase angle error.	
Unit-III	**MEASUREMENT OF POWER AND ENERGY**
Measurement of Power: Single phase dynamometer type wattmeter, LPF and UPF, double elements and three elements dynamometer wattmeter; Expression for deflection and control torque, extension of range of wattmeter by using instrument transformers, measurement of active and reactive power for balanced and unbalanced Systems. Measurement of Energy: Single phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading using RSS meter, three phase energy meter, introduction to net energy metering, maximum demand meters.	
Unit-IV	**DC AND AC BRIDGES**
Measurement of Resistance: Methods of measuring low, medium, high resistance, Wheatstone bridge, carry foster, Kelvin's double bridge, loss of charge method; Measurement of Inductance: Maxwell's bridge, hay's bridge , Anderson's bridge, Owen's bridge; Measurement of Capacitance: Desauty's bridge, Wein's bridge, Schering bridge.	
Unit-V	**TRANSDUCERS AND OSCILLOSCOPES**
Transducers: Definition of transducers, classification of transducers, advantages of electrical transducers, characteristics and choice of transducers, principle of operation of LVDT and capacitor transducers, LVDT applications, strain gauge and its principle of operation, gauge factor, thermistors, thermocouples, synchros, piezo-electric transducers, photovoltaic, photo conductive cells, photo diodes; Cathode ray oscilloscope: cathode ray tube, time base generator, horizontal and vertical amplifiers, CRO probes, applications of CRO, measurement of phase and frequency, Lissajous patterns, sampling oscilloscope, analog oscilloscope, tubeless	
Text Books:	
1. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002. 2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.	
Reference Books:	
1. Buckingham and Price, "Electrical measurements", Prentice Hall, 1nd Edition, 2000. 2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009. 3. A S Morris, "Principles of measurement of instrumentation", Pearson/Prentice Hall of India, 2nd Edition, 1994. 4. H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Publications, 1st Edition 1995.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Explain the types of instruments	CLO 1	T2:3
2	Explain the types of torques associated with secondary instruments	CLO 1	T2:3
3	Understand moving coil instruments	CLO 2	T2:238-249
4	Understand moving iron instruments	CLO 2	T2:257-262
5	Understand extension of range of ammeter	CLO 2	T2:238-249
6	Understand extension of range of voltmeter	CLO 2	T2:238-249
7	Understand the types of errors associated with mc and mi instruments	CLO 2	T2:257-262
8	Explain the principle of electro-static instruments	CLO 3	T2:282
9	Explain the types of electro-static instruments	CLO 3	T2:282
10	Remember the definition of instrument transformer and their uses	CLO 6	T2:313
11	Remember the principle and working of current transformer and their uses	CLO 6	T2:316-319
12	Remember errors of current transformer	CLO 7	T2:316-319
13	Illustrate the working of potential transformer	CLO 6	T2:330-335
14	Remember errors of potential transformer	CLO 7	T2:330-335
15	Understand the principle of operation of DC Crompton potentiometer	CLO 4	T2:330-335
16	Explain standardization of potentiometers	CLO 4	T2:330-335
17	Explain the measurement of resistance using potentiometer	CLO 5	T2:330-335
18	Understand the measurement of voltage, current using potentiometer	CLO 5	T2:330-335
19	Explain polar type AC potentiometer	CLO 5	T2:330-335
20	Understand co-ordinate type AC potentiometer	CLO 5	T2:330-335
21	Explain the standardization of AC potentiometer	CLO 5	T2:330-335
22	Understand the measurement of power using wattmeter	CLO 8	T2:363-371
23	Explain the construction and operation of single-phase wattmeter	CLO 8	T2:363-371
24	Measurement of power using single wattmeter method	CLO 9	T2:363-371
25	Measurement of power using two-wattmeter method	CLO 9	T2:363-371
26	Measurement of power using three- wattmeter method	CLO 9	T2:363-371
27	Explain double element wattmeter	CLO 8	T2:363-371
28	Illustrate the extension of range of wattmeter using instrument transformer	CLO 8	T2:363-371
29	Understand the extension of range of wattmeter using instrument transformer	CLO 8	T2:363-371
30	Explain the measurement of reactive power using various meter	CLO 8	T2:363-371

Lecture No	Topics to be covered	CLOs	Reference
31	Understand the principle of single-phase induction type energy meter	CLO 10	T2:383
32	Explain driving and braking torques	CLO 10	T2:383
33	Understand errors and compensation in energy meters	CLO 10	T2:387
34	Explain errors and compensation	CLO 10	T2:387
35	Illustrate the testing of energy meter using phantom loading	CLO 10	T2:396
36	Classify the various tests for energy meter	CLO 10	T2:387
37	Understand three-phase energy meter	CLO 10	T2:396
38	Explain tri-vector meter and maximum demand meter	CLO 10	T2:396
39	Remember methods of measuring low, medium and high resistance	CLO 11	T2:421-446
40	Explain methods of measuring low, medium and high resistance	CLO 11	T2:421-446
41	Analyse the sensitivity of Wheatstone bridge	CLO 11	T2:424
42	Explain the working of Carley's foster bridge	CLO 11	T2:428
43	Explain the working of Kelvin's double bridge	CLO 11	T2:428
44	Understand the measurement of high resistance based on loss of charge method	CLO 11	T2:437
45	Apply suitable AC bridge for the measurement of unknown parameters using AC bridges	CLO 12	T2:482-486
46	Demonstrate the measurement of unknown inductance using Maxwell's bridge Hay's bridge, Anderson's bridge and Owen's bridge	CLO 12	T2:482-486
47	Explain the use of Desauty's bridge, Wein's bridge and Schering bridge for the measurement of unknown capacitance	CLO 12	T2:488-491
48	Problems		
49	Explain the advantages, characteristics and choice of electric transducers	CLO 14	T2:935-949
50	Summarize the principle of operation of resistor, inductor and capacitor transducers	CLO 14	T2:979-986
51	Explain the principle of working and applications of LVDT	CLO 14	T2:964-966
52	Illustrate the principle of operation and applications of strain gauge	CLO 14	T2, R2,R4
53	Understand the principle, construction and working of thermistors and thermocouples	CLO 15	T2: 979-986
54	Explain the principle, construction and working of synchros and piezoelectric transducer	CLO 15	T2:1046-1050
55	Explain the principle, construction and working of photovoltaic cells, photoconductive cells and photo diodes	CLO 15	T2:964
56	Explain the measurement of strain and gauge sensitivity	CLO 15	T2:820-823
57	Understand the principle and working of cathode ray oscilloscopes and block diagram of cathode ray tube	CLO 16	T2:791-795
58	Explain horizontal amplifier, vertical amplifier, trigger circuit and time base generator of a cathode ray oscilloscope	CLO 16	T2:796,

Lecture No	Topics to be covered	CLOs	Reference
59	Understand screen and probes of cathode ray tube	CLO 16	T2:816-818
60	Explain the working of digital storage oscilloscopes	CLO 17	T2:819

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Construct basic and knowledge in instrumentation.	Guest lectures	PO 1, PO2	PSO3

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**CONTROL SYSTEMS**				
Course Code	**AEE009**				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. P Sridhar, Professor, EEE				
Course Faculty	Dr. P Sridhar, Professor, EEE				

I. COURSE OVERVIEW:

This course is aimed to introduce the students the principles and applications of control systems in everyday life. The basic concepts of block diagram reduction technique, time response analysis of second order system and solutions to time invariant systems. It deals with various time domain tequiniques such as root locus and RH criterion and frequency domain techniques which includes bode plot, and Nyquist plots. It explains the concept of state space analysis both in linear and continuous time systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS011	II	Mathematical Transform Techniques	4
UG	AEE004	III	DC machines and transformers	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Control Systems	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz / Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignments
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	Assignments
PO3	**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	Assignments and Seminars
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	Assignments, and Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 2	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work..	2	Assignments and Seminars
PSO 3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Organize modeling and analysis of electrical and mechanical systems.
II	Analyze control systems by block diagrams and signal flow graph technique.
III	Demonstrate the analytical and graphical techniques to study the stability.
IV	Illustrate the frequency domain and state space analysis.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE009.01	CLO 1	Differentiate between open loop, closed loop system and their importance in real time applications.	PO1, PO3	2
AEE009.02	CLO 2	Predict the transfer function of translational and rotational mechanical, electrical system using differential equation method.	PO2, PO3	2
AEE009.03	CLO 3	Analyze the analogy between electrical, translation and rotational mechanical systems.	PO4, PO7	3
AEE009.04	CLO 4	Apply the block diagram and signal flow graph technique to determine transfer function of an control systems.	PO4, PO3	3
AEE009.05	CLO 5	Demonstrate the response of first order and second order systems with various standard test signals.	PO1, PO3	2
AEE009.06	CLO 6	Estimate the steady state error and its effect on the performance of control systems and gives the importance of PID controllers.	PO2, PO4	2
AEE009.07	CLO 7	Summarize the procedure of Routh – Hurwirtz criteria to study the stability of physical systems.	PO1, PO3	2
AEE009.08	CLO 8	List the steps required to draw the root – locus of any control system and predict the stability.	PO1, PO2	3
AEE009.09	CLO 9	Explain the effect on stability by adding zeros and poles to the transfer function of control system.	PO2, PO3	2
AEE009.10	CLO 10	Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.	PO1, PO2	3
AEE009.11	CLO 11	Describe the characteristics of control system and its stability by plotting Nyquist plot.	PO2, PO3	2
AEE009.12	CLO 12	Compare the behavior of control system in terms of time domain and frequency domain response.	PO1, PO2	3
AEE009.13	CLO 13	Define the state model of control system using its block diagram and give the role of diagonalization in state space analysis.	PO1, PO2	2
AEE009.14	CLO 14	Formulate the state transmission matrix and explain the concept of controllability and observability.	PO2, PO3	3
AEE009.15	CLO 15	Design of lag, lead, lag – lead compensator to improve stability of control system.	PO1, PO2	2
AEE009.16	CLO 16	Apply the concept of different stability criterions and time, frequency response solution to solve real time world applications.	PO2, PO3	2
AEE009.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1, PO2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2		2											2	
CLO 2		2	3											2	
CLO 3				3			3							2	
CLO 4			3	3											
CLO 5	2		3												
CLO 6		2	2												
CLO 7	2		2												
CLO 8	3	3													
CLO 9		2	2												
CLO 10	3	3													
CLO 11		2	2											2	
CLO 12	2	2												2	
CLO 13	2	2													
CLO 14		3	2												
CLO 15	2	2													
CLO 16		2	2												
CLO 17	2	2													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO3	SEE Exams	PO1, PO2, PO3	Assignments	PO1, PO2	Seminars	PO4
Laboratory Practices	PO3, PO4	Student Viva	PO1, PO2	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS	Classes: 08
Control systems: Introduction, open loop and closed loop systems, examples, comparison, mathematical models and differential equations of physical systems, concept of transfer function, translational and rotational mechanical systems, electrical systems, force - voltage and force - current analogy.		
Unit-II	**BLOCK DIAGRAM REDUCTION AND TIME RESPONSE ANALYSIS**	**Classes: 10**
Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedback systems, DC servomotors, signal flow graph, Mason's gain formula; Time response analysis: Standard test signals, shifted unit step, ramp and impulse signals, shifting theorem, convolution integral, impulse response, unit step response of first and second order systems, time response specifications, steady state errors and error constants, dynamic error coefficients method, effects of proportional, derivative and proportional derivative, proportional integral and PID controllers.		
Unit-III	**CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE**	**Classes: 09**
Concept of stability: Necessary and sufficient conditions for stability, Routh's and Routh Hurwitz stability criterions and limitations. Root locus technique: Introduction, root locus concept, construction of root loci, graphical determination of 'k' for specified damping ratio, relative stability, effect of adding zeros and poles on stability.		
Unit-IV	**FREQUENCY DOMAIN ANALYSIS**	**Classes: 10**
Frequency domain analysis: Introduction, frequency domain specifications, stability analysis from Bode plot, polar plot, Nyquist plot, calculation of gain margin and phase margin, determination of transfer function, correlation between time and frequency responses.		
Unit-V	**STATE SPACE ANALYSIS AND COMPENSATORS**	**Classes: 08**
State Space Analysis: Concept of state, state variables and state model, derivation of state models from block diagrams, diagonalization, solving the time invariant state equations, state transition matrix and properties, concept of controllability and observability; Compensators: Lag, lead, lead - lag networks.		
Text Books:		
1. Nagoorkani "Control systems" RBA publications 2. I J Nagrath, M Gopal, "Control Systems Engineering", New Age International Publications, 3rd Edition, 2007. 3. K Ogata, "Modern Control Engineering", Prentice Hall, 4th Edition,2003. 4. N C Jagan, "Control Systems", BS Publications, 1st Edition, 2007.		
Reference Books:		
1. S Palani, "Control Systems Engineering", Tata McGraw-Hill Publications, 1st Edition, 2001. 2. Anand Kumar, "Control Systems", PHI Learning, 1st Edition, 2007. 3. N K Sinha, "Control Systems", New Age International Publishers, 1st Edition, 2002.		

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understand basic concept of the control system	CLO 1	T1:1.1
2	Summarize various types of control systems.	CLO 1	T1:1.2
3	Understand open Loop and closed loop control systems	CLO 2	T1:1.3
4	Explain Open Loop and Closed loop control systems and their differences	CLO 2	T1:1.4-1.7
5	Explain the Differences of open and closed control system	CLO 2	T1:1.4-1.7
6	Analyze the examples of closed control system	CLO 2	T1:1.4-1.7

Lecture No	Topics to be covered	CLOs	Reference
7	Analyze the various examples of closed control system	CLO 2	T1:1.4-1.7
8	Summarize the classification of control systems	CLO 3	T1:1.1
9	Understand feed –back characteristics, Effects of feedback.	CLO 3	T1:1.3
10	Understand the Differential equations, Impulse Response and transfer function of a Control Systems.	CLO 6	T1:1.4
11	Analyze Impulse Response and transfer function of a Control Systems.	CLO 6	T1:1.4
12	Analyze the concept of translational and rotational mechanical system.	CLO 7	T1:1.10
13	Analyze the translational and rotational mechanical system with examples.	CLO 6	T1:1.10
14	Understand the Block diagram representation of systems considering electrical systems.	CLO 7	T1:1.11
15	Understand the Block diagram representation of systems considering electrical systems as examples.	CLO 4	T1:1.11
16	Analyze problems on Block diagram reduction technique.	CLO 4	T1:1.11
17	Understand the Problems on Block diagram algebra.	CLO 5	T1:1.11
18	Analyze the Problems on Block diagram algebra.	CLO 5	T1:1.11
19	Understand the concept of Signal flow graph - Reduction using Mason's gain formula.	CLO 5	T1:1.12
20	Analyze the Signal flow graph - Reduction using Mason's gain formula.	CLO 5	T1:1.12
21	Understand the Time response analysis of system.	CLO 5	T1:3.1
22	Understand the concept Time response of first order systems.	CLO 8	T1:3.5
23	Understand and analyze the concept time response of first order systems.	CLO 8	T1:3.5
24	Understand the characteristic equation of feedback control systems.	CLO 9	T1:3.6
25	Understand the concept of characteristic equation of feedback control systems	CLO 9	T1:3.6
26	Understand the concept of transient response of second order systems - Time domain specifications	CLO 9	T1:3.7
27	Analyze Transient response of second order systems - Time domain specifications	CLO 8	T1:3.7
28	Understand the concept of steady state response - Steady state errors	CLO 8	T1:3.10,3.11
29	Understand the concept of steady state errors and error constants	CLO 8	T1:3.10,3.11
30	Understand the Effects of proportional, derivative and integral systems.	CLO 8	T1:3.8
31	Understand the Effects of proportional derivative, proportional integral systems.	CLO 10	T1:3.8
32	Understand the operation of PID controller.	CLO 10	T1:4.1
33	Understand concept of stability.	CLO 10	T1:4.1
34	Understand concept of stability- Necessary and sufficient conditions for stability.	CLO 10	T1:4.1
35	Understand the concept of Routh's stability criterion.	CLO 10	T1:5.3
36	Understand the limitations of Routh's stability.	CLO 10	T1:5.3
37	Explain the concept of root locus.	CLO 10	T1:5.8

Lecture No	Topics to be covered	CLOs	Reference
38	Analyze Root locus and problems.	CLO 10	T1:5.8
39	Understand graphical determination of 'k' for specified damping ratio, relative stability	CLO 11	T1:4.1
40	Understand the concept of frequency domain response analysis.	CLO 11	T1:4.2
41	Understand the frequency response analysis.	CLO 11	T1:4.3, 4. 4,4.5,4.6
42	Understand the concept of Frequency domain specifications expressions.	CLO 11	T1 :4.7
43	Understand the Frequency domain specifications expressions.	CLO 11	T1:4.3,4. 4,4.5,4.6
44	Understand and analyze transfer function from the Bode Diagram.	CLO 11	T1:4.3,4. 4,4.5,4.6
45	Analyze transfer function from the Bode Diagram-Phase margin and Gain margin.	CLO 11	T1:4.3,4. 4,4.5,4.6
46	Analyze transfer function from the Bode Diagram-Phase margin, Gain margin and phase crossover frequency problems.	CLO 12	T1:4.3,4. 4,4.5,4.6
47	Understand the concept of polar plots with examples.	CLO 12	T1:4.3,4. 4,4.5,4.6
48	Understand the concept of nyquist plots examples.	CLO12	T1:4.8
49	Understand the concept of correlation between time and frequency.	CLO 14	T1:4.9
50	Understand correlation between time and frequency response.	CLO 14	T1:4.3
51	Understand compensation technique.	CLO 14	T1:4.1
52	Analyze compensation technique using pole-zero plot.	CLO 14	T1:4.1
53	Analyze the concept of compensation design.	CLO 15	T1:4.8
54	Analyze the problems compensator design.	CLO 15	T1:4.9
55	Understand concept of state, state variables and state model .	CLO 15	R2:10.1 to20
56	Understand the time invariant state equations, state transition matrix.	CLO 15	R2:10.1to 20
57	Understand the concept of diagonalization.	CLO 15	R2:10.1to 20
58	Understand the concept of state transition matrix and its properties.	CLO 16	R2:10.1to20
59	Understand concept of controllability and observabilit	CLO 16	R2:10.1 to20
60	Analyze the concept of controllability and observability with problems.	CLO 16	R2:10.1to 20

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Output derivative controller feedback systems	NPTEL	PO1, PO2	PSO2
2	Design of brushless DC motor	NPTEL	PO1, PO2	PSO2
3	Real time applications of control theory in modern devices	Guest lectures	PO1, PO2, PO3	PSO2

Prepared by:

Dr. P Sridhar, Professor

HOD, EEE

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Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPLEX ANALYSIS AND PROBABILITY DISTRIBUTION**				
Course Code	AHS004				
Programme	B. Tech				
Semester	II	ECE			
	IV	AE | EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. C Rachana, Assistant Professor				
Course Faculty	Mr. Ch Soma shekhar, Assistant Professor Mr. J Suresh Goud, Assistant Professor Ms. P Rajani, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes complex functions and differentiation, complex integration power series expansion of complex function and single random variables. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Complex Analysis And Probability Distribution	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	3	Seminar
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	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic theory of complex functions to express the power series.
II	Evaluate the contour integration using Cauchy residue theorem.
III	Enrich the knowledge of probability on single random variables and probability distributions.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS004.01	CLO 1	Define continuity, differentiability, analyticity of a function using limits.	PO 1	3
AHS004.02	CLO 2	Understand the conditions for a complex variable to be analytic and/or entire function.	PO 1	3
AHS004.03	CLO 3	Understand the concepts of Cauchy-Riemann relations and harmonic functions.	PO 2	3
AHS004.04	CLO 4	Understand the concept of complex	PO 4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		differentiation to the real-world problems of signals modulated by electromagnetic waves.		
AHS004.05	CLO 5	Evaluate the area under a curve using the concepts of indefinite integration	PO 2	2
AHS004.06	CLO 6	Understand the concepts of the Cauchy's integral formula and the generalized Cauchy's integral formula.	PO 2	2
AHS004.07	CLO 7	Evaluate complex functions as power series and radius of convergence of power series.	PO 1	3
AHS004.08	CLO 8	Understand the concept of complex integration to the real-world problems of flow with circulation around a cylinder.	PO 4	1
AHS004.09	CLO 9	Solve the Taylor's and Laurent series expansion of complex functions	PO 2	3
AHS004.10	CLO 10	Understand the concept of different types of singularities for analytic function.	PO 1	3
AHS004.11	CLO 11	Evaluate poles, residues and solve integrals using Cauchy's residue theorem.	PO 1	3
AHS004.12	CLO 12	Evaluate bilinear transformation by cross ratio property.	PO 1	2
AHS004.13	CLO 13	Identify the conditions of fixed and critical point of Bilinear Transformation.	PO 4	2
AHS004.14	CLO 14	Understand the concept of Cauchy's residue theorem to the real-world problems of Quantum Mechanical scattering and Quantum theory of atomic collisions.	PO 4	2
AHS004.15	CLO 15	Demonstrate an understanding of the basic concepts of probability and random variables.	PO 4	2
AHS004.16	CLO 16	Classify the types of random variables and calculate mean, variance.	PO 2	3
AHS004.17	CLO 17	Finding moment about origin, central moments, moment generating function of probability distribution.	PO 2	3
AHS004.18	CLO 18	Understand the concept of random variables to the real-world problems like graph theory, machine learning and natural language processing	PO 4	3
AHS004.19	CLO 19	Recognize where the binomial distribution and poisson distribution could be appropriate model and find mean, variance of the distributions.	PO 1, PO 2	3
AHS004.20	CLO 20	Apply the inferential methods relating to the means of normal distributions.	PO 1, PO 2	3
AHS004.21	CLO 21	Understand binomial distribution to the phenomena of real-world problem like sick versus healthy.	PO 4	3
AHS004.22	CLO 22	Understand the mapping of normal distribution in real-world problem to analyze the stock market.	PO 1	3
AHS004.23	CLO 23	Use poission distribution in real-world problem to predict soccer scores.	PO 4	3
AHS010.24	CLO 24	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3		3											1		
CLO 4				1											
CLO 5		2											1		
CLO 6		2											1		
CLO 7	3														
CLO 8				1											
CLO 9		3											1		
CLO 10	3												1		
CLO 11	3														
CLO 12	2														
CLO 13				2											
CLO 14				2									1		
CLO 15				2											
CLO 16		3													
CLO 17		3											1		
CLO 18				3									1		
CLO 19	3	2											1		
CLO 20	3	2											1		
CLO 21				3											
CLO 22	3												1		
CLO 23				3											
CLO 24				2											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO 2,PO4	SEE Exams	PO1,PO 2,PO4	Assignments	PO 2	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	**COMPLEX FUNCTIONS AND DIFFERENTIATION**
Complex functions differentiation and integration: Complex functions and its representation on argand plane, concepts of limit, continuity, differentiability, analyticity, Cauchy-Riemann conditions and harmonic functions; Milne-Thomson method.	
Unit-II	**COMPLEX INTEGRATION**
Line integral: Evaluation along a path and by indefinite integration; Cauchy's integral theorem; Cauchy's integral formula; Generalized integral formula; Power series expansions of complex functions and contour Integration: Radius of convergence.	
Unit-III	**POWER SERIES EXPANSION OF COMPLEX FUNCTION**
Expansion in Taylor's series, Maclaurin's series and Laurent series. Singular point; Isolated singular point; Pole of order m; Essential singularity; Residue: Cauchy Residue Theorem. Evaluation of Residue by Laurent Series and Residue Theorem. Evaluation of integrals of the type $\int_0^{2\pi} f(\cos\theta,\sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$ Bilinear Transformation	
Unit-IV	**SINGLE RANDOM VARIABLES**
Random variables: Discrete and continuous, probability distributions, mass function-density function of a probability distribution. Mathematical expectation. Moment about origin, central moments, moment generating function of probability distribution.	
Unit-V	**PROBABILITY DISTRIBUTIONS**
Binomial, Poisson and normal distributions and their properties.	
Text Books:	
1.Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 10th Edition, 2010 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.	
Reference Books:	
1.T.K.V Iyengar, B.Krishna Gandhi, "Engineering Mathematics - III", S. Chand & Co., 12th Edition, 2015. 2.T.K.V Iyengar, B.Krishna Gandhi, "Probability and Statistics", S. Chand & Co., 7th Edition, 2015. 3.Churchill, R.V. and Brown, J.W, "Complex Variables and Applications", Tata Mc Graw-Hill, 8th Edition, 2012.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understanding the complex function in Argand plane	CLO 1	T1:12.1 R1:4.2
2	Apply the limit of a complex function	CLO 1	T1:12.3 R1:4.4
3	Apply the continuity of a complex function	CLO 1	T1:12.3 R1:4.6
4	Apply the differentiability and analyticity of a complex function	CLO 1	T1:12.3 R1:4.7
5-6	Identify and Apply the of Cauchy-Riemann conditions in Cartesian and Polar forms	CLO 3	T1:12.4 R1:4.13
7	Evaluate the Harmonic Conjugates	CLO 3	T1:12.4 R1:4.15
8-9	Apply the Milne-Thomson method to find the Analytic function	CLO 3	T1:12.4 R1:4.20
10-11	Demonstrate the Line Integral for a given path	CLO 5	T1:13.1 R1:5.3
12	Analyze the Cauchy's integral theorem in a given plane	CLO 5	T1:13.2 R1:5.5
13-14	Explain the Cauchy's integral formula	CLO 6	T1:13.3 R1:5.9
15-16	Analyze the Cauchy's general integral formula	CLO 6	T1:13.4 R1:5.10
17	Define the Power series expansions of complex functions and contour Integration	CLO 7	T1:14.1 R1:6.1
18	Evaluate the Radius of convergence of power series complex function	CLO 7	T1:14.2 R1:6.1
19-20	Identify the types of power series expansions	CLO 7	T1:14.4 R1:6.2
21	Define the types of Singularities and its nature	CLO 10	T1:15.2 R1:6.6
22	Define the concept of Residues	CLO 11	T1:15.1 R1:7.4
23-24	Evaluate the Residue	CLO 11	T1:15.1 R1:6.5
25	Evaluate of contour integrals	CLO 11	T1:15.3 R1:7.9
26	Analyze the properties of Bilinear transformation	CLO 12	T1:12.5 R1:8.8
27	Understand the basic concepts of Random variables	CLO 15	T2:26.7 R2:2.2
28-29	Understand the types of Probability distributions	CLO 16	T2:26.8 R2:2.6
30-31	Evaluate the Mass function, Density function	CLO 15	T2:26.8 R2:2.7
32	Define the Expectations of Probability Distribution	CLO 16	T2:26.10 R2:2.6
33-34	Evaluate the Moment and Central moments	CLO 17	T2:25.9

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R2:3.2
35-36	Evaluate the Moment Generating functions	CLO 17	T2:26.11 R2:3.5
37-39	Understand and Apply the Binomial Distribution parameters	CLO 21	T2:26.14 R2:4.4
40-42	Understand and Apply the Poisson Distribution parameters	CLO 23	T2:26.15 R2:4.10
43-45	Understand and Apply the Normal Distribution parameters	CLO 20	T2:26.16 R2:4.15

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With Pos	Relevance With Psos
1	Problem reductions, Conformal mapping	Seminars	PO 1	PSO 1
2	In order to monitor the quality of products to plan effective and efficient designs to improve standards to test and analyze the quality of items	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students based on the taught statements to solve problems	NPTEL	PO 2	PSO 1

Prepared by:
Ms. C Rachana, Assistant Professor

HOD, EEE

V SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**INTEGRATED CIRCUITS APPLICATIONS**				
Course Code	AEC008				
Programme	B.Tech				
Semester	V	ECE | EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. P. Saritha, Assistant Professor, ECE				
Course Faculty	Ms. J. Sravana, Assistant Professor, ECE Ms. N. Anusha, Assistant Professor, ECE Ms. P. Saritha, Assistant Professor, ECE				

I. COURSE OVERVIEW:

Integrated Circuits design can be divided into the broad categories of digital and analog IC design. The physical world is inherently analog indicating that there is always need for analog circuitry. Today the growth of any industry is dependent upon electronics to a great extent. Integrated circuit is electronics and this course IC application acquaints the students with general analog principles and design methodologies using practical devices and applications. It focus on process of learning about signal condition, signal generation, instrumentation, timing and control using various IC circuitry. With modern digitization advantages we need to work with digital data and hence digital ICs play a crucial role in connecting physical world to the more sophisticated digital world. This course focuses on analysis, design and applications of modern digital integrated circuits.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC001	III	Electronic Devices and Circuits	4
UG	AEC006	IV	Pulse and Digital Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Integrated Circuits Applications	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz / Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Lectures and Assignments
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	Assignments
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.	1	Lab related 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.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Lectures and Assignments
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally**.**	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	1	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Be acquainted to principles and characteristics of op-amp and apply the techniques for the design of comparators, instrumentation amplifier, integrator, differentiator, multivibrators, waveform generators, log and anti-log amplifiers.

The course should enable the students to:	
II	Analyze and design filters, timer, analog to digital and digital to analog Converters.
III	Understand the functionality and characteristics of commercially available digital integrated circuits.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
AEC008.01	CLO 1	Illustrate the block diagram, classifications, package types, temperature range, specifications and characteristics of Op-Amp.	PO 1 PO 2	2
AEC008.02	CLO 2	Discuss various types of configurations in differential amplifier with balanced and unbalanced outputs.	PO 1 PO 2	2
AEC008.03	CLO 3	Evaluate DC and AC analysis of dual input balanced output configuration and discuss the properties of differential amplifier and discuss the operation of cascaded differential amplifier.	PO 1	3
AEC008.04	CLO 4	Analyze and design linear applications like inverting amplifier, non-inverting amplifier, instrumentation amplifier and etc. using Op-Amp.	PO 5	2
AEC008.05	CLO 5	Analyze and design non linear applications like multiplier, comparator, log and anti log amplifiers, waveform generators and etc, using Op-Amp.	PO 2	2
AEC008.06	CLO 6	Discuss various active filter configurations based on frequency response and construct using 741 Op-Amp.	PO 5	3
AEC008.07	CLO 7	Design bistable, monostable and astable multivibrators operation by using IC 555 timer and study their applications.	PO 1	3
AEC008.08	CLO 8	Determine the lock range and capture range of PLL and use in various applications of communications.	PO 1	2
AEC008.09	CLO 9	Understand the classifications, characteristics and need of data converters such as ADC and DAC.	PO 1	2
AEC008.10	CLO 10	Analyze the digital to analog converter technique such as weighted resistor DAC, R-2R ladder DAC, inverted R-2R ladder DAC and IC 1408 DAC.	PO 1	3
AEC008.11	CLO 11	Analyze the analog to digital converter technique such as integrating, successive approximation and flash converters.	PO 1	1
AEC008.12	CLO 12	Design adders, multiplexers, demultiplexers, decoders, encoders by using TTL/CMOS integrated circuits and study the TTL and CMOS logic families.	PO 5	1
AEC008.13	CLO 13	Design input/output interfacing with transistor – transistor logic or complementary metal oxide semiconductor integrated circuits.	PO 1 PO 12	2
AEC008.14	CLO 14	Understand the operation of SR, JK, T and D flip-flops with their truth tables and characteristic equations. Design TTL/CMOS sequential circuits.	PO 1	3
AEC008.15	CLO 15	Design synchronous, asynchronous and decade counter circuits and also design registers like shift registers and universal shift registers.	PO 1	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	2	3											1		
CLO 3	3												1		
CLO 4					2										
CLO 5		2											3		
CLO 6					3										
CLO 7	3														
CLO 8	2														
CLO 9	2												1		
CLO 10	3												1		
CLO 11	1														
CLO 12					1										
CLO 13	2											1			
CLO 14	3												1		
CLO 15	3														

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 5, PO 12	SEE Exams	PO 1, PO 2 PO 5, PO 12	Assignments	PO 1 PO 2	Seminars	PO 12
Laboratory Practices	PO 5	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects By Experts		

XIII. SYLLABUS

Unit-I	INTEGRATED CIRCUITS:
Integrated Circuits: Classification of integrated circuits, Package types and temperature ranges; Differential Amplifier: DC and AC analysis of Dual input Balanced output Configuration; Properties of differential amplifier configuration: Dual Input Unbalanced Output, Single Ended Input, Balanced/ Unbalanced Output; DC Coupling and Cascade Differential Amplifier Stages, Level translator. Characteristics of OP-Amps: Op-amp Block Diagram, ideal and practical Op-amp specifications, DC and AC characteristics, 741 op-amp & its features; Op-Amp parameters & Measurement: Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, and Drift.	
Unit-II	**APPLICATIONS OF OP-AMPS:**
Linear applications of Op- Amps: Inverting and non-inverting amplifier, integrator, differentiator, instrumentation amplifier, AC amplifier; Non-linear applications of Op-Amps: Comparators, multivibrators, triangular and square wave generators, non- linear function generation, log and anti log amplifiers.	
Unit-III	**ACTIVE FILTERS AND TIMERS:**
Active Filters: Classification of filters, 1st order low pass and high pass filters, 2 nd order low pass, high pass, band pass, band reject and all pass filters. Timers: Introduction to 555 timer, functional diagram, monostable, astable operations and applications, Schmitt Trigger; PLL: Introduction, block schematic, principles and description of individual blocks, 565 PLL.	
Unit-IV	**DATA CONVERTERS:**
Data converters: Introduction, classification, need of data converters; DAC techniques: Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, DAC characteristics; ADC techniques: Integrating, successive approximation, flash converters, A/D characteristics.	
Unit-V	**DIGITAL IC APPLICATIONS:**
Combinational Design Using TTL/ CMOS ICs: Logic delays, TTL/CMOS interfacing, adders, multiplexer, demultiplexer, decoder, encoder; Sequential design using TTL/ CMOS ICs: SR, JK, T, and D flip-flops; Counters: Synchronous and asynchronous counters, decade counter; Registers: Shift registers, universal shift register, Ring counters and Johnson counters.	
Text Books:	
1. D. Roy Chowdhury — Linear Integrated Circuits‖, New age international (p) Ltd, 2nd Edition, 2003. 2. Ramakanth A. Gayakwad — Op-Amps & linear ICs‖, PHI, 3rd Edition, 2003. 3. John F. Wakerly — Digital Design Principles and Practices‖, Prentice Hall, 3rd Edition, 2005.	
Reference Books:	
1. Salivahanan — Linear Integrated Circuits and Applications‖, TMH, 1st Edition, 2008. 2. S P Bali — Linear Integrated Circuits‖, TMH, 1st Edition, 2008.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 - 3	Discuss the classification of integrated circuits, Package types, temperature ranges and Differential amplifier configurations.	CLO 1	T1:2.2 T2:1.2-1.7
4 - 6	Analyze DC and AC analysis of various configuration of Differential amplifier.	CLO 3	T1:2.5 R1:3.4
7 - 8	Understand differential amplifier stages.	CLO 2	T1:2.4
9 - 10	Understand the DC characteristics of op-amp.	CLO 3	T2:1.12-1.13
11 - 12	Understand the AC characteristics of op-amp.	CLO 3	T1:3.2
13 - 15	Discuss op-amp parameters & measurements.	CLO 3	T1:3.3-3.4
16 - 18	Illustrate the linear applications of op-amp.	CLO 4	T1:2.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
19 - 21	Illustrate the non linear applications of op-amp.	CLO 5	T1:11.1-11.5
22 - 26	Derive and analyze 1st order and 2nd order filters.	CLO 6	T1:4.8
27 - 28	Derive and analyze various types of filters.	CLO 6	T1:7.2
29 - 30	Understand the operation of 555 timer and discuss the operation.	CLO 7	T1:7.2
31- 34	Summarize the operation and applications of multivibrators using 555 timer.	CLO 7	T2:10.4 R2:7.2
35-39	Understand the operation of 565 PLL and discuss the operation.	CLO 8	T1:8.2-8.5
40	Discuss the classifications of data converters.	CLO 9	T1:9.2-9.7
41 - 42	Discuss and Analyze DAC techniques and characteristics.	CLO 10	T1:10.1
43 - 45	Discuss and Analyze ADC techniques and characteristics.	CLO 11	T1:10.2
46 - 47	Design and analyze the combinational circuits using TTL/CMOS logic.	CLO 12	T1:10.3 R2:5.4
48 - 50	Design and analyze the sequential circuits using TTL/CMOS logic.	CLO 14	T3:3.12 R2:12.7
51 - 54	Design and analyze different types of counters.	CLO 15	T3:7.2
55 - 60	Design and analyze different types of registers.	CLO 15	T3:8.4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Design a FET differential amplifier with swamping resistors for dual input balanced output differential amplifier with emitter resistance R_E.	Seminars	PO 1	PSO 1
2	Design and analyze the voltage series negative feedback amplifier and find the voltage gain, input and output resistances, and total output offset voltage with feedback.	Seminars / NPTEL	PO 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:
Mrs. P.Saritha, Assistant Professor, ECE

HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE DESCRIPTOR

Course Title	**POWER ELECTRONICS**				
Course Code	AEE010				
Programme	B.Tech				
Semester	V	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. T. Devaraju, Professor, EEE				
Course Faculty	Mr. S. Srikanth, Assistant Professor, EEE				

I. COURSE OVERVIEW:

Power Electronics course introduces the basic concepts of power semiconductor devices and power converters which is the foundation for power transmission, distribution and utilization of the Electrical Engineering discipline. The course deals with the basic analysis of ac-dc, dc-ac, dc-dc, ac-ac converters.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE001	III	Electronic devices and circuits	4
UG	AEC001	II	Electrical Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total marks
Power electronics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

√	Chalk & talk	√	Quiz	√	Assignments	X	Moocs
√	LCD/ PPT	√	Seminars	X	Mini project	X	Videos
X	Open ended experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		**Level**	**Proficiency assessed by**
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Laboratory Practice

Program Outcomes		Level	Proficiency assessed by
PO2	**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	Seminar
PO3	**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	Laboratory Practice
PO4	**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	Seminar

3= High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-------
PSO2	**Problem-Solving Skills:** To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Seminar
PSO3	**Successful Career and Entrepreneurship:** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.	-	--------

3= High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Integrate the revolutionary development in power transmission, distribution and utilization with the advent of semiconductor devices.
II	Demonstrate rectifiers, choppers and various schemes of pulse width modulated inverters.
III	Explain AC voltage converters and cycloconverters.
IV	Outline complete range of power supplies, including switched mode regulators and applications

IX. COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE010.01	CLO 1	Understand the characteristics of basic elements of power electronics	PO1	2
CAEE010.02	CLO 2	Discuss various turn on and turn off methods of Silicon controlled rectifier	PO1, PO3	2
CAEE010.03	CLO 3	Describe the protection and ratings of thyristors	PO3	2
CAEE010.04	CLO 4	Apply the series parallel operations of thyristors	PO2, PO3	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE010.05	CLO 5	Analyze the operation of single phase and three phase rectifiers with different loads	PO2	3
CAEE010.06	CLO 6	Describe the operation of single phase and three phase dual converter	PO1, PO4	2
CAEE010.07	CLO 7	Understand the principle of operation of AC voltage controller and modes of operation	PO2, PO4	2
CAEE010.08	CLO 8	Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers	PO3	3
CAEE010.09	CLO 9	Describe the principle of operation and classification of cycloconverters	PO1, PO2	2
CAEE010.10	CLO 10	Understand the principle of operation and control strategies of chopper	PO2, PO3	2
CAEE010.11	CLO 11	Describe the classification of choppers	PO1, PO4	2
CAEE010.12	CLO 12	Analyze the importance of AC chopper and switched mode regulators	PO3	3
CAEE010.13	CLO 13	Discuss the principle of operation of series and parallel inverters	PO1, PO2	3
CAEE010.14	CLO 14	Understand the principle of operation of three phase inverters with different modes of operation	PO3, PO4	3
CAEE010.15	CLO 15	Analyze the principle of operation of voltage source inverters and current source inverters	PO1, PO4	2
CAEE010.16	CLO 16	Apply the concept of power electronics and converters to solve real time world applications	PO2, PO3	3
CAEE010.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations	PO3, PO4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2														
CLO 2	2		3											2	
CLO 3			2												
CLO 4		2	3												
CLO 5		2												3	
CLO 6	2			2											
CLO 7		2		2											
CLO 8			3											2	
CLO 9	2	2													
CLO 10		2	2												
CLO 11	2			2										2	
CLO 12			3											3	
CLO 13	2	3													
CLO 14			3	2										3	

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 15	2			2											
CLO 16		2	3												
CLO 17			3	2										2	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1 PO2 PO3 PO4	SEE Exams	PO1 PO2 PO3 PO4	Assignments	PO1 PO2 PO3 PO4	Seminars	PO1 PO2 PO3 PO4
Laboratory practices	PO3 PO4	Student viva	PO1 PO2 PO3 PO4	Mini project	-	Certification	-
Term paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

UNIT - I	POWER SEMICONDUCTOR DEVICES AND COMMUTATION CIRCUITS
Power semiconductor devices and commutation circuits: Thyristors, principle of operation of silicon controlled rectifiers (SCR), bipolar junction transistor (BJT), power metal oxide semiconductor filed effect transistor (MOSFET), power insulated gate bipolar transistor (IGBT), gate turnoff thyristor (GTO) and characteristics, turn on and turnoff methods, dynamic characteristics of SCR, two transistor analogy, unijunction transistor firing circuit, series and parallel operation of SCR's, design of snubber circuit; Specifications and ratings: Ratings of SCR, BJT and IGBT, line commutation and forced commutation circuits, numerical problems.	
UNIT - II	**SINGLE PHASE AND THREE PHASE CONTROLLED RECTIFIERS**
AC - DC converters: Phase control technique, single phase line commutated converters, midpoint and bridge connections, half controlled converters and semi converters with R, RL and RLE loads, derivation of average load voltage and current, active and reactive power inputs to the converters without and with freewheeling diode, numerical problems; Fully controlled converters: Midpoint and bridge connections with R, RL loads and RLE load, derivation of average load voltage and current, line commutated inverters, active and reactive power inputs to the converters without and with freewheeling diode, derivation of load voltage and current, numerical problems; Three phase converters: Three pulse and six pulse converters, midpoint and bridge connections, average load voltage with R and RL loads, effect of source inductance, operation of single phase and three phase dual converters, numerical problems.	
UNIT – III	**AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS**
AC - AC controllers: Introduction, single phase two SCR's in anti-parallel, with R and RL loads, modes of operation of triac, triac with R and RL loads, derivation of RMS load voltage, current and power factor, wave forms, numerical problems; Cycloconverters: Principle of operation of single phase midpoint and bridge type cycloconverters with resistive and inductive loads, continuous and discontinuous mode of operation.	
UNIT - IV	**DC – DC CONVERTERS**
DC - DC converters: Principle of operation of choppers, time ratio control and current limit control strategies, types of choppers, derivation of load voltage and currents with R, RL and RLE loads, AC chopper, problems; Switched mode regulators: Study of buck, boost and buck boost, Cuk regulators.	

UNIT - V	INVERTERS
DC - AC converters: Single phase inverter, basic series inverter, parallel inverter, operation and waveforms, voltage source inverter (VSI), three phase inverters 180, 120 degrees conduction modes of operation, voltage control techniques for inverters, pulse width modulation techniques, reduction of harmonics, current source inverter (CSI) with ideal switches, capacitor commutated type CSI, numerical problems.	
Text Books:	
1. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998. 2. Dr. P S Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2012. 3. Ned Mohan, Tore M Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley and sons, 2002. 4. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001.	
Reference Books:	
1. Vedam Subramanyam, "Power Electronics", New Age International Limited, 2nd Edition, 2006. 2. P C Sen, "Power Electronics", Tata McGraw-Hill Publishing, 1st Edition, 1987. 3. G K Dubey, S R Doradra, A Joshi, R M K Sinha, "Thyristorised Power Controllers", New Age International Limited, 2nd Edition, 2008. 4. V R Moorthi, "Power Electronics Devices", Oxford University Press, 4th Edition, 2005.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1.	Describe the basic elements of power electronics and devices	CLO1	T2: 1.1 R2: 1.1
2.	Understand the Thyristors (SCR's) characteristics	CLO1	T2: 4.1 R2: 1.6
3.	Discuss the Two transistor analogy of SCR	CLO1	T2: 4.2 R2: 1.6
4.	Realize the theory of operation of SCR and Turn on methods	CLO2	T2: 5.1 R2: 1.7
5.	Describe turn off method of SCR class A and Class B commutation	CLO2	T2: 5.3 R2: 1.7
6.	Analyze the turn off method of SCR class C and Class D commutation	CLO2	T2: 5.5 R2: 1.7
7.	Understand turn off method of SCR class E and natural commutation	CLO2	T2: 4.3 R2: 1.7
8.	Discuss the Dynamic characteristics of SCR	CLO1	T2: 4.5 R2: 1.7.1
9.	Describe the operation of UJT firing circuit	CLO2	T2: 4.12 R2: 1.15
10.	Understand the operation Series and parallel connections of SCR's	CLO4	T2: 4.9 R2: 1.8
11.	Analyze the numerical problems on Series and parallel connections of SCR's	CLO4	T2: 4.9 R2: 1.10
12.	Design the Snubber circuit for SCR	CLO3	R2: 2.7
13.	Discuss the characteristics of BJT and Power MOSFET	CLO1	T2: 2.3 R2: 1.4
14.	Understand the characteristics of Power IGBT and GTO	CLO1	T2: 2.5 R2: 1.4
15.	Describe the specifications and ratings: Ratings of SCR, BJT and IGBT	CLO1	T2: 4.6 R2: 1.4
16.	Discuss the fundamentals of phase controlled rectifiers (1ph)	CLO5	T2: 6.1 R2: 5.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
17.	Understand the operation of half converter with R and RL loads	CLO5	T2:6.1.1
18.	Realize the operation of Half controlled converters with RLE load	CLO5	T2: 6.1.2 R2: 5.1.2
19.	Analyze the numerical problems on half controlled converters	CLO5	T2: 6.1.2 R2: 5.1.2
20.	Describe the operation of fully controlled converters with Resistive load	CLO5	T2: 6.3.1 R2: 5.2
21.	Understand the operation of fully controlled converter with RL and RLE loads	CLO5	T2: 6.3.2 R2: 5.4
22.	Derive Active and Reactive power equation for Line commutated converters	CLO5	T2: 6.3.2 R2: 5.4
23.	Describe the Effect of source inductance on converter	CLO5	T2: 6.7.1 R2:5.5
24.	Analyze the numerical problems on fully controlled converters	CLO5	T2: 6.9 R2:5.4
25.	Understand fundamentals, phase controlled rectifiers (3ph) and line commutated inverters	CLO5	T2: 6.5 R2:6.1
26.	Realize the operation of 3-ph Half controlled converters with Resistive RL load and necessary derivations for analysis	CLO5	T2: 6.6.2 R2: 6.1
27.	Analyze the numerical problems on three phase half controlled converters	CLO5	T2: 6.6.2 R2:6.1
28.	Explain the operation of 3-ph fully controlled converters with R & RL load and necessary derivations	CLO5	T2: 6.6.3 R2: 6.4
29.	Discuss the operation of 3-ph full controlled converters with RLE load and necessary derivations	CLO5	T2: 6.6.3 R2: 6.4
30.	Understand the Effect of source inductance	CLO5	T2: 6.7.2 R2: 4.11
31.	Describe the introduction to Dual Converters	CLO6	T2: 6.8 R2: 6.11
32.	Explain the operation of single phase and three phase dual converter operation	CLO6	T2: 6.9 R2: 6.11
33.	Analyze the AC-AC converters: AC voltage controllers	CLO7	T2: 9.1 R2: 8.1
34.	Understand the principle of operation of single phase AC voltage controller	CLO7	T2: 9.2 R2: 8.5
35.	Describe principle of operation of single phase AC voltage controller	CLO7	T2: 9.3 R2: 8.4
36.	Explain the Modes of operation of Triac	CLO7	T2: 9.3.2 R2: 8.12
37.	Analyze the numerical problems on AC voltage controller	CLO8	T2: 9.3.2 R2: 8.4
38.	Discuss the principle of operation and control strategies of Cyclo converters	CLO9	T2: 10.1 R2: 9.41
39.	Understand the principle of operation of Single phase midpoint Cyclo converters with resistive load	CLO9	T2: 10.1.1 R2: 9.42
40.	Describe the principle of operation of Single phase Cyclo converter Bridge configuration Waveforms	CLO9	T2: 10.1.2 R2: 9.42.1
41.	Analyze the numerical problems on cyclo converters	CLO9	T2: 10.1.2 R2: 9.42.2
42.	Explain the principle and control strategies of choppers	CLO10	T2: 7.1 R2: 9.40
43.	Realize the operation of Step down choppers	CLO10	T2: 7.2 R2: 9.40.1
44.	Describe the operation of Step up choppers	CLO10	T2: 7.3 R2: 9.40.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
45.	Discuss the operation of class A chopper	CLO11	T2: 7.4.1 R2: 9.40.3
46.	Understand the operation of class B and class C chopper	CLO11	T2: 7.4.2 R2: 9.40.4
47.	Describe the operation of class D and class E chopper	CLO11	T2: 7.4.4 R2: 9.40.5
48.	Analyze the numerical problems on choppers	CLO11	T2: 7.7 R2: 9.40.1
49.	Describe the switched mode regulators	CLO12	T2: 7.6 R2: 10.3
50.	Discuss the switched mode regulators	CLO12	T2: 7.6.2 R2: 10.4
51.	Analyze the numerical problems on choppers	CLO11	T2: 7.5 R2: 10.5
52.	Analyze 1ph inverter (DC-AC Converter)	CLO13	T2: 8.1.1 R2: 9.1
53.	Understand the operation of single phase full bridge inverter and series inverter	CLO13	T2: 8.9 R2: 9.2
54.	Discuss the operation of parallel Capacitor inverter	CLO13	T2: 8.10 R2: 9.6
55.	Describe the operation of Three phase Voltage source inverter	CLO14	T2: 8.4.1 R2: 9.32
56.	Explain the operation of Three phase Voltage source inverter	CLO14	T2: 8.4.2 R2: 9.33
57.	Understand the Voltage control and PWM techniques for inverters	CLO14	T2: 8.5 R2: 9.36
58.	Explain the operation of sinusoidal pulse width modulation	CLO15	T2: 8.6.3 R2: 9.37
59.	Describe the operation of current source inverter with ideal switches	CLO15	T2: 8.8.1 R2: 9.38
60.	Understand the operation of commutated type CSI	CLO15	T2: 8.8.2 R2: 9.17

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Gate characteristics and different gating schemes	Guest lecture	PO2, PO4	PSO2
2	R and RC triggering circuits of SCR	Nptel videos	PO2, PO4	PSO2
3	Jones and morgans chopper	Guest lecture	PO2, PO4	PSO2

Prepared by:
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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**TRANSMISSION AND DISTRIBUTIION SYSTEMS**				
Course Code	AEE011				
Programme	B.Tech				
Semester	V	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. G Hari Krishna, Assistant Professor, EEE				
Course Faculty	Mr. G Hari Krishna, Assistant Professor, EEE				

I. COURSE OVERVIEW:

This course is an extension of Power generation systems. It deals with basic theory of Transmission lines modeling and their performance analysis. Also this course gives emphasis on mechanical design of transmission lines, cables and insulators. It also focuses on different distribution systems and calculation of voltage drops in distribution systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE003	III	Power Generation systems	4
UG	AEE002	II	Electrical circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Transmission and Distribution systems	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ATT.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz/ATT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 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 25 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.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminars
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	Assignments
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	Assignments
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	Assignments
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	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Seminars
PSO2	Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO3	The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Evaluate the voltage regulation and efficiency of different transmissions lines.
II	Demonstrate the mechanical design of overhead lines, cables and insulators.
III	Illustrate the performance of different types of distribution systems.
IV	Discuss the operation of different distribution schemes and design of feeders.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE011.01	CLO 1	Formulate the transmission line parameters(resistance, inductance and capacitance)	PO2, PO3, PSO1	3
AEE011.02	CLO 2	Estimate the value of inductance and capacitance of different configurations so as to compensate it	PO1, PO2, PO3, PO4	2
AEE011.03	CLO 3	Illustrate the effect of ground on the capacitance calculations	PO1, PO2, PO3, PO4	1
AEE011.04	CLO 4	Explain corona, effects of corona in power system, power loss due to corona, advantages and disadvantages	PO1, PO2, PO3, PO4, PSO1	2
AEE011.05	CLO 5	Classify the transmission line based on the length of the conductor and voltage levels.	PO3	2
AEE011.06	CLO 6	Analyze the nominal T model, nominal-π models and end capacitor models of medium transmission lines and long length transmission lines	PO1, PO2, PO3, PO4	2
AEE011.07	CLO 7	Evaluate the efficiency and regulation of short, medium and long length transmission lines.	PO1, PO2, PO3, PO4	1
AEE011.08	CLO 8	Describe Ferranti effect in long transmission lines.	PO3, PO4, PSO1	2
AEE011.09	CLO 9	Differentiate different insulators used in overhead and underground transmission lines	PO3, PO4, PSO1	1
AEE011.10	CLO 10	Deduce the string efficiency of suspension type insulators, voltage distribution across string of insulators and methods to improve string efficiency.	PO3, PO4, PSO1	2
AEE011.11	CLO 11	Construct single core and three core underground cables for transmission of power in highly populated areas.	PO2, PO3, PO4, PO6	2
AEE011.12	CLO 12	Calculate the sag and tension with equal and unequal heights of towers	PO1, PO2, PO4	2
AEE011.13	CLO 13	Illustrate the effect of wind and ice on weight of the conductors for the calculation of sag.	PO1, PO2	2
AEE011.14	CLO 14	Compare different distribution systems (AC Vs DC distribution, Ring main Vs Radial).	PO2, PO4, PSO1	2
AEE011.15	CLO 15	Evaluate the voltage drops in AC distributors and DC distributors. Design of substation	PO2, PO3, PO4	2
AEE011.16	CLO 16	Discuss Indian electricity rules, various voltage levels of transmission and distribution systems, Indian grid scenario.	PO2, PO6, PSO1	2
AEE011.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.		

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1		3	3										2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 2	3	3	1	1											
CLO 3	1	1	1	1											
CLO 4	1	1	2	2									2		
CLO 5			2	2									2		
CLO 6	1	1	2	3											
CLO 7	1	1	1	2											
CLO 8			2	2									2		
CLO 9			1	1									2		
CLO 10			2	2									2		
CLO 11		2	2	2		1									
CLO 12	2	2		1											
CLO 13	2	2													
CLO 14		2		2									2		
CLO 15		2	2	3											
CLO 16		2				2							2		
CLO 17															

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO3, PO4, PO6	SEE Exams	PO1, PO2, PO3, PO4, PO6	Assignments	PO2, PO3, PO4	Seminars	PO1, PO6
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	TRANSMISSION LINE PARAMETERS
Transmission line parameters: Types of conductors, simple diagrams of typical towers and conductors for 400, 220 and 132 kV operations, calculation of resistance for solid conductors, calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR and GMD, symmetrical and asymmetrical conductor configuration with and without transposition, numerical problems, capacitance calculations for symmetrical and asymmetrical single and three phase lines, single and double circuit lines, effect of ground on capacitance, numerical problems; Corona: Types, critical disruptive voltages, factors affecting corona, methods for reducing corona power loss, charge voltage diagram, audible noise, radio interference.	
UNIT-II	**MODELING AND PERFORMANCE OF TRANSMISSION LINES**
Classification of transmission lines: Short, medium and long line and their model representations, nominal T, nominal π and A, B, C, D constants for symmetrical and asymmetrical networks, numerical problems, mathematical solutions to estimate regulation and efficiency of all types of lines, numerical problems; Long transmission line: Rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, methods of voltage control, Ferranti effect, incident, reflected and refracted waves, surge impedance and surge impedance loading of long lines, wave length and velocity of propagation of waves, representation of long lines, equivalent T and equivalent π network model, numerical problems.	
UNIT-III	**OVERHEAD INSULATORS AND UNDERGROUND CABLES**
Overhead insulators: Types of insulators, voltage distribution, string efficiency and methods for improvement, capacitance grading and static shielding, numerical problems. Underground cables: Types of cables, construction, types of insulating materials, calculations of insulation resistance and stress in insulation, capacitance of single and three core belted cables, grading of cables, capacitance grading, description of inter sheath grading, numerical problems.	
UNIT-IV	**MECHANICAL DESIGN OF TRANSMISSION LINES**
Sag and tension calculations: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ice on weight of conductor, stringing chart and sag template and its applications, numerical problems.	
UNIT-V	**DISTRIBUTION SYSTEMS**
Distribution systems: Classification, comparison of DC vs AC and underground vs overhead, radial and ring main system, requirements and design features, Substation: Substation design, equipments, types of substations, bus bar arrangement layout, bus schemes, location, Kelvin's law for the design of feeders and its limitations; voltage drop calculations in DC distributors: Radial DC distributor fed at one end and at both the ends (equal / unequal voltages) and ring main distributor, voltage drop calculations in AC distributors, power factors referred to receiving end voltage and with respect to respective load voltages, numerical problems; Basic concept of interconnected systems: Indian electricity rules, various voltage levels of transmission and distribution systems, Indian grid scenario.	
Text Books:	
1. C L Wadhwa, "Electric Power Systems", New age publications, New Delhi, 9th Edition, 2007. 2. Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002. 3. Turan Gonen, "Electrical Power Distribution System Engineering", CRC Press, 3rd Edition, 2014. 4. V Kamaraju, "Electrical Power Distribution Systems", TMH, Publication, Edition 2009.	
Reference Books:	
1. J B Gupta, "A Course in Power Systems", S K Kataria and Sons, 2013 Edition, 2013 2. D Kothari and I J Nagrath, "Power System Engineering", McGraw-Hill Education, 2nd Edition, 2007. 3. V K Mehta and Rohit Mehta, "Principles of Power System", S Chand, 3rd revised Edition, 2015. 4. M L Soni, P V Gupta, U S Bhatnagar and A Chakrabarthy, "A Text Book on Power System Engineering", Dhanpat Rai and Co Pvt. Ltd., revised Edition, 2009.	

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	List out the types of conductors	CLO 1	R1:P2:1.1 -1.4, 2.2-2.7
3	Show the simple diagrams of typical towers and conductors for 400, 220 and 132 kV operations	CLO 2	R1:P2:2.3
4	Calculate the resistance of solid conductors, numerical problems	CLO 3	R1:P2:5.2
5	Compute the inductance of single phase single circuit lines and double circuit lines	CLO 2	T1:2.1-2.5
6	Calculate the inductance of three phase single circuit lines.and explain the concept of GMR and GMD	CLO 3	T1:2.6
7	Determine the inductance of three phase double circuit lines, concept of GMR and GMD symmetrical conductor without configuration transposition, numerical problems	CLO 3	T1:2.9-2.10
8	Compute the inductance of three phase double circuit lines, concept of GMR and GMD symmetrical conductor without configuration , numerical problems	CLO 4	T1:2.9-2.10
9-11	Determine the capacitance of single phase lines, single circuit and double circuit lines. symmetrical three phase lines, single circuit lines, asymmetrical three phase lines, single and double circuit lines	CLO 4	T1:3.1-3.6
12	Illustrate the effect of ground on capacitance. numerical problems	CLO 4	T1:3.7
13	Describe the effect of corona.	CLO 5	T1:6.2
14	Interpret the critical disruptive voltages, factors affecting corona	CLO 5	T1:6.1
15	List out the methods for reducing corona power loss, charge voltage diagram	CLO 6	T1:6.2-6.3
16	Predict the audible noise, radio interference with corona effect.	CLO 6	T1:6.5
17	Classify the types of transmission lines: Short, medium and long line and their model representations	CLO 5	T1:4.1
18	Demonstrate the performance of short transmission lines	CLO 7	T1:4.2
19	Explain nominal T and A, B, C, D constants for symmetrical and asymmetrical networks for medium transmission lines .	CLO 7	T1:4.3
20	estimate the regulation and efficiency of all types of lines by mathematical solutions	CLO 7	T1:4.3
21-23	Interpret the Long transmission line: Rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, Ferranti effect	CLO 7	T1:4.4-4.5
24	List out the methods of voltage control	CLO 9	T1:10.1-10.2
25-27	Discuss the incident, reflected and refracted waves, surge impedance and surge impedance loading of long lines	CLO 9	T1:12.4

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
28	Examine the wave length and velocity of propagation of waves	CLO 9	T1:12.4
29	Represent the long lines in terms equivalent T and equivalent π network model.	CLO 9	T1:4.4
30	Classify the types of insulators	CLO 8	T1:8.1
31-33	Determine the voltage distribution in a string of insulators , string efficiency	CLO 10	T1:8.2
34-36	Identify the methods(capacitance grading and static shielding) for improvement fo string of insulators	CLO 10	T1:8.3
37	Classify the types of cables based on construction.	CLO 10	T1:9.9
38-39	Explain the construction, types of insulating materials, calculations of insulation resistance and stress in insulation.	CLO 11	T1:9.4-9.5
40	Determine the capacitance of single and three core belted cables,	CLO 11	T1:9.5
41-43	Illustrate the concept of grading (capacitance grading, description of inter sheath grading) of cables.	CLO 10	T1:9.3
44-47	Calculate the Sag and tension with equal and unequal heights of towers	CLO 11	T1:7.2
48	Interpret the effect of wind and ice on weight of conductor	CLO 12	T1:7.3
49-50	Sketch the stringing chart and sag template and list out its applications	CLO 12	T1:7.4-7.5
51	Compare the DC vs AC and underground vs overhead, radial and ring main system and classify the types of distribution systems.	CLO 12	R1:P2:1.4 -1.5
52	Describe the requirements and design features of distribution systems.	CLO 12	R1:P3:17. 5-17.7
53	Explain substation design, equipments, types of substations	CLO 13	R1:P3:17. 9
54	Describe the bus bar arrangement layout, bus schemes	CLO 13	R1:P3:17. 9
55	Explain Kelvin's law for the design of feeders and its limitations	CLO 13	R1:P2
56	Calculate the voltage drop in DC distributors	CLO 14	R1:P2:9.2 -9.7
57-58	Determine the voltage drop in Radial DC distributor fed at one end and at both the ends (equal / unequal voltages) and ring main distributor	CLO 14	R1:P2:9.9
59	Determine the voltage drop calculations in AC distributors, power factors referred to receiving end voltage and with respect to respective load voltages, numerical problems	CLO 14	R1:P2:10. 1-10.3
60	Discuss the basic concept of interconnected systems: Indian electricity rules, various voltage levels of transmission and distribution systems, Indian grid scenario.	CLO 14	R1:P2:1.1 1-1.12

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Practical implementation i.e .modelling of transmission lines.	Project work in PSCAD	PO2,PO5,PO4	PSO1,PSO3
2	Distribution feeders and substation	Visiting nearby substations	PO3,PO4,PO7	PSO1,PSO3

Prepared by:
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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**INDUSTRIAL AUTOMATION AND CONTROL**				
Course Code	**AEE511**				
Programme	B.Tech				
Semester	V	EEE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	0	3	3	2
Chief Coordinator	Mr. P Mabuhussain, Assistant Professor				
Course Faculty	Mr. P Mabuhussain, Assistant Professor				

I. COURSE OVERVIEW:

This course provides an overall exposure to the technology of industrial automation and control as widely seen in factories. The course discusses of related topics from the architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems. It also gives an emphasis on PID controllers, PLC hardware and programming, hydraulic, pneumatic and electric actuators and CNC Machines.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE004	III	DC Machines and Transformers	4
UG	AEE007	IV	AC Machines	4
UG	AEE008	IV	Electrical Measurements and Instrumentation	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Industrial Automation and Control	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical and application skills of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Discussion and Seminars
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	Seminars
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	Laboratory Practice
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	Laboratory Practice

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Problem Solving**: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO2	**Professional Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Seminars
PSO3	**Modern Tools in Electrical Engineering:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	2	Videos, Open ended experiments

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Illustrate the functioning of programmable logic controllers and implementation in automation of industry.
II	Analyze working of hardware related to programmable logic controllers.
III	Demonstrate control system applications in industry using programmable logic controllers.
IV	Apply sequential logic to industrial applications and control systems.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE511.01	CLO 1	Describe the various elements of an Industrial Automation Systems and how they are organized hierarchically in levels.	PO1	3
AEE511.02	CLO 2	Define the different terms used for characterizing the performance of an instrument/ measurement system.	PO1, PO2	3
AEE511.03	CLO 3	Name the different methods of measuring temperature, pressure, force, displacement and speed.	PO1, PO2	3
AEE511.04	CLO 4	Study the signal conditioning circuits, different types of errors.	PO3	3
AEE511.05	CLO 5	Write the input-output relationship of a P-I-D controller	PO1, PO2	3
AEE511.06	CLO 6	Justify the use of feed forward and ratio control schemes.	PO2, PO5	2
AEE511.07	CLO 7	Explain the two schemes for predictive control Suggest a suitable compensation scheme for control of a process with inverse response.	PO1, PO5	2
AEE511.08	CLO 8	Define Sequence and Logic Control and Name the major functions performed by a PLC.	PO1, PO5	2
AEE511.09	CLO 9	Describe the hardware structure of a PLC Program and the execution of a PLC Program.	PO2,PO5	3
AEE511.10	CLO 10	Describe motivations for formal modelling in the design of sequence control programs for an industrial control problem.	PO2, PO5	2
AEE511.11	CLO 11	Describe the physical organization of hardware in the PLC.	PO1, PO2	3
AEE511.12	CLO 12	Define Numerical Control and describe its advantages and disadvantages.	PO2, PO3	2
AEE511.13	CLO 13	Name the types of control valves and sketch their ideal flow characteristics.	PO1, PO2	2
AEE511.14	CLO 14	Describe the principles of operation of hydraulic systems and understand its advantages.	PO1, PO2	3
AEE511.15	CLO 15	Describe pressure switches, as well as pressure and flow gauges used in hydraulic systems.	PO1, PO2	2
AEE511.16	CLO 16	Demonstrate energy saving with variable speed drive method of flow control compared to throttling.	PO2, PO3	2
AEE511.17	CLO 17	Explain with schematic diagrams, open loop and closed loop control schemes used for step motors.	PO2, PO3	2
AEE511.18	CLO 18	Describe the operational features of dc motor drives, Induction motor drives, BLDC motor drives for Electrical actuators.	PO1, PO2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	3	3													
CLO 3	3	3												2	
CLO 4			3											2	
CLO 5	3	2												2	
CLO 6		2			2									2	
CLO 7		2			2									2	
CLO 8	2				2										2
CLO 9		3			3										2
CLO 10		2			2										
CLO 11	2	2													2
CLO 12		2	2												
CLO 13	2	2													
CLO 14	3	2													
CLO 15	2	2													
CLO 16		2	2											2	
CLO 17		2	2											2	
CLO 18	2	2													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO3, PO5, PSO2,PSO3	SEE Exams	PO1, PO2, PO3, PO5, PSO2,PSO3	Assignments	PO2, PO3, PO5	Seminars	PO2, PO5
Laboratory Practices	PO3, PSO3	Student Viva	PO2, PO3, PSO3	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	INTRODUCTION TO INDUSTRIAL AUTOMATION AND CONTROL
Introduction to Industrial Automation and Control: Introduction to industrial automation and control architecture of industrial automation system, measurement systems specifications, temperature measurement, pressure and force measurement, displacement and speed measurement, signal conditioning circuits, errors and calibration.	
UNIT-II	**PROCESS CONTROL**
Process control: Introduction to process control, PID control, controller tuning, implementation of PID controllers, special control structures, feed forward and ratio control special control structures: predictive control, control of systems with inverse response.	
UNIT-III	**PROGRAMMABLE LOGIC CONTROL SYSTEMS**
Programmable logic control systems: introduction to sequence or logic control and programmable logic controllers, the software environment and programming of PLCs, formal modeling of sequence control specifications. Programming , programming of PLCs: sequential function charts, the PLC hardware environment	
UNIT-IV	**CNC MACHINES AND ACTUATORS**
CNC machines and actuators: Introduction to computer numerically controlled machines, control valves, hydraulic actuation systems, principle and components, directional control valves, switches and gauges, industrial hydraulic circuits.	
UNIT-V	**ELECTRICAL MACHINE DRIVES**
Electrical machine drives: Energy savings with variable speed drives, step motors: principles, construction and drives, electrical actuators, DC motor drives, electrical actuators: induction motor drives, electrical actuators, BLDC motor drives.	
Text Books:	
1. Stamatios Manesis, George Nikolakopoulos, “Introduction to Industrial Automation”, CRC press, 2018. 2. Kok Kiong Tan, Andi Sudjana Putra, “Drives and Control for Industrial Automation”, springer-verlag Londoan limited, 2011. 3. S.K. Bhattacharya & S. Bhattacharya, “Electrical Measurement and Control (WBSCTE)”, Vikas Publishing House Pvt Ltd, 2015	
Reference Books:	
1. Madhu Chanda Mitra, Samarjit Sen Gupta, “Programmable Logic Controllers and Industrial Automation: An Introduction”, Penram International Publishing (India) Pvt. Ltd., 1 st Edition, 2008. 2. K Krishnaswamy, S Vijayachitra, “Industrial Instrumentation”, New Age Publications, 1 st Edition, 2010. 3. Rajesh Mehra, Vikrant Vij, “PLCs & SCADA: Theory and Practice”, Laxmi publications, 2nd Edition, 2016.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1	Understand the benefits of industrial automation and control.	CLO 1	T1: 1.1 – 1.5
2	Know the architecture of industrial automation.	CLO 1	T1: 1.1 – 1.5
3	Illustrate the different terminology used in measuring systems	CLO 2	T3: 1.1.1 – 1.1.2
4	Explain the different methods used for measuring the temperature.	CLO 3	T3: 1.3.1
5	Describe the operation of force and pressure measuring devices.	CLO 3	T3: 1.3.3
6	Discuss the operation of displacement measuring circuits.	CLO 3	T3: 1.3.2 - 1.3.4
7	Discuss the operation of speed measuring devices.	CLO 3	T3: 1.3.8
8	Analyse the different signal conditioning circuits used for measuring circuits.	CLO 4	T3: 2.1 – 2.4
9	Analyse the different types of errors in the instruments during the measurement.	CLO 4	T3: 5.2
10	Illustrate the process control system and issues related to process control	CLO 5	T3: 5.7
11	Describe the PID controllers used in the control circuits and list the advantages of each type of PID controllers	CLO 5	T3: 5.7
12	Understand the different methods used for tuning of PID controllers	CLO 5	T3: 5.7
13	Implement a electronic and digital PID controller for process control and differentiate them with each other	CLO 5	T3: 5.7
14	Justify the use of feed forward controller in addition to conventional feedback controller.	CLO 6	T1: 9.1 -9.4
15	Write the typical applications of ratio control and give two possible arrangements for achieving ratio control	CLO 6	T1: 9.1 -9.4
16	Explain with an example the difficulty in controlling a process with dead time.	CLO 7	T1: 9.1 -9.4
17	Draw and explain the function of Smith Predictor Compensation Scheme.	CLO 7	T1: 9.1 -9.4
18	Write down the transfer function of process with inverse response and sketch its step response.	CLO 7	T1: 9.1 -9.4
19	State three major differences between Logic Control and Analog Control	CLO 8	T1: 9.1 -9.4
20	Define a Programmable Logic Controller and name its major structural components	CLO 8	T1: 6.2 – 6.3
21	Name the major functions performed by a PLC along with the structure and execution of a PLC Program	CLO 9	T1: 3.1 – 3.8
22	Design RLL Diagrams for simple industrial logic control problems	CLO 9	T1: 3.1 – 3.8
23	Describe motivations for formal modelling in the design of sequence control programs for an industrial control problem.	CLO 10	T1: 7.1 – 7.5
24	Describe the major steps in the design of a sequence control program for an industrial control problem.	CLO 10	T1: 7.1 – 7.5
25	Develop a Finite State machine model for simple industrial control problems	CLO 10	T1: 7.1 – 7.5
26	Describe the major features of the IEC 1131-3 standard for PLC programming	CLO 10	T1: 7.2 -7.4
27	Describe the major syntax conventions of the SFC programming language	CLO 10	T1: 7.2 -7.4

Lecture No	Topics to be covered	CLOs	Reference
28	Develop SFC programs for simple sequence control problems	CLO 10	T1: 7.2 -7.4
29	Describe the physical organization of hardware in the PLC	CLO 11	T1: 6.1 – 6.10
30	Describe typical Function modules used in PLC systems	CLO 11	T1: 6.1 – 6.10
31	Name and describe the major components and classifications of CNC Machines	CLO 12	T1: 5.7
32	Explain the basic principle of operation of a pneumatically actuated control valve	CLO 13	T1: 5.7
33	Name types of control valves and sketch their ideal flow characteristics.	CLO 13	T1: 5.7
34	Describe the principles of operation of hydraulic systems and understand its advantages	CLO 14	T1: 2.2
35	Describe the constructional and functional aspects of hydraulic pumps and motors	CLO 14	T1: 2.3
36	Describe the major types of direction control valves, their construction, operation and symbol	CLO 14	T1: 5.7
37	Describe pressure switches, as well as pressure and flow gauges used in hydraulic systems	CLO 15	T2: 2.1 - 2.4
38	Interpret hydraulic system symbols and circuit diagrams	CLO 15	T2: 2.1-2.4
39	Demonstrate energy saving with variable speed drive method of flow control compared to throttling	CLO 16	T2: 3.2
40	Identify the major constructional difference between a permanent magnet and variable reluctance type motor.	CLO 16	T2: 3.2.3
41	Develop the switching sequence for a given step motor according to given requirements.	CLO 17	T2: 3.2.1
42	Explain with schematic diagrams, open loop and closed loop control schemes used for step motors.	CLO 17	T2: 3.2.1
43	Derive the dynamic speed response characteristics relating armature voltage, load torque and speed.	CLO 18	T2: 3.2.2
44	Describe the realization of a variable voltage controlled source using switch mode power converters.	CLO 18	T2: 3.2.3
45	Describe the structure and principle of operation of PM BLDC motor.	CLO 18	T2: 3.2.2

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Introduction to Human Machine Interface (HMI) and its interfacing with PLC	Seminars, Open ended experiments	PSO 2, PO5	PSO 3
2	Controlling of Variable frequency Drive (VFD) through PLC	Seminars, Open ended experiments	PSO 2, PO5	PSO 3

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ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**OPTIMIZATION TECHNIQUES**				
Course Code	AHS012				
Programme	B.Tech				
Semester	V	CSE | IT | EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	2	1	3	-	-
Chief Coordinator	Mr. R M Noorullah, Associate Professor CSE				
Course Faculty	Mr. R M Noorullah, Associate Professor CSE				

I. COURSE OVERVIEW:

The primary objective of this course is to introduce the methods of optimization techniques, precise mathematical concept, study how to design algorithms, establish their correctness, study their efficiency and memory needs. The goal is to maintain a balance between theory, numerical computation, and problem setup for solution by optimization software and applications to engineering systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS003	I	Computational Mathematics and Integral Calculus	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Optimization Techniques	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Presentation on real-world 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	2	Seminar
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	Assignment

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:

I	Learn fundamentals of linear programming through optimization
II	Apply the mathematical results and numerical techniques of optimization theory to concrete Engineering Problems
III	Understand and apply optimization techniques to industrial applications.
IV	Apply the dynamic programming and quadratic approximation to electrical and electronic problems and applications.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS012.01	CLO 1	Explain the various characteristics and phases of linear programming.	PO 1	3
AHS012.02	CLO 2	Formulate the various linear programming problems by using graphical and simplex methods	PO 1	3
AHS012.03	CLO 3	Understand the artificial variable techniques like two phase and Big-M methods.	PO 1	2
AHS012.04	CLO 4	Explain Transportation problem and the formulation of the problem by using optimal solution.	PO 2	2
AHS012.05	CLO 5	Solve the assignment problems by using optimal solutions and the variance of assignment problems.	PO 2	2
AHS012.06	CLO 6	Describe the travelling sales man problem by using assignment method.	PO 2	2
AHS012.07	CLO 7	Explain the sequencing and the types of sequencing methods.	PO 10	1
AHS012.08	CLO 8	Use n jobs through two machines and n jobs through three machines to solve an appropriate problem.	PO 10	1
AHS012.09	CLO 9	Use two jobs through m machines to solve an appropriate problem.	PO 2	3
AHS012.10	CLO 10	Understand theory of games and the terminologies used in theory of games concept.	PO 2	3
AHS012.11	CLO 11	Determine appropriate technique to solve to a given problem.	PO 1	3
AHS012.12	CLO 12	Solve the problems by using dominance principle and Graphical method.	PO 1	3
AHS012.13	CLO 13	Understand the Bellman's principle of optimality.	PO 1	3
AHS012.14	CLO 14	Describe heuristic problem-solving methods with stages.	PO 1, PO 2	2
AHS012.15	CLO 15	Understand the mapping of real-world problems to algorithmic solutions.	PO 2	2
AHS012.16	CLO 16	List out the various applications of dynamic programming.	PO 2	2
AHS012.17	CLO 17	Define the shortest path problem with approximate solutions.	PO 1, PO 2	3
AHS012.18	CLO 18	Explain the linear programming problem with approximate solutions.	PO 1, PO 2	2
AHS012.19	CLO 19	Define the various quadratic approximation methods for solving constraint problems.	PO 1, PO 2	2
AHS012.20	CLO 20	Explain the direct quadratic approximation for solving the constraint problems.	PO 1, PO 2	2
AHS012.21	CLO 21	Explain the quadratic approximation method by using lagrangian function.	PO 1	3
AHS012.22	CLO 22	Describe the variable metric methods for constrained optimization.	PO 1	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2	3												1		
CLO 3	2												1		
CLO 4		2													
CLO 5		2													
CLO 6		2													
CLO 7										1					
CLO 8										1					
CLO 9		3											1		
CLO 10		3											1		
CLO 11	3														
CLO 12	3														
CLO 13	3														
CLO 14	2	2											1		
CLO 15		2													
CLO 16		2													
CLO 17	3	3											1		
CLO 18	2	2											1		
CLO 19	2	2											1		
CLO 20	2	2											1		
CLO 21	3														
CLO 22	2														

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1 PO 2 PO 10	SEE Exams	PO 1 PO 2 PO 10	Assignments	PO 10	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT I	**LINEAR PROGRAMMING**	**Classes:09**
Definition, characteristics and phases, types of models, operations research models, applications, linear programming problem formulation, graphical solution, simplex method; Artificial variables techniques: Two-phase method, Big-M method.		
UNIT II	**TRANSPORTATION AND ASSIGNMENT PROBLEMS**	**Classes:09**
Transportation problem, formulation, optimal solution, unbalanced transportation problem, degeneracy, assignment problem, formulation, optimal solution, variants of assignment problem, traveling salesman problem.		
UNIT III	**SEQUENCING AND THEORY OF GAMES**	**Classes:09**
Sequencing: Introduction, flow-shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing two jobs through m machines. 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.		
UNIT IV	**DYNAMIC PROGRAMMING**	**Classes:09**
Introduction: Terminology, Bellman's principle of optimality, applications of dynamic programming shortest path problem, linear programming problem.		
UNIT V	**QUADRATIC APPROXIMATION**	**Classes:09**
Quadratic approximation methods for constrained problems: Direct quadratic approximation, quadratic approximation of the Lagrangian function, variable metric methods for constrained optimization.		
Text Books:		
1. A Ravindran, "Engineering Optimization", JohnWiley&Sons Publications, 4th Edition, 2009. 2. Hillier, Liberman, "Introduction to Operation Research", Tata McGraw-Hill, 2nd Edition,2000.		
Reference Books:		
1. Dr. J K Sharma, "Operation Research", Mac Milan Publications, 5th Edition, 2013. 2. Ronald L. Rardin, "Optimization in Operation Research", Pearson Education Pvt. Limited, 2005. 3. N V S Raju, "Operation Research", S M S Education, 3rd Revised Edition.		

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Reference
1	Introduction, Characteristics and phases, Types of Models	T1:1.1-1.2
2-5	Operations Research Models and Applications, Linear Programming Problem Formulation, LPP solution by Graphical solution	T1:1.3
6-7	LPP solution by Simplex Method	T1: 1.3, 1.4
8-13	Artificial Variable Techniques by Two Phase Method, Artificial Variable Techniques by M Method, Transportation Problem: Introduction, assumptions and description, Formulation and Solution of Transportation Problem	T1:3.1,3.3, T1:3.5-3.6, T1:3.8
14-15	NWCM method problems, Row Minima Method Problems	T1 :6.1
16-18	Column Minima Method Problems, Least Cost Method Problems	T1: 2.5
19-21	VAM or Penalty Method Problems, Degeneracy in Transportation Problems	T1: 6.2
22-23	Unbalanced Transportation Problems	T1:11.3.6
24-26	Assignment Problem definition, method formulation and solution, Hungarian Method of Assignment Problem	T1: 6.3,6.4
27-30	Variations of the Assignment problems – unbalance problems, Travelling Salesman Problem, Processing n jobs through one machine problems	T1: 4.1 T1:4.3,4.5 T1:4.6,4.9
31-35	Processing n jobs through two machines problems, Processing n jobs through three machines problems, Processing n jobs through m machines problems, Characteristics of Games, Game Models, Terminology, Formulation	T1:5.1-5.3 T1:5.5 T1:5.7-5.9
36-38	Rules of Game Theory(with saddle point and without saddle point), 2X2 Games Problems, 3X3 Games Problems, 2Xn Games or mX2 Games Problems	T1: 7.1-7.5
39-43	Graphical method for 2Xn Games or mX2 Games Problems, Introduction, Characteristics, Formulation of Dynamic Programming Problems, Bellman"s Principles of Optimality Problem	T1: 8.1-8.3
44-45	Bellman's Principles of Optimality Problem	T1:11.1
46-49	Applications of Dynamic Programming, Shortest path problem by using Dynamic Programming Problem	T1:11.1-11.2
50-52	Solution of LPP by using Dynamic Programming Problem, Types of Non-Linear Programming Problems, Direct Quadratic Approximation Problems	T2:10.1-10.2
53-56	Quadratic Approximation by Lagrangian Function Problems, Constrained External problem with more than one equality constraint problems	T2:10.2-10.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No.	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Skip lists, Problem reductions, Polynomial time and intractability	Seminars/ NPTEL	PO 1	PSO 1
2	Encourage students to write programs based on the taught algorithms to solve problems.	NPTEL	PO 1	PSO 1

Prepared by:

Mr.R.M.Noorullah **HOD, EEE**

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**				
Course Code	AHS015				
Programme	B.Tech				
Semester	V	ECE | IT | CSE | MECH |CIVIL | EEE			
Course Type	Skill				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	2	1	3	-	-
Chief Coordinator	Ms E. Sunitha, Assistant Professor, MBA				
Course Faculty	Ms E.Sunitha, Assistant Professor, MBA Ms S.Lakshmi , Assistant Professor, MBA Ms G.Joseph Mary, Assistant Professor, MBA Mr. P.Nagesh Assistant Professor, MBA				

I. 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.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-----

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Business Economics and Financial Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 units and each unit carries equal weight age 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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.	1	Assignments.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**	1	Assignments.
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	Seminars.
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	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	---	----
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	1	Seminar
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	----	----

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the concepts of managerial economics and financial analysis for optimal decision making in business environment.
II	Analyze the market dynamics namely demand, elasticity of demand and pricing in different market structures
III	Gain the knowledge on the production theories and cost analysis while dealing with the production and factors of production.
IV	Study the various pricing methods which are adopted in attracting the potential customers for the different commodities.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS015.01	CLO 1	Describe the economic activities performed by the businessmen in the business for profit earning.	PO 11	3
AHS015.02	CLO 2	Understand the significance of demand, its analysis, measurement of demand and its forecasting .	PO 2	1
AHS015.03	CLO 3	Write the production function through the Cobb Douglas Production Function.	PO 8	1
AHS015.04	CLO 4	Design and implement different structures of market covering how price is determined under different market structures	PO 8, PO 9	2
AHS015.05	CLO 5	Analyze different forms of business organizations existing in the modern business.	PO 2	3
AHS015.06	CLO 6	Describe the allocation of capital which plays a vital role in a business organization.	PO 11	3
AHS015.07	CLO 7	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods	PO 9, PO11	3
AHS015.08	CLO 8	Apply the Principle of double entry to give an exposure to the maintenance of books of records and allocation of profits in an enterprise.	PO 2, PO8	1
AHS015.09	CLO 9	Explain the significance and objectives of trial balance and final accounts for knowing arithmetical accuracy of books of accounts	PO 2	1
AHS015.10	CLO 10	Understand the Ratio analysis to give an idea about financial forecasting	PO 11	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1											3				
CLO2		1												1	
CLO3								1							
CLO4								1	3						
CLO5									3						
CLO6											3				
CLO7									3		3				
CLO8		1						1						1	
CLO9		1												1	
CLO10											3				

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 2, PO8, PO 9, PO11	SEE Exams	PO 2, PO8, PO 9, PO11	Assignments	PO 2	Seminars	PO9,PO11
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-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	
UNIT-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, Opportunity cost, Fixed vs. Variable costs, Explicit costs vs. Implicit costs, out of pocket costs vs. Imputed costs, Break-even analysis, Determination of Break – Even point (Simple Problems) , Managerial Significance of BEA.	
UNIT-III	**MARKETS& NEW ECONOMIC ENVIRONMENT**
Market 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.	
UNIT-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).	
UNIT-V	**INTRODUCTION TO FINANCIAL ACCOUNTING AND FINANCIAL ANALYSIS**
Accounting Concepts and Conventions, Introduction to IFRS– Double – Entry Book keeping, Journal, Ledger, Trial balance, Final accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments.) Financial Analysis through Ratios: Significance, limitations of Ratio Analysis and Ratios Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio). Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt-Equity ratio, Interest Coverage ratio) and profitability ratios (Gross profit Ratio, Net profit ratio, Operating Ratio, P/E Ratio and EPS), Du Pont Chart.	
Text Books:	
1. Aryasri, "Managerial Economics and Financial Analysis", TMH publications, 4 th Edition, 2012. 2. M. Kasi Reddy, Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications,	

New Delhi, 2 nd Edition, 2012.

3. Varshney, Maheswari, "Managerial Economics", Sultan Chand Publications, 11th Edition, 2009.

Reference Books:

1. D.N. Dwivedi, "Managerial Economics", Vikas Publication House Pvt.Ltd, 2nd Edition, 2012.
2. S.N. Maheshwari & S.K.Maheshwari, "Financial Accounting", Vikas Publication House Pvt.Ltd, 4th Edition, 2012.
3. R.Narayana Swamy, "Financial Accounting- A managerial Perspective", Pearson publications, 1st Indian Reprint Edition, 2012.
4. J.V.Prabhakar Rao & P.V.Rao, "Managerial Economics & Financial Analysis", Maruthi Publishers, 1st Revised Edition, 2011.
5. .Kasi Reddy & Saraswathi, "Managerial Economics and Financial Analysis", PHI Publications, New Delhi, 10th Revised Edition, 2012.
6. Varshney & Maheswari, "Managerial Economics", Sulthan Chand Publishers, 1st Revised Edition, 2009.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Explain about managerial economics according to the business	CLO 1	T1- 1.3-1.8
3-4	Describe about demand analysis, the Law of Demand and Demand Function.	CLO 2	T1-2.2-2.11
5-6	Understand elasticity of the demand of the product, different types, Measurement of Elasticity of Demand and Factors influencing on Elasticity of Demand.	CLO 2	T1-3.3-3.20
6-7	State different methods of Demand Forecasting and the factors governing Demand Forecasting.	CLO 4	T1-4.6-4.19
8-9	Demonstrate the Production function, features of Iso-Quants and Iso-Costs,	CLO 4	T1- 5.3-5.18
10-12	Different types of Internal Economies, External Economies and Law of Returns with appropriate examples	CLO 4	T1- 5.3-5.18
13-14	Illustrate different types of costs	CLO 5	T1- 5.29-6.8
15-16	Explain the Significance and Limitations of Break-Even Analysis	CLO 5	T1- 7.13-7.14
17-18	Calculate Break-Even Point (Simple Problems)	CLO 6	T1- 7.1-7.12
19-20	Illustrate the features, price-output determination under Perfect Competition, Monopoly and Monopolistic competition Markets.	CLO 6	T1- 8.4-8.16
22-23	Demonstrate the Objectives, Policies and Methods of Pricing Strategies and Price Methods.	CLO 7	T1- 8.21-8.25
24-25	Describe Features of business, Definitions of Various forms of Business Units.	CLO 7	T1-9.3-9.15
26-27	State the Merits & Demerits of Different types of Public	CLO 8	T1- 9.2-10.23
28-29	Enterprises Changing Business Environment to Post Liberalization Scenario.	CLO 8	T1- 9.2-10.23
30-31	Explain the significance and classification of capital, Methods	CLO 9	T1- 11.3-11.5
32-33	Demonstrate the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems.	CLO 9	T1-12.1-12.26
34-35	Illustrate the Significance of Financial Accounting, Double Entry, Accounts.	CLO 8	T1-13.4-13.15
36-37	Accounting Concepts and Conventions	CLO 8	T1-13.4-13.15
38-39	Explain the meaning, advantages and Limitations of the Journal, Ledger and Trial Balance	CLO 10	T1-13.5-13.68
40-41	Final Accounts and Solve simple Problems.	CLO 8	T1-13.4-13.15
42-43	Describe Meaning, Definitions and Limitations of Ratio Analysis	CLO 10	T1-14.1-14.8
44-45	Compute different types of Financial Ratios (Problems)	CLO 10	T1-14.4-14.18

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with PO's	Relevance with PSO's
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest lectures	PO 2	PSO 1

Prepared by:
Ms E. Sunitha, Assistant Professor, MBA

HOD, MBA

VI SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**DISASTER MANAGEMENT**				
Course Code	ACE551				
Programme	B.Tech				
Semester	VI	CSE|IT|EEE			
Course Type	Open Elective-I				
Regulation	IARE – R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. Gude Ramakrishna, Associate Professor, CE.				
Course Faculty	Ms. P. Navya, Assistant Professor, IT. Ms. K. Sai saranya, Assistant Professor, CSE. Mr. R. Tarun kumar, Assistant Professor, CE. Mr. Selva Prakash, Assistant, CE.				

I. COURSE OVERVIEW:

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Disaster Management	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 units and each module carries equal weight age 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

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 8th and 16th 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 25 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 centre. 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.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Seminars
PO2	**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	Seminars
PO3	**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	Discussion of real-time applications
PO6	**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	Discussion of real-time applications

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	-
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Discussion of real-time applications
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	2	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Identify the major disaster types and develop an understanding of modern disaster management.
II	Recognize and develop awareness of the chronological phases of natural disaster response and refugee relief operations.
III	Understand the key concepts of disaster management related to development and the relationship of different disaster management activities.
IV	Categorize the organizations that are involved in natural disaster assistance and relief system.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE551.1	CLO 1	Integrate knowledge and to analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.	PO 1	2
ACE551.2	CLO 2	Analyze and evaluate the environmental, social, cultural, economic, legal and organizational Aspects influencing vulnerabilities and capacities to face disasters. and to know about different types of environmental hazards	PO 1	2
ACE551.3	CLO 3	Obtain knowledge on different types of natural and man- made disasters. Work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery)	PO 1	2
ACE551.4	CLO 4	Describe endogenous and exogenous hazards their harmful effects to the environment. Case studies of India	PO 2	2
ACE551.5	CLO 5	Analyze, and communicate information on risks, relief needs and order to formulate strategies for mitigation.	PO 2	2
ACE551.6	CLO 6	Understand the Mitigation and control measures of exogenous hazards.	PO 2	2
ACE551.7	CLO 7	Understand different approaches of different phases	PO 2	2
ACE551.8	CLO 8	Capacity to analyze and evaluate research work on the field of emergencies and disaster.	PO 3	2
ACE551.9	CLO 9	Demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used. And emerging approaches of disasters.	PO 2	2
ACE551.10	CLO 10	Analyze the future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments.	PO 2	2
ACE551.11	CLO 11	Understand integrated approach for disaster preparedness, mitigation & awareness; Mitigation.	PO 1	2
ACE551.12	CLO 12	Understand different types of institution for disaster mitigation and management	PO 1	-
ACE551.13	CLO 13	Design and perform research on the different aspects of the emergencies and disaster.	PO 1; PO 6	2
ACE551.14	CLO 14	Relate their interconnections, particularly in the field of the Public Health aspects of the disasters.	PO 1; PO 2	2
ACE551.15	CLO 15	Understand different approaches to prevent disasters.	PO 2	2
ACE551.16	CLO 16	Understanding the race process of dealing with work place hazards.	PO 2	2
ACE551.17	CLO 17	Identification of natural calamities that tends to hazards and disasters.	PO 1; PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												3		2
CLO 2	3	2												2	
CLO 3	1													2	
CLO 4		2	2										3		2
CLO 5		2												2	
CLO 6		2											3		2
CLO 7		3													
CLO 8			3												
CLO 9			2											2	
CLO 10		2													2
CLO 11			3											2	
CLO 12	3	1													
CLO 13	3					2									
CLO 14	2	2											3		2
CLO 15		3											3		
CLO 16		2													2
CLO 17			2										3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES - DIRECT

CIE Exams	PO 3	SEE Exams	PO 2	Assignments	PO 3	Seminars	PO 1,PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

UNIT-I	ENVIRONMENTAL HAZARDS AND DISASTERS
Environmental hazards and disasters: meaning of environmental hazards, environmental disasters and environmental stress; concept of environmental hazards, environmental stress and environmental disasters, different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach, human ecology and its application in geographical researches.	
UNIT-II	**TYPES OF ENVIRONMENTAL HAZARDS AND DISASTERS**
Types of environmental hazards and disasters: Natural hazards and disasters, man induced hazards and disasters, natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards.	
UNIT-III	**ENDOGENOUS HAZARDS**
Endogenous hazards, volcanic eruption, earthquakes, landslides, volcanic hazards/ disasters, causes and distribution of volcanoes, hazardous effects of volcanic eruptions, environmental impacts of volcanic eruptions. Earthquake hazards/ disasters, causes of earthquakes, distribution of earthquakes, hazardous effects of, earthquakes, earthquake hazards in India, human adjustment, perception and mitigation of earthquake.	
UNIT-IV	**EXOGENOUS HAZARDS**
Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters; Infrequent events: Cyclones , lightning , hailstorms; Cyclones: Tropical cyclones and local storms, destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation); Cumulative atmospheric hazards/ disasters: Floods, droughts, cold waves, heat waves floods; Causes of floods, flood hazards India, flood control measures (human adjustment, perception and mitigation); Droughts: Impacts of droughts, drought hazards in India, drought control measures, extra planetary hazards/ disasters, man induced hazards /disasters, physical hazards/ disasters, soil erosion, Soil erosion: Mechanics and forms of soil erosion, factors and causes of soil erosion, conservation measures of soil erosion; Chemical hazards/ disasters: Release of toxic chemicals, nuclear explosion, sedimentation processes; Sedimentation processes: Global sedimentation problems regional sedimentation problems, sedimentation and environmental problems, corrective measures of erosion and sedimentation, biological hazards/ disasters, population explosion.	
UNIT-V	**EMERGING APPROACHES IN DISASTER MANAGEMENT**
Emerging approaches in Disaster Management. Three Stages 1. Pre, disaster stage (preparedness) 2. Emergency Stage 3. Post Disaster stage, Rehabilitation.	
Text Books:	
1. Pardeep Sahni, “Disaster Mitigation: Experiences and Reflections”, PHI Learning Pvt. Ltd., 1 st Edition, 2001. 2. J. Glynn, Gary W. Hein Ke, “Environmental Science and Engineering”, Prentice Hall Publishers, 2 nd Edition, 1996.	
Reference Books:	
1. R.B.Singh (Ed), “Environmental Geography”, 2 nd Edition, 1990. 2. R.B. Singh (Ed), “Disaster Management”, 2 nd Edition, 2006.	

XIV. COURSE PLAN:

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

Lecture No	Topic's to be covered	Course Learning Outcomes (CLOs)	Reference
1	Environmental Hazards & Disasters:	CLO 1	T1:22.5 R1:2.3
2	Meaning of Environmental Hazards	CLO 2	T1:22.5 R1:2.4
3	Environmental Stress	CLO 2	T1:22.6 R1:2.6
4	Environmental stress.	CLO 4	T1:22.7 R1:4.4
5-6	Concept of Environmental Hazards	CLO 4	T1:22.7 R1:4.10
7	Environmental stress & Environmental Disasters	CLO 7	T1:22.8 R1:4.15
8	Ecology	CLO 9	T1:22.9 R1:5.4
9	Different Approaches	CLO 9	T1:22.9 R1:5.8
10	Landscape Approach -.	CLO 11	T1:23.10 R1:6.8
11	Ecosystem approach -Perception approach.	CLO 11	T1:23.10 R1:6.13
12-13	Human ecology & its application in geographical researches	CLO 13	T1:23.9 R1:7.5
14	Types of Environmental hazards & Disasters	CLO 11	T1:23.10 R1:7.5
15-16	Natural hazards and Disasters	CLO 9	T1:23.10 R1:8.1
17-18	Man induced hazards & Disasters	CLO 14	T1:23.1 R1:9.2
19-20	Natural Hazards- Planetary Hazards/ Disasters	CLO 14	T1:23.1 R1:9.4
21-22	Planetary Hazards-Endogenous Hazards - Exogenous Hazards	CLO 14	T1:23.1 R1:9.9
23-24	Volcanic Eruption – Earthquakes – Landslides	CLO 14	T1:23.1 R1:9.10
25-26	Volcanic Hazards/Disasters- Causes and distribution of Volcanoes	CLO 14	T2:27.5 R1:10.2
27-28	Hazardous effectsof volcanic eruptions	CLO 17	T2:27.7 R1:11.3
29-30	Environmental impacts of volcanic eruptions - Earthquake Hazards/ disasters - Causes of Earthquakes	CLO 17	T2:27.8 R1:11.6
31	Distribution of earthquakes - Hazardous effects of - earthquakes - Earthquake Hazards in India	CLO 19	T2:27.12 R1:11.7
32-33	Exogenous hazards/ disasters - Infrequent events- Cumulative atmospheric hazards/ disasters	CLO 19	T2:27.12 R1:11.8
34-35	Infrequent events: Cyclones, Lightning, Hailstorms, Cyclones: Earthquake Hazards in India	CLO 20	T2:27.12 R1:11.9
36-37	Tropical cyclones and Local storms	CLO 20	T2:27.12 R1:11.10
38	Destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation)	CLO 21	T2:27.14 R1:12.3
39-40	Cumulative atmospheric hazards/ disasters : Floods, Droughts, Cold waves, Heat waves Floods	CLO 22	T2:27.1 R1:12.7

Lecture No	Topic's to be covered	Course Learning Outcomes (CLOs)	Reference
41-42	Flood control measures (Human adjustment, perception and mitigation),	CLO 23	T2:27.17 R1:12.15
43-44	Droughts: Impacts of droughts, Drought hazards in India	CLO 23	T2:27.18 R1:12.19
45	Extra Planetary Hazards/ Disasters- Man induced Hazards /Disasters	CLO 24	T2:27.19 R2:14.4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Methods for obtaining flow nets, seepage in anisotropic soils	Seminars/Guest Lectures	PO 3;PO 4	PSO 1
2	Stresses in soil due to externally applied line, strip and trapezoidal loading	Seminars/Guest Lectures	PO 1	PSO 1
3	Fields tests to determine the shear strength of soils	Seminars/NPTEL	PO 4	PSO 1

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HOD, EEE.

INSTITUTE OF AERONAUTICAL ENGINEERING

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ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE DESCRIPTOR

Course Title	**JAVA PROGRAMMING**				
Course Code	ACS552				
Programme	B.Tech				
Semester	VI	EEE | ECE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. Y Harika Devi, Assistant Professor				
Course Faculty	Mr. N V Krishna Rao, Assistant Professor Mr. S Laxman Kumar, Assistant Professor Ms. G Geetha , Assistant Professor Mr. Santosh patel, Assistant Professor				

I. COURSE OVERVIEW:

This course explains the fundamental ideas behind the object oriented approach to programming. Knowledge of java helps to create the latest innovations in programming. Like the successful computer languages that came before, java is the blend of the best elements of its rich heritage combined with the innovative concepts required by its unique environment. This course involves OOP concepts, java basics, inheritance, polymorphism, interfaces, packages, Exception handling, multithreading, files, JDBC. This course is presented to students by power point projections, course handouts, lecture notes, assignments, objective and subjective tests.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACS001	I	Computer Programming	3
UG	ACS002	II	Data Structures	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Java Programming	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Seminars
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	Seminars
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	Assignments
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	5 minutes Video

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Lectures, Assignments
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	1	Lectures
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic object oriented programming concepts and apply them in problem solving.
II	Illustrate inheritance concepts for reusing the program.
III	Demonstrate on the multi-tasking by using multiple threads.
IV	Develop data-centric applications using JDBC.
V	Understand the basics of java file management.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACS552.01	CLO 1	Use object oriented programming concepts to solve real world problems.	PO 1,PO 2	2
ACS552.02	CLO 2	Explain the concept of class and objects with access control to represent real world entities.	PO 1,PO 3	3
ACS552.03	CLO 3	Demonstrate the behavior of programs involving the basic programming constructs like control structures, constructors.	PO 2	2
ACS552.04	CLO 4	Describe the concept of operators and variables, arrays, parameter passing.	PO 1	
ACS552.05	CLO 5	Use overloading methodology on methods and constructors to develop application programs.	PO1, PO 2	2
ACS552.06	CLO 6	Demonstrate the implementation of inheritance (multilevel, hierarchical and multiple) by using extend and implement keywords.	PO 1,PO 2	2
ACS552.07	CLO 7	Describe the concept of interface and abstract classes to define generic classes.	PO 1	3
ACS552.08	CLO 8	Use dynamic and static polymorphism to process objects depending on their class.	PO 1,PO 2	2
ACS552.09	CLO 9	Illustrate different techniques on creating and accessing packages (fully qualified name and import statements).	PO 2,PO 4	2
ACS552.10	CLO 10	Understand the impact of exception handling to avoid abnormal termination of program using checked and unchecked exceptions.	PO 2	2
ACS552.11	CLO 11	Demonstrate the user defined exceptions by exception handling keywords (try, catch, throw, throws and finally).	PO 1	3
ACS552.12	CLO 12	Use multithreading concepts to develop inter process communication.	PO 3	3
ACS552.13	CLO 13	Understand and implement concepts on file streams and operations in java programming for a given application programs.	PO 2	2
ACS552.14	CLO 14	Describe the backend connectivity process in java program by using JDBC drivers.	PO 2, PO 3	2
ACS552.15	CLO 15	Develop java application to interact with database by using relevant software component (JDBC Driver).	PO 2, PO 3	2
ACS552.16	CLO 16	Understand text, byte, and character input/output streams.	PO 2	2
ACS552.17	CLO 17	Demonstrate the import statement usage and built-in packages.	PO 1, PO 2	2
ACS552.18	CLO 18	Understand the use of interrupting threads in the real world.	PO 1, PO 2	2
ACS552.19	CLO 19	Demonstrate the use of programming in the real world.	PO 1, PO 2,PO 12	3
ACS552.20	CLO 20	Posses the knowledge and skills for employability and to succeed in national and international level competitive exams.	PO 1, PO 2, PO 12	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											2	1	
CLO 2	3		3										2	1	
CLO 3		2													
CLO 4	3												2		
CLO 5	3	2												2	
CLO 6	3	2													
CLO 7	3												1	1	
CLO 8	3	2													
CLO 9		2												1	
CLO 10		2											2		
CLO 11	3													1	
CLO 12			3												
CLO 13		2													
CLO 14		2	3										2	2	
CLO 15		2	3											1	
CLO 16		2													
CLO 17	3	2													
CLO 18	3	2													
CLO 19	3	2	3									2	2	1	
CLO 20	3	2	3									1	2	1	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 3, PO 12	SEE Exams	PO 1, PO 2, PO 3, PO 12	Assignments	PO 3	Seminars	PO 1, PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	OOPS CONCEPTS AND JAVA PROGRAMMING
OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, constructors, methods, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow statements, arrays, parameter passing.	
UNIT-II	**INHERITANCE**
Inheritance: Inheritance hierarchies, super and subclasses, member access rules, Polymorphism: Dynamic binding, method overriding, abstract classes and methods	
UNIT-III	**EXCEPTION HANDLING AND MULTITHREADING**
Exception Handling: Benefits of exception handling, the classification of exceptions, usage of try, catch, throw, throws and finally. Multithreading: Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads.	
UNIT-IV	**INTERFACES AND PACKAGES**
Interface: Interfaces vs Abstract classes, defining an interface, implement interfaces, Packages: Defining, creating and accessing a package, importing packages.	
UNIT-V	**FILES AND CONNECTING TO DATABASE**
Files: streams – byte streams, character stream, text input/output, binary input/output, file management; Connecting to Database: Connecting to a database, querying a database and processing the results, updating data with JDBC.	
Text Books:	
1. Herbert Schildt and Dale Skrien, "Java Fundamentals – A comprehensive Introduction", McGraw Hill, 1st Edition, 2013. 2. Herbert Schildt, "Java the complete reference", McGraw Hill, Osborne, 7th Edition, 2011.2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2012. 3. T.Budd, "Understanding Object- Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage), 1999.	
Reference Books:	
1. P.J.Dietel and H.M.Dietel , "Java How to program", Prentice Hall, 6th Edition, 2005. 2. P.Radha Krishna , "Object Oriented programming through Java", CRC Press, 1st Edition, 2007. 3. S.Malhotra and S. Choudhary, " Programming in Java", Oxford University Press, 2nd Edition, 2014.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-4	Data abstraction, encapsulation, inheritance, polymorphism dynamic binding, Need of Classes and objects, Benefits of OOP, procedural and object oriented programming paradigm.	CLO 1	T1: 1.5, 4.1, 4.2 R2:1.2, 1.3, 1.5, 2.3
5-6	History of java, comments, data types Variables, constants, scope and life time of variables.	CLO 2	T1:1.4, 2.2, 2.5
7-9	Operators, operator hierarchy, expressions type	CLO 3	T1:2.6-2.14,

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	conversion and casting, Enumerated types, control flow control flow block scope conditional statements, loops, break and continue statements.		3.1-3.16 R2:3.5, 3.6
10	Simple java program.	CLO 3	T1: 2.15
11	Use of arrays, formatted input and output.	CLO 4	T1:5.1-5.4
12-13	Methods, parameter passing, constructors.	CLO 4, CLO 5	T1:22.8 R1:4.15
14-15	Static fields, static methods and user defined methods.	CLO 4, CLO 5	T1: 6.2-6.7 R2:4.1.5, 4.1.7, 4.1.8
16-18	Inheritance, Inheritance hierarchies, super and subclasses member access rules.	CLO 6	T1:7.1-7.3
19-20	Polymorphism, dynamic binding method overriding, abstract classes and methods.	CLO 8	T1:7.4, 7.5, 7.13, 7.14
21-24	Exception Handling , benefits of exception handling, the classification of exceptions, exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally.	CLO 10, CLO 11	T1: 7.9-7.12 R2:4.2
25-31	Multithreading, Differences between multiple processes and multiple threads, thread states.	CLO 12	T1:8.1-8.5 R2: 4.4
32-33	Creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication.	CLO 12, CLO 18	T1:8.6, 8.7 R2:4.4
34-35	Interface, Interfaces VS Abstract classes, defining an interface implements interfaces.	CLO 7	T1:9.1-9.3 R2:4.3
36-37	Accessing implementations through interface references, extending interface.	CLO 7	T1: 10.1, 10.2, 10.7, 10.8, 10.10, 10.11 R2:5.5,5.6
38-40	Packages, Defining creating packages.	CLO 9, CLO 17	T1:10.12, 10.14 R2:5.8
40-41	Accessing a package, understanding CLASSPATH.	CLO 9	T1:12.1 R2: 6.2
42-44	Importing packages, programs.	CLO 17	T1:12.2-12.11 R2:6.3, 6.4, 6.5, 6.8
45-46	Files, streams, byte streams, character stream.	CLO 13, CLO 16	T1:11.3-11.4 R2: 7.2, 7.3
47-48	Text input/output, binary input/output.	CLO 13	T1: 11.12 R2:7.1, 7.2.3
49	Random access files operations, file management.	CLO 13	T1:11.10 R2:7.6
50	File management using file class.	CLO 13	T1:11.12
51	Connecting to Database, JDBC Type 1 to 4 drivers.	CLO 14	R2:9.2
52	Connecting to a database, querying a database.	CLO 15	R2:9.4
53-55	Processing the results, updating data with JDBC.	CLO 15	R2:9.4
56-57	Application programming in the real world.	CLO 19	R2:8.3
58-60	The concept of complex programs which solved real world problems.	CLO 20	R2:12.8

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	GUI programming, Applets	Seminars / Assignments / NPTEL	PO 1	PSO 1
2	Swing components, applet applications	Seminars / Guest Lectures / NPTEL	PO1	PSO 1
3	J Frame, JApplet, JButton, Applet applications	Assignments / Laboratory Practices	PO 2	PSO 2

Prepared by:
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HOD, EEE

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**MICROCONTROLLERS AND DIGITAL SIGNAL PROCESSING**				
Course Code	AEC022				
Programme	B.Tech				
Semester	VI	EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. J. Sravana, Assistant Professor, ECE				
Course Faculty	Ms. J. Sravana, Assistant Professor, ECE				

I. COURSE OVERVIEW:

Microcontrollers and digital signal processing course is intended to introduce the architecture, programming of microprocessors, microcontrollers and interfacing various hardware circuits to microprocessors and microcontrollers. The topics covered are architecture, addressing modes, instruction set of 8086 and 8051**.** Understand need of microprocessors, microcontrollers in development of various projects and to know complete architectural, programming, interfacing details of 8086 microprocessor-8051 microcontroller.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC019	IV	Digital and pulse circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Microcontroller and digital signal processing	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Lectures, Assignments
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	Assignments
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	Lab related 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	Seminars

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	1	Seminar
PSO 2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Enrich the knowledge of evolution of processor.
II	Apply the concept of assembly language programs for different applications.
III	Analyze and apply the concepts of discrete signals using discrete fourier transform.
IV	Analyze and design IIR and FIR digital filters.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC022.01	CLO 1	Understand and Describe the evolution and basic architecture of 8086	PO 1 PO 2	2
AEC022.02	CLO 2	Discuss the segmentation and programming model and List out the register organization	PO 1 PO 2	2
AEC022.03	CLO 3	Understand the difference between microprocessors and microcontrollers	PO 1	3
AEC022.04	CLO 4	Understand and describe input/output ports of 8051 and register organization	PO 1	2
AEC022.05	CLO 5	Describe different types of memory like special function register for program memory and data memory	PO 2	2
AEC022.06	CLO 6	Discuss the addressing modes of 8051 microcontroller	PO 1	3
AEC022.07	CLO 7	Discuss the instruction set of 8051 microcontroller	PO 1	3
AEC022.08	CLO 8	Develop assembly language program for 8051 based operations.	PO 1	2
AEC022.09	CLO 9	Discuss and illustrate the Timers/counters, serial communication	PO 1	2
AEC022.10	CLO 10	Understand and discuss external memory	PO 1 PO 12	3
AEC022.11	CLO 11	Understand and discuss clock circuits and i/o memory	PO 1	1
AEC022.12	CLO 12	Develop assembly code for real time control.	PO 5 PO 12	1
AEC022.13	CLO 13	Develop assembly code for real time control to interfacing ADC and DAC	PO 1 PO 2	2
AEC022.14	CLO 14	Understand the frequency domain representation and discrete Fourier transforms	PO 1 PO 12	3
AEC022.15	CLO 15	Understand the FFT and FFT algorithms, inverse FFT and FFT with general radix- N.	PO 5	3
AEC022.16	CLO 16	Analyze and design of FIR digital filters	PO 2 PO 12	2
AEC022.17	CLO 17	Analyze and design of IIR filters and digital filters using window techniques	PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	2	3											1		

CLOs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 3	3												1		
CLO 4															
CLO 5		2													
CLO 6															
CLO 7	3														
CLO 8	2														
CLO 9	2												1		
CLO 10	3											2	1		
CLO 11	1														
CLO 12					1							2			
CLO 13	2	2													
CLO 14	3											2	1		
CLO 15	3				1										
CLO 16		2										2			
CLO 17		2													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO 1, PO 2, PO 5, PO 12	SEE Exams	PO 1, PO 2, PO 5, PO 12	Assignments	PO 1, PO 2	Seminars	PO 12
Laboratory Practices	PO 5	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	MICROPROCESSORS AND MICROCONTROLLER
Evaluation of processors, 8086 architecture, functional diagram, register organization, memory segmentation, microcontrollers, comparison of microprocessors and microcontrollers, microcontroller survey, 8051 architecture, pin diagram of 8051, I/O ports, memory organization, counters and timers,	

serial data input / output, interrupts	
Unit-II	**INSTRUCTION SET AND PROGRAMMING OF 8051**
Addressing modes, Instruction set of 8051, programming of 8051, timers and counters, serial communication.	
Unit-III	**8051 MICRO CONTROLLER DESIGN**
Microcontroller design: External memory and memory space decoding, clock circuits, memory mapped I/O. Keyboard Interface, Seven segment numeric display interface, D/A and A/D converter interface to 8051.	
Unit-IV	**INTRODUCTION TO DIGITAL SIGNAL PROCESSING AND FAST FOURIER TRANSFORMS**
Discrete time signals and sequences, linear shift invariant systems, stability and causality, frequency domain representation of discrete time signals and systems, review of discrete Fourier transforms, Fast Fourier transforms, radix2 decimation in time and decimation in frequency, FFT algorithms, inverse FFT and FFT with general radix- N.	
Unit-V	**IIR AND FIR DIGITAL FILTERS**
Analog filter approximations, Butterworth and Chebyshev, design of IIR digital filters from analog filters, step and impulse invariant techniques, characteristics of FIR digital filters, frequency response; Design of FIR digital filters: Fourier method, digital filters using window techniques.	
Text Books:	
1. A K ray and K M Bhurchandani, "Advanced microprocessors and peripherals", Tata McGraw-Hill, 2nd Edition 2006. 2. John G Proakis, Dimitris G Manolakis, "Digital signal processing, principles, Algorithms and applications", Pearson Education / PHI, 4th Edition. 2007.	
Reference Books:	
1. Ajay V Deshmukh, "Microcontrollers and application", TMGH, 1st Edition, 2005. 2. Kenneth J Ayala, " The 8051 microcontroller", Cengage learning, 3rd Edition 2010. 3. Li tan Elsevier, "Digital signal processing: fundamentals and applications", 1st Edition, 2008.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1-6	Introduction of MDSP, Architecture of 8086, Functional diagram	CLO 1	T1-2.1 R1-2.3
7-9	Register organization of 8086, flag register structure, Memory segmentation, memory address and physical memory	CLO 2	T1-20.1
10-12	Differences between microprocessors and microcontrollers, Architecture of 8051 microcontroller, Pin diagram of 8051	CLO 2	T1-8.1 R2-2.1
13-16	Register organization, I/O ports in 8051 and operation of each port	CLO 3	T1–8.1 R2-2.7
17-20	Memory organization of 8051, timers and counters	CLO 4	T1-10.1
21-24	Addressing modes in 8051 with examples	CLO 5	T1-10.11 R2-3.1
25-32	Instruction set of 8051with different addressing modes	CLO 6	T1-11.1 R2-3.8
33-35	Simple programs related to 8051	CLO 6	T1-11.12 R2-4.1.1
36-37	8051 Real time control, Interrupts used in 8051	CLO 7	T1-17.1

Lecture No	Topics to be covered	CLOs	Reference
38-39	Microcontroller design: External memory and memory space decoding	CLO 8	T1-14.1 R2-21.1
40-41	Clock circuits, memory mapped I/O	CLO 8 CLO 9	T1-14.9 R2-17.1
42	Keyboard Interface, Seven segment numeric display interface	CLO 10	T1-19.1 R2-3.1
43-44	D/A and A/D converter interface to 8051	CLO 11	T1-19.4 R2-41.1
45-46	Discrete time signals and sequences, linear shift invariant systems, stability and causality	CLO 12	T1-19.6 R2-23.1
47-48	Frequency domain representation of discrete time signals and systems.	CLO 13	R2-9.3
49	Review of discrete Fourier transforms	CLO 14	R2-9.1
50	Fast Fourier transforms, radix2 decimation in time	CLO 15	R2-9.7
51-53	Decimation in frequency, FFT algorithms, inverse FFT and FFT with general radix-N	CLO 15	T2-27.7
54	Analog filter approximations Chebyshev	CLO 15	T2-27.8
55-56	Analog filter approximations, Butterworth, design of IIR digital filters from analog filters.	CLO 17	T2-27.12
57	Step and impulse invariant techniques, characteristics of FIR digital filters.	CLO 17	T2-27.12 R1-11.8
58	Frequency response, design of FIR digital filters	CLO 17	R1-11.8
59-60	Fourier method, digital filters using window techniques	CLO 17	R1-11.9

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To introduce concepts of evolution of processor.	Guest Lectures	PO 1	PSO 1
2	Analyze and understand the assembly language apply to real time applications.	Seminars /NPTEL	PO 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:
Ms. J Sravana, Assistant Professor

HOD, EEE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**POWER SYSTEM ANALYSIS**				
Course Code	AEE012				
Programme	B.Tech				
Semester	VI	EEE			
Course Type	Professional Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. T. Anil Kumar, Assistant Professor, EEE				
Course Faculty	Mr. T. Anil Kumar, Assistant Professor, EEE				

I. COURSE OVERVIEW:

Power system analysis deals formation impedance and admittance matrices for power system network, finding different electrical parameters for various buses in power system, study fault analysis and represent power system using per unit system, understand steady state and transient stability of power system.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE002	II	Electrical Circuits	4
UG	AEE011	V	Transmission And Distribution System	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Power System Analysis	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Assignment And PPTs
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	Assignment And PPTs
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	Assignment And PPTs
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	Assignment And PPTs

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Assignment And PPTs
PSO2	**Professional Skills:** Identify the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Determine the bus impedance and admittance matrices for power system network..
II	Calculate various parameters at different buses using load flow studies and numerical methods.
III	Discuss the symmetrical component theory, sequence networks, short circuit calculations and per unit representation power system.
IV	Understand the steady state stability of power system and suggest improvements.
V	Analyze the transient stability of power system and check methods to improve the stability.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE012.01	CLO 1	Define the basic terminology of graph theory to form bus impedance and admittance matrices..	PO1	2
AEE012.02	CLO 2	Determine the bus impedance and admittance matrices for power system.	PO1,PO3	3
AEE012.03	CLO 3	Draw the algorithms to form bus impedance and admittance matrices for configuration of primitive network.	PO1,PO3	3
AEE012.04	CLO 4	Understand necessity of load flow studies and derive static load flow equations.	PO1,PO2	3
AEE012.05	CLO 5	Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms.	PO1,PO2, PO5	2
AEE012.06	CLO 6	Compare various numerical methods of load flow studies and analyze DC load flow studies.	PO2	2
AEE012.07	CLO 7	Draw the equivalent reactance network of three phase power system using per unit system.	PO1	2
AEE012.08	CLO 8	Calculate the electrical parameters under symmetrical fault conditions and understand symmetrical component theory.	PO1	3
AEE012.09	CLO 9	Compute the electrical parameters under unsymmetrical faults with and without fault impedance.	PO1,PO2	3
AEE012.10	CLO 10	Discuss the steady state stability, dynamic stability and transient stability of power system.	PO1,PO2	3
AEE012.11	CLO 11	Describe steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve.	PO1,PO2, PO3	3
AEE012.12	CLO 12	Determination of steady state stability and methods to improve steady state stability of power system.	PO1,PO2, PO3	2
AEE012.13	CLO 13	Derive the swing equation to study steady state stability of power system.	PO1,PO3	2
AEE012.14	CLO 14	Predict the transient state stability of power system using equal area criteria and solution of swing equation.	PO1,PO2, PO3	2
AEE012.15	CLO 15	Suggest the methods to improve transient stability, discuss application of auto reclosing and fast operating circuit breakers.	PO1,PO2, PO3	2
AEE012.16	CLO 16	Apply the concept of graph theory, numerical methods, symmetrical and unsymmetrical fault to understand steady state and transient analysis.	PO1,PO2, PO3,PO5	2
AEE012.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1,PO2, PO3,PO5, PO9,PO10, PO12	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2												2		
CLO 2	2		3										2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 3	2		3										2		
CLO 4	2		3										3		
CLO 5	2	3			2								2		
CLO 6		2											2		
CLO 7	2												2		
CLO 8	3												3		
CLO 9	2	3											3		
CLO 10	2	3											3		
CLO 11	2	3	3										3		
CLO 12	1	2	2										3		
CLO 13	1		2										3		
CLO 14	1	3	3										3		
CLO 15	1	2	2										2		
CLO 16	1	3	3		2								3		
CLO 17	2	2	2		2				3	3		3	2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1,PO2 PO3,PO5	SEE Exams	PO1,PO2, PO3,PO5	Assignments	PO1,PO2 PO3,PO5	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

Unit-I	POWER SYSTEM NETWORK MATRICES
Graph Theory: Definitions, bus incidence matrix, Y bus formation by direct and singular transformation methods, numerical problems; Formation of Z Bus: Partial network, algorithm for the modification of Z	

bus matrix for addition of element from a new bus to reference bus, addition of element from a new bus to an old bus, addition of element between an old bus to reference bus and addition of element between two old busses (Derivations and Numerical Problems), modification of Z bus for the changes in network (Numerical Problems).	
Unit-II	**POWER FLOW STUDIES AND LOAD FLOWS**
Load flows studies: Necessity of power flow studies, data for power flow studies, derivation of static load flow equations; Load flow solutions using Gauss Seidel method: Acceleration factor, load flow solution with and without PV buses, algorithm and flowchart; Numerical load flow solution for simple power systems (Max. 3 buses): Determination of bus voltages, injected active and reactive powers (Sample one iteration only) and finding line flows / losses for the given bus voltages; Newton Raphson method in rectangular and polar coordinates form: Load flow solution with or without PV busses derivation of Jacobian elements, algorithm and flowchart, decoupled and fast decoupled methods, comparison of different methods, DC load flow study.	
Unit-III	**SHORT CIRCUIT ANALYSIS PER UNIT SYSTEM OF REPRESENTATION**
Per unit system: Equivalent reactance network of a three phase power system, numerical problems; Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors, numerical problems; Symmetrical component theory: Symmetrical component transformation, positive, negative and zero sequence components, voltages, currents and impedances. Sequence networks: Positive, negative and zero sequence networks, numerical problems; Unsymmetrical fault analysis: LG, LL, LLG faults with and without fault impedance, numerical problems.	
Unit-IV	**STEADY STATE STABILITY ANALYSIS**
Steady state stability: Elementary concepts of steady state, dynamic and transient stabilities, description of steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve and determination of steady state stability and methods to improve steady state stability.	
Unit-V	**TRANSIENT STATE STABILITY ANALYSIS**
Swing equation: Derivation of swing equation, determination of transient stability by equal area criterion, application of equal area criterion, critical clearing angle calculation, solution of swing equation, point by point method, methods to improve stability, application of auto reclosing and fast operating circuit breakers.	
Text Books:	
1. I J Nagrath & D P Kothari, "Modern Power system Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition. 2. M A Pai, "Computer Techniques in Power System Analysis", TMH Publications. 3. B.R.Gupta, " power system analysis and design",S.CHAND publications 4. K Umarao, "Computer techniques and models in power systems", I K International Pvt. Ltd.	
Reference Books:	
1. Stagg , El Abiad, " Computer Methods In Power System". Tata McGraw-Hill.1968. 2. Grainger and Stevenson, "Power System Analysis", Tata McGraw-Hill, 3rd Edition, 2011. 3. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition 2006. 4. Abhijit Chakrabarthi and Sunita Haldar, "Power system Analysis Operation and control", 3rd Edition, PHI, 2010.	

XIV. COURSE PLAN:

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

Lecture No.	Topics to be covered	CLOs	Reference
1	Introduction to graph theory.	CLO1	T4:9.4.1 R1:3.1-3.2
2	Solve numerical problems on graph theory.	CLO1	T4:9.4.1 R1:3.1-3.2

Lecture No.	Topics to be covered	CLOs	Reference
3	Building bus incidence matrix.	CLO2	T4:9.4.3 R1:3.3-3.5
4	Forming Y bus formation by direct method.	CLO2	T4:9.2 R1:3.3-3.5
5,6	Forming Y bus formation by singular transformation. methods,	CLO2	T4:9.2 R1:3.3-3.5
7	Solve numerical problems on bus matrices.	CLO2	T4:9.2 R1:3.3-3.5
8	Formation of ZBUS: Partial network.	CLO3	T4:9.4 R1:4.1
9	Algorithm for the Modification of Z Bus Matrix for addition element from a new bus to reference.	CLO3	T4:9.3&9.5 R1:4.2
10	Algorithm for the Modification of Z Bus Matrix for addition element from a new bus to an old bus.	CLO3	T4: 9.3&9.5 R1:4.3-4.4
11,12	Algorithm for the Modification of Z Bus Matrix for addition element between an old bus to reference Addition of element between two old	CLO3	T4: 9.3&9.5 R1:4.3-4.4
13	Study of necessity of power flow studies – Data for power flow studies – derivation of static load flow equations.	CLO4	T4:9.1 R1:8.1
14	Solution of load flow solutions using Gauss Seidel Method: Acceleration Factor.	CLO5	T4:9.8 R1:8.2
15	Load flow solution with and without P- V buses, Algorithm and Flowchart.	CLO5	T4:9.9.1 R1:9.2
16,17	Find numerical load flow solution for simple power systems (Max. 3- Buses): Determination of bus voltages, injected active and	CLO5	T4:9.8 R1:9.2
18,19	Discuss on newton raphson method in rectangular form: load flow, solution with or without PV busses- Derivation of jacobian elements.	CLO5	T4:9.10 R1:9.2
20	Discussion newton raphson method in polar co- ordinates form: load flow solution with or without pv busses-Derivation of jacobian	CLO5	T4:9.11.2 R1:9.2
21,22	Study on decoupled and fast decoupled methods for load flow solution.	CLO5	T4:9.12 R1:9.2
23	Comparison of Different Methods – DC load Flow.	CLO6	T4:9.4.12 R1:9.2
24,25	Short Circuit Analysis: Short Circuit Current and MVA Calculations.	CLO7	T4:10.3 R1:6.1-6.3
26	Understand fault levels.	CLO7	T4:10.4 R1:6.1-6.3
27	Application of series reactors.	CLO7	T4:10.4 R1:6.1-6.3
28	Solving numerical problems (Symmetrical fault Analysis).	CLO8	T4:10.4 R1:6.4
29	Understand symmetrical component transformation, positive, negative and zero sequence components.	CLO8	T4:10.5 R1:
30	Draw sequence networks.	CLO8	T4:10.6 R1:6.3
31	Derive sequence voltages, currents and impedances.	CLO08	T4:10.7 R1:6.3
32	Solving numerical problems on symmetrical components.	CLO8	T4:10.5 R1:6.3
33,34	Understand LG fault with and without fault impedance and numerical problems.	CLO9	T4:10.13 R1:6.3
35,36	Study fault with and without fault impedance and numerical problems.	CLO9	T4:10.13 R1:6.1-6.3
37,38	Determine LLG fault with and without fault impedance and numerical problems.	CLO09	T4:10.16 R1:6.1-6.3
39	Compare LG, LL, LLG faults with and without fault impedance and numerical problems.	CLO9	T4:10.17 R1:6.1-6.3
40,41	Introduction to steadystate, dynamic and transient stabilities.	CLO10	T4:13.1 R1:10.1
42,44	Description of steady state stability power limit, transfer reactance, synchronizing power coefficient.	CLO11	T4:13.2 R1:10.3

Lecture No.	Topics to be covered	CLOs	Reference
45,46	Plot Power Angle Curve and determination of steady state,. stability.	CLO11	T4:13.2 R1:
47,48	Explain methods to improve steady state stability.	CLO12	T4:13.2 R1:10.3
49	Derivation of swing equation.	CLO13	T4:13.3 R1:10.2
50,51	Determination of transient stability by equal area criterion.	CLO14	T4:13.6 R1:10.5
52	Application of equal area criterion to different cases.	CLO14	T4:13.7 R1:10.5
53	Discuss importance of critical clearing angle calculation.	CLO14	T4:13.6 R1:10.5
54,55	Solving numerical problems on equal area criteria.	CLO14	T4:13.7 R1:10.5
56	Solution of swing equation: point-by- point method.	CLO14	T4:13.8 R1:10.5
57	Explain methods to improve stability.	CLO15	T4:13.11 R1:10.6
58	Application of auto reclosing and fast operating circuit breakers.	CLO15	T4:13.11 R1:10.7

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Formation of bus impedance and admittance matrices using digital methods.	MATLAB Software	PO1, PO5	-
2	Power flow studies in integrated system.	Introduction To Distribution Generation	PO1, PO3	PSO1

Prepared by:
Mr. T. Anil Kumar, Assistant Professor

HOD, EEE

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE DESCRIPTOR

Course Title	**SOLID STATE ELECTRIC MOTOR DRIVES**				
Course Code	AEE010				
Programme	B.Tech				
Semester	VI	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. T. Devaraju, Professor, EEE				
Course Faculty	Mr. S. Srikanth, Assistant Professor, EEE				

I. COURSE OVERVIEW:

This course is an extension of power electronics applications to AC and DC drives. Control of DC Motor drives with single phase and three phase converters and choppers are given in detail. The control of AC motor drives with variable frequency converters and variable voltage are presented.

II. COURSE PRE-REQUISITES:

Level	Course code	Semester	Prerequisites	Credits
UG	AEE004	III	DC machines	4
UG	AEE007	IV	AC machines	4
UG	AEE010	V	Power Electronics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total marks
Solid state electric motor drives	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

√	Chalk & talk	√	Quiz	√	Assignments	X	MOOCs
√	LCD / PPT	√	Seminars	X	Mini project	X	Videos
X	Open ended experiments						

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 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total marks**
Type of assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		**Level**	**Proficiency assessed by**
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to	2	Laboratory Practice

Program Outcomes		Level	Proficiency assessed by
	the solution of complex engineering problems.		
PO2	**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	Seminar
PO3	**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	Laboratory Practice
PO4	**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	Seminar

3= High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-------
PSO2	**Problem-Solving Skills:** To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Seminar
PSO3	**Successful Career and Entrepreneurship:** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.	-	--------

3= High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (Cos):

The course should enable the students to:	
I	Demonstrate DC drives through phase controlled rectifiers and choppers.
II	Analyze operating principle of four quadrant DC drives.
III	Illustrate the speed control of induction motors through various parameters.
IV	Outline the separate and self control of synchronous motors.

IX. COURSE LEARNING OUTCOMES:

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE013.01	CLO 1	Understand the speed control of DC motors with single phase controlled rectifiers	PO1, PO3	3
CAEE013.02	CLO 2	Analyze the speed control of DC motors with three phase controlled rectifiers	PO1, PO2	3
CAEE013.03	CLO 3	Describe the speed torque characteristics of DC motors with variation in firing angle of the controlled rectifiers	PO1, PO4	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
CAEE013.04	CLO 4	Demonstrate the motoring and braking operations of DC motor drives	PO2, PO4	2
CAEE013.05	CLO 5	Analyze the four quadrant operation of DC Drive with dual converter and closed loop operation	PO1, PO4	2
CAEE013.06	CLO 6	Describe the operation of chopper fed DC motors	PO2, PO3	3
CAEE013.07	CLO 7	Apply the variable voltage operation of induction motors with AC voltage controllers	PO2, PO4	2
CAEE013.08	CLO 8	Analyze the variable frequency operation of induction motors with voltage source inverters and current source inverters	PO4	2
CAEE013.09	CLO 9	Describe the variable frequency operation of induction motors with cycloconverters and closed loop operations	PO3	3
CAEE013.10	CLO 10	Understand the speed control of induction motor through static rotor resistance control	PO2, PO4	2
CAEE013.11	CLO 11	Demonstrate the vector control operation of induction motor with direct methods	PO2	2
CAEE013.12	CLO 12	Describe the vector control operation of induction motor with indirect methods	PO1, PO4	2
CAEE013.13	CLO 13	Analyze the speed control of synchronous motor with voltage source inverters and current source inverters	PO2, PO4	2
CAEE013.14	CLO 14	Understand the speed control of synchronous motor with variable frequency control using cycloconverters	PO1, PO3	3
CAEE013.15	CLO 15	Demonstrate the closed loop control of synchronous motors with block diagram	PO2, PO4	2
CAEE013.16	CLO 16	Apply the concept of solid state electric drives to solve real time world applications	PO1	3
CAEE013.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations	PO2	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3		2												
CLO 2	3	2												2	
CLO 3	3			2											
CLO 4		2		3											
CLO 5	2			2										3	
CLO 6		2	3												
CLO 7		2		2											
CLO 8				2										2	
CLO 9			3												
CLO 10		2		3											

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 11		2												2	
CLO 12	2			2										3	
CLO 13		2		2											
CLO 14	3		2											3	
CLO 15		2		2											
CLO 16	3														
CLO 17		3												3	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1 PO2 PO3 PO4	SEE Exams	PO1 PO2 PO3 PO4	Assignments	PO1 PO2 PO3 PO4	Seminars	PO1 PO2 PO3 PO4
Laboratory practices	PO1 PO2 PO3 PO4	Student viva	PO1 PO2 PO3 PO4	Mini project	-	Certification	-
Term paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

UNIT - I	CONTROL OF DC MOTORS THROUGH PHASE CONTROLLED RECTIFIERS
Introduction to thyristor controlled drives: Single phase semi and fully controlled converters connected to DC separately excited and dc series motors, continuous current operation, output voltage and current waveforms, speed and torque expressions, speed torque characteristics, problems on converter fed DC motors; Three phase semi and fully controlled converters connected to DC separately excited and DC series motors, output voltage and current waveforms, speed and torque expressions, speed torque characteristics and problems.	
UNIT - II	**SPEED CONTROL OF DC MOTORS**
Introduction to four quadrant operation: Motoring operations, electric braking, plugging, dynamic and regenerative braking operations; Four quadrant operation of DC motors by dual converters, closed loop operation of DC motor; Chopper fed DC drives: Single quadrant, two quadrant and four quadrant chopper fed DC separately excited and series excited motors, continuous current operation output voltage and current wave forms, speed torque expressions, speed torque characteristics, problems on chopper fed DC motors and closed loop operation.	
UNIT - III	**SPEED CONTROL OF INDUCTION MOTORS THROUGH VARIABLE VOLTAGE AND FREQUENCY**
Variable voltage characteristics: Control of induction motor by AC voltage controllers, waveforms, speed torque characteristics. Variable frequency characteristics: Variable frequency characteristics, variable frequency control of induction motor by voltage source and current source inverter and cycloconverters, pulse with modulation control, comparison of voltage source inverter and current source inverter operations, speed torque characteristics, numerical problems on induction motor drives, closed loop operation of induction motor drives.	

UNIT - IV	SPEED CONTROL OF INDUCTION MOTORS THROUGH ROTOR RESISTANCE AND VECTOR CONTROL
Static rotor Resistance control: Slip power recovery schemes, static Scherbius drive, static Kramer drive, their performance and speed torque characteristics, advantages and applications, vector control of induction motor drives: Principles of vector control, vector control methods, direct methods of vector control, indirect methods of vector control and problems.	
UNIT - V	**SPEED CONTROL OF SYNCHRONOUS MOTORS**
Separate control and self control of synchronous motors, operation of self controlled synchronous motors by voltage source inverter and current source inverter cyclo converters. Load commutated CSI fed synchronous motor, operation, waveforms, speed torque characteristics, applications, advantages and numerical problems, closed loop control operation of synchronous motor drives (block diagram only), variable frequency control, cycloconverter, PWM, variable frequency inverter and current source inverter.	
Text Books:	
1. PV Rao, "Power Semiconductor Drives", BS Publications, 1st Edition, 2014. 2. G K Dubey, "Fundamentals of Electric Drives", Narosa Publications, 2nd Edition, 2001. 3. SB Devan, GR Slemon, A Straughen, "Power semiconductor drives", Wiley Pvt. Ltd,. 4th Edition, 2001. 4. B K Bose, "Modern Power Electronics and AC Drives", Prentice Hall India Learning Private Limited, 2005.	
Reference Books:	
1. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill Publication, 5th Edition, 2008. 2. John Hindmarsh, Alasdair Renfew", Electrical machines and drive systems", Oxford Butterworth Heinemann, 3rd Edition. 3. Austin Hughes, "Electrical motors and drives Fundamentals Types and Applications", Elsevier, 3rd Edition, 2006. 4. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998. 5. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001 6. J. Gnanavadivel, "power semi conductor drives", Anuradha, 2nd Edition, 2007	

XIV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1.	Understand the principle of thyristor controlled drives	CLO1	T2: 1.1, R6: 2.1
2.	Describe the operation of Single phase semi controlled converters connected to DC separately excited motors	CLO1	T2: 5.11 R6: 2.5.1
3.	Understand the operation Single phase semi controlled converters connected to DC series motors	CLO1	T2: 5.1.2 R6: 2.5.2
4.	Analyze the problems on Single phase semi controlled converters fed DC motors	CLO3	T2: 5.11 R6: 2.5.2
5.	Discuss the operation of Single phase fully controlled converters connected to DC separately excited motors	CLO1	T2: 5.10 R6: 2.5.3
6.	Describe the operation of Single phase fully controlled converters connected to DC series motors	CLO1	T2: 5.1.2 R6: 2.6.2
7.	Analyze the problems on Single phase fully controlled converters fed DC motors	CLO3	T2: 5.10 R6: 2.6.2
8.	Demonstrate the operation of Three phase semi controlled converters connected to DC separately excited motors	CLO2	T2: 5.13 R6: 3.2.1
9.	Understand the operation of Three phase semi controlled converters connected to DC series motors	CLO2	T2: 5.13 R6: 3.3.1
10.	Analyze the problems on three phase semi controlled converters fed DC motors	CLO3	T2: 5.13 R6: 3.2.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
11.	Describe the operation of Three phase fully controlled converters connected to DC separately excited motors	CLO2	T2: 5.12 R6: 3.2.2
12.	Discuss the operation of Three phase fully controlled converters connected to DC series motors	CLO2	T2: 5.12 R6: 3.3.2
13.	Analyze the problems on three phase fully controlled converters fed DC motors	CLO3	T2: 5.12 R6: 3.2.1
14.	Understand the four quadrant operation of DC motors	CLO5	T2: 5.3 R6: 4.1
15.	Describe the electric braking operations	CLO4	T2: 5.3.1 R6: 4.2.1
16.	Demonstrate the Regenerative braking operations of DC motors	CLO4	T2: 5.3.2 R6: 4.2.2
17.	Discuss the Four quadrant operation of DC motors by dual converters	CLO5	T2: 5.14.2 R6: 4.3
18.	Describe the closed loop operation of DC motor with four quadrant operations	CLO5	T2: 5.14.3 R6: 4.3
19.	Understand the operation of Single quadrant chopper fed DC separately excited and series motors	CLO6	T2: 5.18 R6: 5.3
20.	Describe the operation of Two quadrant chopper fed DC separately excited and series motors	CLO6	T2: 5.19 R6: 5.6.2
21.	Analyze the problems on Chopper fed DC motors	CLO6	T2: 5.19 R6: 5.6.2
22.	Discuss the operation of Four quadrant chopper fed DC separately excited and series motors	CLO6	T2: 5.20 R6: 5.7
23.	Analyze the problems on four quadrant chopper drives	CLO6	T2: 5.20 R6: 5.6.2
24.	Demonstrate the Closed loop operation of chopper fed DC motors	CLO6	T2: 5.21 R6: 5.7
25.	Understand the variable voltage characteristics of induction motor	CLO7	T2: 6.1.1 R6: 6.5
26.	Discuss the speed control of induction motor by AC voltage controllers	CLO7	T2: 6.11 R6: 6.6.1
27.	Describe the Speed torque characteristics of induction motor with variable voltage	CLO7	T2: 6.11.1 R6: 6.6.2
28.	Demonstrate the variable frequency characteristics of induction motor	CLO7	T2: 6.12.1 R6: 7.1
29.	Understand the operation of voltage source inverter fed induction motor	CLO8	T2: 6.13.1 R6: 7.5
30.	Discuss the operation of current source inverter fed induction motor	CLO8	T2: 6.17 R6: 7.6
31.	Describe the operation of cycloconverter fed induction motor	CLO9	T2: 6.14
32.	Apply the pulse width modulation control for variable frequency control of induction motor	CLO9	T2: 6.9 R6: 7.6
33.	Distinguish voltage source inverter and current source inverter	CLO8	T2: 6.17.3 R6: 7.8
34.	Analyze the numerical problems on stator voltage control	CLO9	T2: 6.12 R6: 7.6
35.	Demonstrate the Closed loop operation of induction motor drives	CLO8	T2: 6.15 R6: 6.8
36.	Analyze the numerical problems on induction motor drives	CLO9	T2: 6.13 R6: 7.6.1
37.	Understand the operation of rotor resistance control of induction motors	CLO10	T2: 6.20 R6: 8.1
38.	Discuss the Static rotor Resistance control of induction motors	CLO10	T2: 6.20.2 R6: 8.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
39.	Demonstrate the Slip power recovery schemes of induction motor	CLO10	T2: 6.21 R6: 8.4
40.	Describe the operation of static Scherbius drive	CLO10	T2: 6.21.1 R6: 8.4.1
41.	Understand the operation of static Kramer drive	CLO10	T2: 6.21.2 R6: 8.4.2
42.	List the advantages and applications of slip power recovery schemes	CLO10	T2: 6.21 R6: 8.4.2
43.	Analyze the problems on rotor resistance control	CLO10	T2: 6.21 R6: 8.5
44.	Discuss the vector control of induction motor drives	CLO11	T2: 6.24 R6: 6.8
45.	Understand the principles of vector control of induction motor	CLO11	T2: 6.25 R6: 6.8.1
46.	Describe the vector control methods of induction motor	CLO11	T2: 6.26 R6: 6.8.2
47.	Demonstrate the direct methods of vector control	CLO11	T2: 6.26.1 R6: 6.8.3
48.	Discuss Indirect methods of vector control and problems.	CLO12	T2: 6.26.2 R6: 6.8.3
49.	Analyze the problems on vector control of induction motor	CLO11	T2: 6.26.1 R6: 6.8.4
50.	Understand the Separate control of synchronous motors	CLO13	T2: 7.5.1 R6: 9.3.1
51.	Describe the Self control of synchronous motors	CLO13	T2: 7.5.2 R6: 9.3.1
52.	Demonstrate the operation of self controlled synchronous motors by voltage source inverter	CLO13	T2: 7.3 R6: 9.4
53.	Discuss the operation of self controlled synchronous motors by current source inverter	CLO13	T2: 7.3.1 R6: 9.4
54.	Understand the operation of self controlled synchronous motors by cycloconverter	CLO14	T2: 7.3.2 R6: 9.4.2
55.	Describe the operation of Load commutated CSI fed synchronous motor	CLO13	T2: 7.5 R6: 9.7
56.	List the Applications and advantages of synchronous motor drives	CLO13	T2: 7.7 R6: 9.7
57.	Analyze the Numerical problems on synchronous motor drives	CLO13	T2: 7.5 R6: 9.7
58.	Demonstrate the closed loop control operation of synchronous motor drives with block diagram	CLO15	T2: 7.6 R6: 9.10
59.	Discuss the operation of variable frequency control of synchronous motor with cycloconverter	CLO14	T2: 7.6.1 R6: 9.8
60.	Describe the Variable frequency inverter and current source inverter fed synchronous motor	CLO13	T2: 7.6.2 R6: 9.8

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Inverters fed AC motor drives and its control methods	Guest lecture	PO2	PSO2
2	Speed control of special motors using converters	Guest lecture	PO2	PSO2

Prepared by:
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INSTITUTE OF AERONAUTICAL ENGINEERING

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ELECTRICAL AND ELECTRONOCS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENERGY AUDIT AND MANAGEMENT**				
Course Code	AEE503				
Programme	B. Tech				
Semester	VI	EEE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. V. Chandra Jagan Mohan, Assistant Professor				
Course Faculty	Dr. V. Chandra Jagan Mohan, Assistant Professor				

I. COURSE OVERVIEW:

Energy audit and management deals Principles of energy audit and conservation; Energy efficiency in buildings; Energy efficient motors, lighting, instruments and significance of energy economics. Communication and marketing strategies, opportunities for renewable source, very good management strategies for conservation, giving good motivation for employs, maintaining up to date records of audit for effective management, it also deals with internal and external bench marking, it also deals with energy and material balance.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE003	III	Power Generation Systems	4
UG	AEHS015	V	Business Economics and Financial Analysis	4

III. MARKS DISTRIBUTION:

Subject	SEE examination	CIA Examination	Total marks
Energy Audit And Management	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

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 units and each unit carries equal weight age 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 emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
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Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five 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 / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		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	Discussion
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	Discussion, assignment
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	Discussion
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	Discussion, seminar
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.	2	Discussion
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2	Discussion, assignment
PO10	**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, assignment
PO11	**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	Assignment

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Problem solving:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Discussion
PSO2	**Professional Skills**: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	2	Assignment
PSO3	**Modern Tools in Electrical engineering:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test ,maintain power system and applications.	2	Seminar

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	To impart knowledge on energy scenario, fundamentals of energy audit and management.
II	To develop skills in analyzing and assessing the energy efficient measures, audit and management in commercial and industrial applications.
III	To inculcate ethics in practicing energy audit and management considering society, environment and sustainability.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
AEE503.01	CLO 1	Demonstrate knowledge on auditing practices, management measures and economics of energy.	PO11	2
AEE503.02	CLO 2	Analyze auditing practices, management measures and economics of energy.	PO1,PO11	2
AEE503.03	CLO 3	Design an appropriate energy management measures in commercial and industrial applications.	PO1,PO11	2
AEE50304	CLO 4	Provide feasible solutions for problems associated with energy auditing and management through proper investigation and interpretation of data.	PO1,PO4	2
AEE503.05	CLO 5	Use appropriate techniques for energy auditing and management.	PO1,PO3,	2
AEE503.06	CLO 6	Solve energy auditing and management problems with societal relevance	PO6	2
AEE50307	CLO 7	Consider environment and sustainability in energy auditing and management.	PO7	2
AEE503.08	CLO 8	Follow relevant rules and regulations in practicing energy audit and management.	PO8	2
AEE503.09	CLO 9	Communicate effectively on energy audit in written and graphical forms.	PO10	2
AEE503.10	CLO 10	Consider financial issues in energy audit and management.	PO11	2
AEE503.11	CLO 11	Devise energy policy planning and implementation.	PO3	1
AEE503.12	CLO 12	Analyze energy balance sheet and management information System.	PO4	2
AEE503.13	CLO 13	Know about Instruments for audit and monitoring energy and energy savings, types and accuracy.	PO11	2
AEE503.14	CLO 14	Knowledge on marketing and communicating training and planning.	PO10	3
AEE503.15	CLO 15	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO3	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1											2		2		
CLO 2	2										2		2		
CLO 3	2										2		2		2
CLO 4	2			2									2		
CLO 5	2		2										2	2	
CLO 6						2							2	2	
CLO 7							2						3		
CLO 8								2					2		
CLO 9										2			2		
CLO 10											2		2		
CLO 11			1										2		2
CLO 12				2									2		
CLO 13											2		2		2
CLO 14										3			2		
CLO 15			3										2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XII. SYLLABUS

UNIT-I	GENERAL ASPECTS
General philosophy: Need of energy audit and management, definition and objective of energy management, general principles of energy management, energy management skills, energy management strategy; Energy audit: need, types, methodology and approach, energy management approach, understanding energy costs, bench marking, energy performance, matching energy usage to requirements, maximizing system efficiency, optimizing the input energy requirements, fuel and energy substitution.	

UNIT-II	PROCEDPROCEDURES AND TECHNIQUES , EVALUATION OF SAVING OPPURTUNITIES AND ENERGY AUDIT RREPORTING
Data gathering: Level of responsibilities, energy sources, control of energy and uses of energy, facts, figures and impression about energy / fuel and system operations, past and present operating data, special tests, questionnaire for data gathering; Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of energy inputs and rejections; Evaluations: Heat transfer calculations, evaluation of electric load characteristics, process and energy system simulation, determining the savings in Rs, noneconomic factors, conservation opportunities, estimating cost of implementation; Audit report: The plant energy study report, importance, contents, effective organization, report writing and presentation.	
UNIT-III	ENERGY POLOCY PLANNING AND IMPLEMENTATION
Policy planning: Force field analysis, energy policy purpose, perspective, contents and formulation, location of energy manager, top management support, managerial functions, role and responsibilities of energy manager, accountability. Motivating: Motivation of employees, requirements for energy action planning; Implementation: Designing, barriers, strategies, marketing and communicating training and planning.	
UNIT-IV	ENERGY BALANCE AND MIS
Energy balance: First law of efficiency and second law of efficiency, facility as an energy system, methods for preparing process flow, materials and energy balance diagram, identification of losses, improvements; MIS: Energy balance sheet and management information system (MIS) energy modeling and optimization.	
UNIT-V	ENERGY AUDIT INSTRUMENTS
Instruments: Instruments for audit and monitoring energy and energy savings, types and accuracy	
Text Books:	
1. W R Murphy, G Mckay, “Energy Management”, Butterworth’s, 2nd Edition, 2009. 2. C B Smith, “Energy Management Principles”, Pergamon Press, 2nd Edition, 1981. 3. I G C Dryden, “Efficient Use of Energy”, Butterworths, 1st Edition, 1982. 4. AV Desai, “Energy Economics” , Wiley Eastern, 1st Edition, 1991.	
Reference Books:	
1. D A Reay, “Industrial Energy Conservation”, Pergammon Press, 1st Edition, 1977. 2. W C Turner, “ Energy Management Handbook, John Wiley and Sons, 6th Edition , 2006. 3. L C Witte, P S Schmidt, D R Brown, “Industrial Energy Management and Utilization”, .Hemisphere Publication, Washington, 1st Edition, 1988.	

XIII. COURSE PLAN:

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

Lecture No.	Topics to be covered	CLOs	Reference
1	Need of energy audit and management	CLO1	T3:9.4.1
2	Objective of energy management	CLO1	T3:9.4.1
3	Principles of energy management	CLO2	T3:9.4.3
4	Energy management approach or strategies	CLO2	T4:9.2
5-6	Understanding energy costs	CLO2	T4:9.2
7	Bench marking	CLO2	T4:9.2
8	Matching energy usage to requirements	CLO3	T4:9.4

9	Maximizing system efficiency	CLO3	T4:9.3&9.5
10	Fuel and energy substitution	CLO3	T4: 9.3&9.5
11-12	Energy sources	CLO3	T4: 9.3&9.5
13	Control of energy and uses of energy	CLO4	T4:9.1
14	Figures and impression about energy / fuel and system operations	CLO5	T4:9.8
15	Questionnaire for data gathering	CLO5	T4:9.9.1
16-17	Incremental cost concept	CLO5	T4:9.8
18-19	Mass and energy balance	CLO5	T4:9.10
20	Evaluation of electric load characteristics	CLO5	T4:9.11.2
21-22	Determining the savings in Rs	CLO5	T2:9.12
23	Determining the savings in Rs	CLO6	T4:9.4.12
24-25	Audit report	CLO7	T4:10.3
26	Location of energy manager	CLO7	T2:10.4
27	Top management support	CLO7	T4:10.4
28	Role and responsibilities of energy manager	CLO8	T4:10.4
29	Motivation of employees	CLO8	T4:10.5
30	Energy action planning and implementation	CLO8	T4:10.6
31	Marketing and communicating training	CLO8	T4:10.7
32	First law of efficiency and second law of efficiency	CLO8	T3.10.5
33	Facility as an energy system	CLO9	T4:10.13
34	Methods for preparing process flow	CLO9	T4:10.13
35	Identification of losses and improvements	CLO9	T4:10.16
36	Energy balance sheet	CLO9	T4:10.17
37	Management information system (MIS)	CLO10	T4:13.1
38	Energy modeling and optimization	CLO5	T4:13.2
39	Instruments for audit	CLO13	T4:13.2
40	Monitoring energy	CLO13	T4:13.2

XIV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S. NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Instruments of audit, their accuracy.	Seminars	PO1, PO4	PSO3
2	Power flow studies in integrated system.	Introduction To Distribution Generation/ Seminars	PO1, PO6	PSO1

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