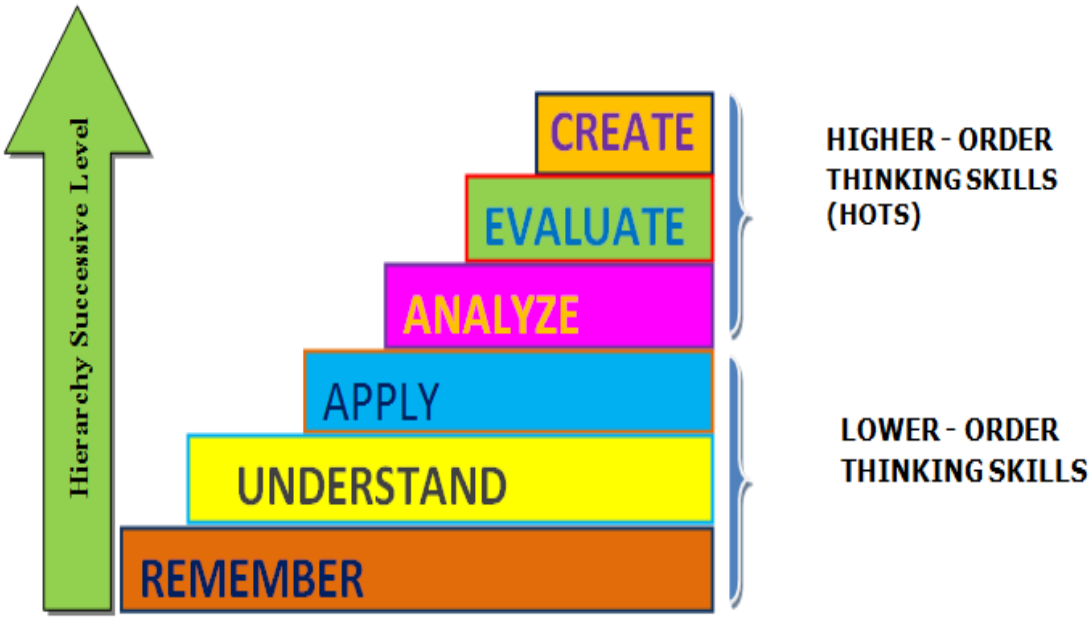
COURSE DESCRIPTOR BOOKLET

B.Tech

ELECTRONICS AND COMMUNICATION 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

ELECTRONICS AND COMMUNICATION 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	**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.	2	Projects
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.	3	Lectures, Assignments
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real world applications using optimal resources as an Entrepreneur.	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	

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	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

ELECTRONICS AND COMMUNICATION 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	**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, Embeddedsystems etc., in the design and implementation of complex systems	1	Seminar
PSO 2	**Problem-Solving Skills**: An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analyticalskills to arrive cost effective and appropriate solutions.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur	-	-

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
AHS002.21	CLO 21	Apply the technique of Jacobian and	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
		inverse Jacobian relation to real world problems such as kinematics and inverse kinematic solutions of robot manipulators.		
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 function 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													

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

ELECTRONICS AND COMMUNICATION 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
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.	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship**: An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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-world 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 employability and to succeed in national and International level competitive examinations.	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	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											
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 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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
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 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 Bessels 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 Bessels 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

ELECTRONICS AND COMMUNICATION 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	**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.	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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														
CLO 13	3	1													
CLO 14	1														
CLO 15	2														
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
20	Calculate the total, permanent and temporary hardness of	CLO 5	T2:6

Lecture No	Topics to be covered	CLOs	Reference
	sample hard water by using EDTA		
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

ELECTRONICS AND COMMUNICATION 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	**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..	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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		

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R1:6.8
10	Acquire knowledge of basic terms related to lasers	CLO 5	T1:19.10 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

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

II SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION 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 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	Mini Project
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	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	**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..	1	
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.	3	Assignments
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real world applications using optimal resources as an Entrepreneur.	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	Implement linear 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	Describe the concept of collision and its resolving methods in 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									3	
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	3	
CLO 14	2	3			2									3	
CLO 15	3	3			2								1		
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	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

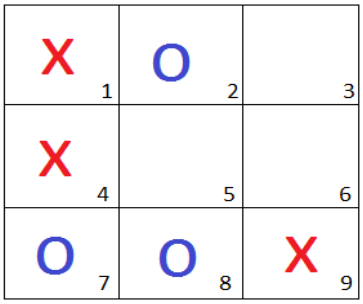
Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
11 – 14	Sorting techniques: Bubble sort, selection sort, insertion sort, and quick sort; merge sort, and comparison of sorting algorithms.	CLO 7	T1:5.2 R2 : 10.2
15 – 16	Stacks: Primitive operations, implementation of stacks using 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.

Prepared by:
B Padmaja, Associate Professor, CSE

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL CIRCUITS**				
Course Code	**AEE002**				
Programme	B.Tech				
	II	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	**Mr. T. Vignyesh, Assistant Professor.EEE**				
Course Faculty	**Mr. T Anil Kumar, Assistant Professor, EEE** **Mr. K Raju, Associate Professor, EEE** **Mr. T Vigneysh, 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	**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.	2	Assignment and Seminar
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.	--	--
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	--	--

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												1		
CLO 2	3												2		
CLO 3	3	3											3		
CLO 4	3	3											3		
CLO 5	3	2											1		
CLO 6	3	2											1		
CLO 7	3	2											2		
CLO 8	3	2											2		
CLO 9	3	3											2		
CLO 10	3	3											3		
CLO 11	3	3											3		
CLO 12	3	2											2		
CLO 13	3	3	3										2		
CLO 14	3	3	3										2		
CLO 15	3	3											2		
CLO 16	3	3											2		
CLO 17	3	3											2		

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

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Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION 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	**Professional Skills**: The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	-	-
PSO 2	**Problem-Solving Skills**: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	-	-
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	Written Test – Verbal Aptitude for Placement and Higher studies

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 3
2	Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work.	Seminars / NPTEL	PO 9	PSO 3
3	To build confidence for communicating in English and create interest for the life-long learning of English language.	Guest lecture	PO 10	PSO 3

Prepared by:
Ms. B Anand Lakshmi, Associate Professor

HOD, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION 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	Dr. M Anitha, Professor Mr. J Suresh Goud, 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	**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	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS004.04	CLO 4	Understand the concept of complex differentiation to the real-world problems of signals modulated by electromagnetic waves.	PO 4	1
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:

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												1		
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									1		
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 R2:3.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
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, FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELETRONICS AND COMMUNICATION 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	**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.	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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

III SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION 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	Dr. P Ashok Babu, Professor Mr. B Naresh, Assistant Professor Mrs. G Mary Swarnalatha, 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, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Quiz
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	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 researchmethods 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	**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.	2	Seminars 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.	2	Quiz and Assignments
PSO 3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

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	PO 3	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		the concepts of load lines, operating points and incremental analysis.		
AEC001.15	CLO 15	Identify the various transistor biasing circuits and its usage in applications like amplifiers.	PO 1	3
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		

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 10	2	2												3	
CLO 11	2												2		
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

Lecture No.	Topics to be covered	CLOs	Reference
9	Understand diode load line	CLO 1	R5: 1.7
10-11	Solve the diode capacitance equations	CLO 1	T1: 5.8 -5.10
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

Lecture No.	Topics to be covered	CLOs	Reference
45	Understand fixedbias	CLO 15	T1: 8.4
46	Understand emitter feedback circuit	CLO 15	T1:8.5
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:
Mr. V.R.Seshagiri Rao

HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL SYSTEM DESIGN**				
Course Code	AEC002				
Programme	B.Tech				
Semester	III	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. K Nehru, Professor				
Course Faculty	Dr. Lalith Kumar Kaul, Professor Dr. P Munaswamy, Professor Mr. C Srihari, Assistant Professor				

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
-	-	-	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital System Design	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 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	3	Seminar
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary Settings.	2	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:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	2	Seminar
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	-	-
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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Formulate and solve problems involving number systems and operations related to them and generate different digital codes.
II	Describe and analyze functions of logic gates and optimize the logic functions using K -map and Quine - McClusky methods.
III	Demonstrate knowledge of combinational and sequential logic circuits elements like Adders, Multipliers, flip-flops and use them in the design of latches, counters, sequence detectors, and similar circuits.
IV	Design a simple finite state machine from a specification and be able to implement this in gates and edge triggered flip-flops.

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
AEC002.01	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	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC002.02	CLO 2	Illustrate the switching algebra theorems and apply them for reduction of Boolean function.	PO 1	2
AEC002.03	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 1	3
AEC002.04	CLO 4	Discuss about digital logic gates and their properties, and implement logic gates using universal gates.	PO 1	3
AEC002.05	CLO 5	Evaluate functions using various types of minimizing algorithms like Boolean algebra.	PO 1	1
AEC002.06	CLO 6	Evaluate functions using various types of minimizing algorithms like Karnaugh map or tabulation method.	PO 5	3
AEC002.07	CLO 7	Design Gate level minimization using K-Maps and realize the Boolean function using logic gates.	PO 5	3
AEC002.08	CLO 8	Analyze the design procedures of Combinational logic circuits like adder, binary adder, carry look ahead adder.	PO 5	1
AEC002.09	CLO 9	Understand bi-stable elements like latches, flip-flop and illustrate the excitation tables of different flip flops.	PO 5	3
AEC002.10	CLO 10	Analyze and apply the design procedures of small sequential circuits to build the gated latches.	PO 5	2
AEC002.11	CLO 11	Understand the concept of Shift Registers and implement the bidirectional and universal shift registers.	PO 5	2
AEC002.12	CLO 12	Implement the synchronous counters using design procedure of sequential circuit and excitation tables of flip – flops.	PO 5	3
AEC002.13	CLO 13	Implement the Asynchronous counters using design procedure of sequential circuit and excitation tables of flip – flops.	PO 5	2
AEC002.14	CLO 14	Understand and analyze the design of a finite state machine and implement Moore and mealy machine.	PO 5, PO 9	2
AEC002.15	CLO 15	Understand and analyze the merger chart methods like merger graphs, merger table for completely and incompletely specified machines.	PO 9	2
AEC002.16	CLO 16	Apply the concept of digital logic circuits to understand and analyze real time applications.	PO 9	1
AEC002.17	CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 5, PO 9	1.5

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												3		
CLO 2	2												2		
CLO 3	3												1		
CLO 4	3														
CLO 5	1														
CLO 6					3										
CLO 7					3										
CLO 8					1										
CLO 9					3								2		
CLO 10					2								1		
CLO 11					2										
CLO 12					3										
CLO 13					2										
CLO 14					3				1				2		
CLO 15									2						
CLO 16									1						
CLO 17					1				2				2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO5, PO 9	SEE Exams	PO 1, PO 5,PO 9	Assignments	PO 1, PO 5	Seminars	PO 1, PO 5
Laboratory Practices	PO 5	Student Viva	-	Mini Project	PO 9	Certification	-
Term Paper	PO 5						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Unit-I	FUNDAMENTALS OF DIGITAL TECHNIQUES
Review of number systems: Decimal, binary, octal and hexa decimal, base conversion methods, complements of numbers; binary codes: Binary coded decimal, excess-3, gray codes, error detecting and error correcting codes.	
Unit-II	**BOOLEAN ALGEBRA AND THEOREMS**
Boolean algebra: Postulates and theorems; Logic gates and truth tables, representation of switching functions, sum of products and product of sums forms, karnaugh map representation, minimization using karnaugh map Quine - McClusky method of minimization.	
Unit-III	**DESIGN OF COMBINATIONALCIRCUITS**
Design of combinational circuits using conventional AND, OR, NOT, NAND, NOR and EX-OR gates. Adders and subtractors: Half adder, full adder, half subtractor, full subtractor. Parallel adder, serial adder, carry look ahead adder, binary coded decimal adder, 1"s complement subtractor, 2„s complement subtractor.	
Unit-IV	**SEQUENTIAL CIRCUITS**
Flip Flops: SR flip flop, JK flip flop, D flip flop, T flip flop, excitation tables, race around condition, master slave flip flop; Counters: Design of synchronous and asynchronous counters; Shift registers: Modes of operation, bidirectional shift registers, ring counters, Johnson counters.	
Unit-V	**CAPABILITIES AND MINIMIZATION OF SEQUENTIAL MACHINES**
Synchronous sequential circuits: State table, state diagram, state assignment, state minimization; Sequential circuits example: Sequence detectors, binary counters; Mealy and Moore machines: Capabilities and limitations of finite state machine, state equivalence and machine minimization of completely specified or incompletely specified machines, partition method, Merger table and graph method.	
Text Books:	
1. M. Morris Mano, Michael D. Ciletti, " Digital Design", Pearson Education, 3rd Edition, 2008. 2. Zvi. Kohavi, "Switching and Finite Automata Theory", Tata McGraw Hill, 3rd Edition, 2004. 3. John M. Yarbrough, "Digital logic applications and design", Thomson publications, 2nd Edition, 2006.	
Reference Books:	
1. Roth, "Fundamentals of Logic Design", Cengage learning, 5th Edition, 2004. 2. A. Anand Kumar,"Switching Theory and Logic Design", Prentice Hall of India, 1st 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
1-5	Number systems, base conversion methods.	CLO 1	T1:1.5-1.7 R1:1.6-1.8
6-8	Complements of numbers, codes-binary codes, BCD code and its properties.	CLO 2	T1:1.7 R1:1.9
9-11	Unit distance code, alphanumeric codes, and error detecting and correcting codes	CLO 3	T1:1.7 R1:2.0
12-15	Basic theorems and its properties, switching functions, canonical and standard form.	CLO 4	T1:2.1-2.6 R1:2.3-2.5
16-18	Algebraic simplification of digital logic gates, properties of XOR gates.	CLO 5	T1:2.8 R1:2.6
19-21	Universal gates, Multilevel NAND/NOR realizations.	CLO 6	T1:3.7-3.8 R1:3.2-3.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
22-24	Tabular method.	CLO 7	T1:3.9 R1:4.0
25-32	Combinational design, arithmetic circuits- adders, substractors.	CLO 8	T1:4.1-4.9 R1:4.2-4.6
33-35	Serial adder, 1's complement substractor, 2's complement substractor.	CLO 9	T1:5.1-5.2 R1:4.7-4.8
36-38	Combinational and sequential circuits, the binary cell, the fundamentals of sequential machine operation.	CLO 10	T1:5.3-5.5 R1:5.0-5.2
39-42	Flip-flop, D-Latch Flip-flop, "Clocked T" Flip-flop, "Clocked JK "flip-flop.	CLO 11	T1:5.3-5.5 R1:5.3-5.4
43-45	Design of a clocked flip-flop conversion from one type of flip-flop to another.	CLO 12	T1:5.3-5.5 R1:5.5-5.7
46-48	Registers and counters.	CLO 13	T1:6.1-6.5 R1:6.1-6.3
49-51	Introduction, State diagrams, Analysis of synchronous sequential circuit	CLO 14	T1:6.6-6.8 R1:6.4-6.6
52-54	Approaches to the design of synchronous sequential finite state machines, design aspects State reduction, design steps, realization using flip-flop.	CLO 15	T1:7.1-7.2 R1:7.0-7.2
55-58	Finite State machine – Capabilities and limitations, mealy and Moore models.	CLO 16	T1:7.3-7.4 R1:7.3-7.5
59-63	Minimization of completely specified and incompletely specified sequential machines, partition techniques and merger chart methods – concept of minimal cover table.	CLO 17	T1:7.5-7.6 R1:7.7-7.8

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	PO 1,PO 5	PSO 1
2	Design of combinational circuits using universal gates.	Seminars / NPTEL	PO 5,PO 9	PSO 1
3	Verilog programming for combinational and sequential circuits.	Guest Lectures	PO 5,PO 9	PSO 1

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**PROBABILTY THOERY AND STOCHASTIC PROCESS**				
Course Code	**AEC003**				
Programme	B.Tech				
Semester	III	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mrs. G Ajitha, Assistant Professor, ECE				
Course Faculty	Dr. M V Krishna Rao, Professor, ECE Mr. N Nagaraju, Assistant Professor, ECE Mrs. G Ajitha, Assistant Professor, ECE Mr. G Anil Kumar Reddy, Assistant Professor, ECE				

I. COURSE OVERVIEW:

The course addresses the concepts, principles and techniques of sets and probability and random variable and random process. The course teaches the fundamentals of probability applying the concepts of mean,variance and development techniques. This course forms the basis for the study of advanced subjects like signals and systems. Students will learn probability concepts and difference between random variable and random process and estimation of power spectral density.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS004	II	Complex Analysis and Probability Distributions	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Probability Theory and Stochastic Process	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
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab related exercises
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	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	**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	Seminar
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.	2	Lab related exercises
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Know the theoretical formulation of probability, random variables and stochastic processes.
II	Be Familiar with the basic concepts of the theory of random variables in continuous and discrete time domain and analyze various analytical properties such as statistical averages.
III	Understand the concept of stationary in random processes and study various properties such as autocorrelation, cross correlation and apply them for signal analysis.
IV	Relate time domain and frequency domain representations of random processes and model different scenarios of random environment in signal processing 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
AEC003.01	CLO 1	Understand probabilities and be able to solve	PO 1, PO 2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		using an appropriate sample space		
AEC003.02	CLO 2	Remember different random variables and their properties	PO 1, PO 2	3
AEC003.03	CLO 3	Discuss various operations like expectations from probability density functions (pdfs) and probability distribution functions	PO 1, PO 2, PO 4	3
AEC003.04	CLO 4	Remember Transformations of random variables	PO 1, PO 2	2
AEC003.05	CLO 5	Perform Likelihood ratio tests from pdfs for statistical engineering problems.	PO 1, PO 2	3
AEC003.06	CLO 6	Understand Operations on multiple random variables like moments	PO 1, PO 2	3
AEC003.07	CLO 7	Calculate Mean and covariance functions for simple random variables.	PO 1, PO 2	3
AEC003.08	CLO 8	Understand the Ergodic processes	PO 1	2
AEC003.09	CLO 9	Understand Auto-correlation and cross correlation properties between two random variables	PO 1, PO 2	3
AEC003.10	CLO 10	Explain the concept of random process; differentiate between stochastic, stationary and ergodic processes.	PO 1	3
AEC003.11	CLO 11	Explain the concept of power spectral density and power density spectrum of a random process.	PO 1, PO 4	3
AEC003.12	CLO 12	Apply the power density spectrum of a random process in system concepts	PO 1, PO 4	3
AEC003.13	CLO 13	Remember the Autocorrelation to stochastic process	PO 1	3
AEC003.14	CLO 14	Remember the Autocorrelation to stochastic process	PO 1,PO 2	3
AEC003.15	CLO 15	Apply the Gaussian Noise to stochastic process	PO 2, PO 4	3
AEC003.16	CLO 16	Apply the concept of probability theory and random process to understand and analyze real time applications	PO 4	1
AEC003.17	CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	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	3	3											3	2	
CLO 2	3	3											3	2	
CLO 3	3	3		3									3	2	
CLO 4	2	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 5	3	3											3	2	
CLO 6	3	3											3	2	
CLO 7	3	3											3	2	
CLO 8	2														
CLO 9	3	3													
CLO 10	3												3	2	
CLO 11	3			3									3		
CLO 12	3			3											
CLO 13	3												3	2	
CLO 14	3	3													
CLO 15		3		3											
CLO 16											1		3		
CLO 17											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	PO 1	Seminars	PSO 1
Laboratory Practices	PO 2, PO 4	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	PROBABILITY AND RANDOM VARIABLE
Introduction to probability through sets and probability: Relative frequency; Experiments and sample spaces, discrete and continuous sample spaces; Events; Probability definitions and axioms; Mathematical model of experiments; Probability as a relative frequency; Joint probability; Conditional probability, total probability; Baye's theorem and independent events. Random variable: Definition of random variable, conditions for a function to be a random variable, discrete, continuous and mixed random variable.	

Unit-II	DISTRIBUTION AND DENSITY FUNCTIONS
Distribution and density functions: Distribution and density functions definitions and properties; Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional distribution, methods of defining conditioning on an event, conditional density, properties. Operation on one random variable expectations: Introduction, expected value of a random variable, function of a random variable, moments about the origin, central moments, variance and skew; Chebyche's inequality; Characteristic function; Moment generating function; Transformations of a random variable: Monotonic transformations for a continuous random variable; Non monotonic transformations of continuous random variable; Transformation of a discrete random variable.	
Unit-III	**MULTIPLE RANDOM VARIABLES AND OPERATIONS**
Multiple random variables: Vector random variables, joint distribution function, properties of joint distribution; Marginal distribution functions, conditional distribution and density: Point conditioning, conditional distribution and density: Interval conditioning, statistical independence, sum of two random variables, sum of several random variables; Central limit theorem. Operations on multiple random variables: Expected value of functions of random variables: Joint moments about the origin, joint central moments, joint characteristic functions and jointly Gaussian random variables: Two random variables case and N random variable case, properties; Transformations of multiple random variables; Linear transformations of Gaussian random variables	
Unit-IV	**STOCHASTIC PROCESSES: TEMPORAL CHARACTERISTICS**
The random process concept, classification of processes, deterministic and non deterministic processes, distribution and density functions, concept of stationary and statistical independence; First order stationary processes; Second order and wide sense stationary, N Order and strict sense stationary, time averages and periodicity, mean Ergodic processes, correlation Ergodic processes; Autocorrelation function and its properties; Cross correlation function and its properties; Covariance functions; Gaussian random processes; Poisson random process.	
Unit-V	**STOCHASTIC PROCESSES: SPECTRAL CHARACTERISTICS**
Power spectrum: Properties, relationship between power spectrum and autocorrelation function; The cross power density spectrum, properties, relationship between cross power spectrum and cross correlation function. Spectral characteristics of system response: Power density spectrum of response; cross-power density spectrums of input and output of a linear system. Introduction to white Gaussian noise process and its properties.	
Text Books:	
1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", Tata McGraw Hill, 4th Edition, 2001. 2. Scott Miller, Donald Childers, "Probability and random process", Elsevier, 2nd Edition, 2012. 3. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age Publications, 1st Edition, 2003.	
Reference Books:	
1. Athanasius Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", PHI, 4th Edition, 2002. 2. Henry Stark, John W. Woods, "Probability and Random Processes with Application to Signal Processing", Pearson Education, 3rd Edition, 2014. 3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", Oxford, 3rd Edition, 1999.	

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 probability through sets and probability and Relative frequency.	CLO 1	T1:1.1-1.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
2-5	Define sample spaces, Events and axioms of probability.	CLO 1	T1:1.3
6-7	Define Joint, Conditional, total probability, Baye‘s theorem and independent events.	CLO 1	T1: 1.4,1.5
8-10	Define random variable, conditions for a function to be a random variable.	CLO 2	T1:2.1
11-13	Define distribution and density functions definitions and their properties, standard random variables.	CLO 3	T1 : 2.2- 2.5
14-15	Explain Conditional distribution and density.	CLO 3	T1: 2.6
16-20	Explain expectation of random variable, moment’s central moments, variance and skew.	CLO 3	T1: 3.1-3.2
21-22	Demonstrate Characteristic function and Moment generating function.	CLO 3	T1:3.3
23-24	Distinguish monotonic and non monotonic transformations.	CLO 4	T1: 3.4
25-27	Define Vector random variables, joint distribution, density and their properties.	CLO 4	T1:4.1-4.4
28-32	Define point, interval conditioning, independence and central limit theorem where conditional probability has applied.	CLO 5	T1:4.5-4.7
33-35	Define Expected value, Joint moments, joint central moments and joint characteristic functions where multiple random variables have applied.	CLO 6	T1: 5.1-5.3
36-38	Explain Transformations where multiple random variables can be applied.	CLO 8	T1: 5.4
39-40	Define Covariance functions.	CLO 7	R1:5.4-5.6
41-42	Define random process, distribution and density functions, stationary and statistical independence.	CLO 11	T1:6.1-6.2
43-45	Define First order stationary and second order stationary.	CLO 10	R1:7.1-7.2
46-49	Distinguish time and statistical averages, auto and cross correlations of random process.	CLO 12	T1:6.2-6.6
50-54	Define Auto-correlation and cross correlation.	CLO 9	R3:9.4-9.6
55-56	Define Power spectrum and cross Power spectrum.	CLO 13	T1:7.1-7.5
57-58	Define Gaussian noise process and its properties.	CLO 15	R2:7.4-7.6
59-60	Derive Spectral characteristics of system response.	CLO 14	T1:8.2-8.4

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

S NO	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Elementary aspects of probability theory on random consideration.	Seminars / Guest Lectures	PO 1, PO 2	PSO 1
2	Principles of random signals and to provide tools to deal with systems involving such signals.	Seminars / NPTEL	PO 2, PO 4	PSO 2
3	Encourage students to solve problems based on random process in real time applications.	Seminars	PO 1, PO 3, PO 4	PSO 2

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL TECHNOLOGY**				
Course Code	AEE017				
Programme	B.Tech				
Semester	III	ECE			
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	Dr. V.C.Jagan Mohan, Assistant Professor, EEE Mr. A Sathish Kumar, Assistant Professor, EEE Mr. Muralidhar Nayak, Assistant Professor, EEE				

I. COURSE OVERVIEW:

This course deals with the network analysis, first order, second order series RL, RC, RLC series circuits in differential equations and laplace transformation approach, two port networks, design of filters like constant K filters, T filters, Pi filters and symmetrical attenuators like T attenuator, lattice attenuator, this course also enlightens the students with the construction, principle, classification, regulation, losses, efficiency, parallel operation and different testing methods of DC machines and single phase transformers.

II. COURSE PRE-REQUISITES:

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

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electrical Technology	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 8^{th} and 16^{th} 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
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	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	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:** 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.	-	-
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..	2	Seminars
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real world applications using optimal resources as an Entrepreneur	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyze the transient response of RL, RC and RLC circuits for DC excitation.
II	Discuss the configurations of two port networks and evaluate two port network parameters.
III	Understand the classification and design principles of filters and symmetrical attenuators.
IV	Describe the principle of operation and testing methods of DC machines and 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
CAEE007.01	CLO 1	Understand the transient response of series RL and RC circuits by differential and Laplace transform approach.	PO1	3
CAEE007.02	CLO 2	Understand the transient response of series RLC circuit by differential and Laplace transform approach.	PO2	2
CAEE007.03	CLO 3	Explain impedance parameters in two port networks and conversion of impedance parameters into all other parameters.	PO2	2
CAEE007.04	CLO 4	Explain admittance parameters in two port networks and conversion of admittance parameters into all other parameters.	PO1, PO2	3
CAEE007.05	CLO 5	Explain ABCD parameters in two port networks and conversion of ABCD parameters into all other parameters.	PO1, PO2	3
CAEE007.06	CLO 6	Explain H-parameters in two port networks and conversion of Hybrid parameters into all other parameters.	PO1, PO2	3
CAEE007.07	CLO 7	Describe the classification of different types of filters and advantages	PO1, PO3	3
CAEE007.08	CLO 8	Describe the classification of pass band and stop band filters and their characteristic impedance.	PO1, PO3	3
CAEE007.09	CLO 9	Understand the design of constant 'k' low pass filter and high pass filter and applications	PO1, PO3	3
CAEE007.10	CLO 10	Understand the m-derived t-section, band pass filter and band elimination filter and applications.	PO1, PO3	3
CAEE007.11	CLO 11	Understand the T-type attenuator, pi- type attenuator, bridged 'T' type attenuator, lattice attenuator.	PO1, PO3	3
CAEE007.12	CLO 12	Understand the working principle of DC generator, types of generators and their characteristics.	PO1, PO2, PO4	2
CAEE007.13	CLO 13	Understand the working principle of DC motor, development of torque and their characteristics to find losses and efficiency.	PO1, PO2, PO4	2
CAEE007.14	CLO 14	Understand the principle of operation of single phase transformer types and their construction.	PO1, PO2	2
CAEE007.15	CLO 15	Determine the losses and efficiency of transformer using open circuit and short circuit test data.	PO1, PO2, PO4	2
CAEE007.16	CLO 16	Apply the concept of network theorems, DC machines and AC machines to solve real time applications.	PO1, PO3	2
CAEE007.17	CLO 17	Process the knowledge and skills for employability and to succeed 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		2													
CLO 3		2													
CLO 4	3	2													
CLO 5	3	2													
CLO 6	3	2													
CLO 7	2		3												
CLO 8	2		3												
CLO 9	2		3												
CLO 10	2		3												
CLO 11	2		3												
CLO 12	3	2		3										2	
CLO 13	3	2		3										2	
CLO 14	3	2		3										2	
CLO 15	3	2		3										2	
CLO 16	2		2												
CLO 17	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	PO3
Laboratory Practices	PO4	Student Viva	-	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	TRANSIENT ANALYSIS (FIRST AND SECOND ORDER CIRCUITS)	Classes: 09
Transient response of RL, RC, and RLC Series circuits DC excitations, initial conditions, solution using differential equations approach and Laplace transform method.		

UNIT - II	TWO PORT NETWORKS	
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	**FILTERS AND SYMMETRICAL ATTENUATORS**	**Classes: 09**
Filters: Classification of Filters, Filter Networks, Classification of Pass Band and Stop Band, Characteristics Impedance in the Pass and Stop Bands, Constant-k Low Pass Filter, High Pass Filter, m- derived T-Section, Band Pass filter and Band Elimination filter. Symmetrical Attenuators: T-Type Attenuator, pi- Type Attenuator, Bridged T type Attenuator, Lattice Attenuator.		
UNIT - IV	**D.C. MACHINES**	**Classes: 09**
D.C Generators: Principle of operation of DC Machines, EMF equation, types of generators, voltage build up, critical resistance, magnetization and load characteristics of DC generators. D.C. Motors: Types of DC motors, back EMF, torque equation, characteristics, losses and efficiency, Swinburne's test, brake test on DC shunt motor, Speed control of DC shunt motor, three point starter, applications, numerical problems.		
UNIT - V	**SINGLE PHASE TRANSFORMERS**	**Classes: 09**
Principle of operation of single phase transformer, types, constructional features, phasor diagram on no load and load, equivalent circuit, losses and efficiency of transformer and regulation, OC and SC tests, (Simple problems)		
Text book:		
1. J B Gupta, "Theory and Performance of Electrical Machines", S K Kataria & Sons publications, 14th edition, 2010. 2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition 2010 3. A Chakrabarhty, ―Electric Circuits‖, Dhanipat Rai & Sons Publication 6th Edition, 2010. 4. I J Nagrath, D P Kothari, ―Electrical Machines‖, Tata Mc Graw Hill Publication, New Delhi, 2 nd Edition, 2010.		
References:		
1. V K Mehta, ―Principles of Electrical Engineering‖, S Chand Publications, Re print, 2005 2. I J Nagarath, D P Kothari, ―Theory and Problems of basic electrical engineering‖, PHI Publications, 1st Edition, 2013. 3. N C Jagan, C Lakhminaraya, ―Network Analysis‖, BS Publications 2nd Edition, 2011. 4. Sudhakar, Shyam Mohan, ―Electrical Circuits‖, Mc Graw Hill Publication, 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	Understand Concepts of basic electrical engineering	CLO 1	T2: 11.1 R3: 7.4
2-4	Understand the Transient behavior of R, L and C elements in a circuit and numerical problems on transient behavior of R, L and C circuits	CLO 1	T2: 11.1 R3: 7.4
5-7	Compute initial conditions and time response for current and voltage in first order R-L circuits and numerical problems on transient behavior of R-L circuits	CLO 1	T2: 11.2 R3: 8.2
8-10	Compute initial conditions and time response for current and voltage in first order R-C circuits and numerical problems on transient behavior of R-C circuits	CLO 1	T2: 11.3 R3: 8.3

Lecture No	Topics to be covered	CLOs	Reference
11-12	Compute initial conditions and time response for current and voltage in first order R-L-C circuits	CLO 1	T2: 11.4
13-15	Compute initial conditions and time response for current and voltage in first order R-C circuits	CLO 1	T2: 11.3 R3: 8.3
16-17	Apply the concept of transient response of first order R-L circuits using Laplace transform for solving numerical problems on transient behavior of R-L circuits	CLO 1	T2: 13.2 R3: 8.2
18-19	Apply the concept of transient response of first order R-C circuits Laplace transform for solving numerical problems on transient behavior of R-C circuits	CLO 1	T2: 13.3 R3: 7.4.4
20	Compute initial conditions for current and voltage in second order RLC circuit s	CLO 2	T2: 11.3 R3: 8.0
21	Compute initial conditions for current and voltage in second order RLC circuit s	CLO 2	T2: 13.4 R3: 8.4
22	Compute initial conditions for current and voltage in second order RLC circuits Laplace transform	CLO 2	T2: 13.5 R3: 8.4
23	Understand parameters useful for computing different networks	CLO 3	T2: 13.6 R3: 8.4
24-26	Understand Impedance parameters for two port networks and numerical problems	CLO 3	T2: 15.2 R3: 9.1
27-29	Understand Admittance parameters for two port networks and numerical problems	CLO 4	T2: 15.3 R3: 9.3
30-31	Able to compute Hybrid parameters for two port networks and numerical problems	CLO 6	T2: 15.6 R3: 9.6
32-33	Able to compute ABCD Parameters for two port networks and numerical problems	CLO 5	T2: 15.4 R3: 9.5
34-35	Understand the conversion one parameter to another parameter	CLO 4	T2: 15.8 R3: 9.7
36	Understand the conditions for Reciprocity and Symmetry	CLO 4	T2: 15.8 R3: 9.8
37-38	Understand the series, parallel and cascaded connection of two port networks and numerical problems	CLO 4	T2: 15.9 R3: 9.7
39-40	Understand image parameters for two port networks and numerical problems	CLO 6	T2: 15.10 R3: 9.9
41-42	Remember filters and its applications, and filters concept, filter networks classification, and its types	CLO7	T2: 17.1 R3: 10.1
43-44	Understand the designing of constant K-low pass filter and numerical problems	CLO9	T2: 17.6 R3: 10.8
45	Understand the designing of m-derived band pass filter	CLO 10	T2: 17.8 R3: 10.9
46	Understand the designing of m-derived band elimination filter	CLO 10	T2: 17.8 R3: 10.9
47	Understand the designing of symmetrical T-type attenuator	CLO 11	T2: 17.12 R3: 10.10
48	Understand the designing of Pi-type attenuator	CLO 11	T2: 17.13 R3: 10.11
49	Understand the designing of symmetrical lattice type attenuators	CLO 11	T2: 17.14 R3: 10.11
50	Understand the designing of bridged T - type attenuator	CLO 11	T2: 17.15 R3: 10.11
51	Understand working principle, constructional features, EMF induced in DC generator	CLO 12	T1: 4.2 R2: 2.2
52	Explain performance characteristics of DC generator	CLO 12	T1: 4.11 R2: 2.5
53	Understand working principle, constructional features, EMF induced in DC motor	CLO 13	T1: 4.3 R2: 3.2

Lecture No	Topics to be covered	CLOs	Reference
54	Understand efficiency, losses and torque developed	CLO 13	T1: 4.3 R2: 3.4
55	Explain different test conducts on DC machines	CLO 13	T1: 4.14 R2: 3.6
56	Understand working principle, constructional features and types of single phase transformer	CLO 14	T1: 1.2 R2: 4.2
57	Explain phasor diagram under different power factor conditions	CLO 15	T1: 1.6 R2: 4.4
58	Understand losses and efficiency of transformer and regulation types of single phase transformer	CLO 15	T1: 1.10 R2: 4.6
59	Explain different test conducts on single phase transformer	CLO 15	T1: 1.7 R2: 4.9

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

S. No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Digital simulation of electric circuits.	Guest Lecture	PO1, PO3	PSO2

Prepared by:

Mr. K Devender Reddy, Assistant Professor

HOD, ECE

TITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION 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. P Rajani, Assistant Professor				
Course Faculty	Dr. S Jagadha, Professor Ms. L Indira, Assistant Professor Mr. J Suresh Goud, Assistant Professor Ms. C Rachana, 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
-	-	-	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:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embeddedsystems etc., in the design and implementation of complex systems	1	Seminar
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analyticalskills to arrive cost effective and appropriate solutions.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur	-	-

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 R1:12.7
40-41	Solve by Charpit's method	CLO 23	T2:27.17

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			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 .P. Rajani, Assistant Professor, FE

HOD,ECE

IV SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRONIC CIRCUIT ANALYSIS**				
Course Code	AEC004				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	3	3	2
Chief Coordinator	Mr. J. Siva Ramakrishna, Assistant Professor				
Course Faculty	Ms. G. Mary Swarna Latha, Assistant Professor Mr. C. Srihari, Assistant Professor				

I. COURSE OVERVIEW:

The course will make them learn the basics to design and analysis of single stage and multistage amplifiers. Demonstrate the ability to analyze the frequency response of different types of amplifiers. Interpret the concept of feedback and classify various types of feedback amplifiers. Understand the principle of oscillation and design different types of oscillators. Further, design concepts of large signal (power) amplifiers are explained.

II. COURSE PRE-REQUISITES:

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

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electronic Circuit 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	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	Lab related exercises
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1	Design 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	Development of Mini Projects

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 and 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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awarness and environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real world applications using optimal resources as an Enterpreneur.	2	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Design and analyse single stage and multi stage Amplifiers
II	Analyse the frequency response of different types of Amplifiers
III	Interpret the concept of feedback and classify various types of feedback amplifiers
IV	Understand the principle of oscillation and design different types of oscillators

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
AEC004.01	CLO 1	Design various amplifier circuits using Bipolar Junction Transistors in Common	PO 1, PO2, PO12	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		Emitter, Common Base and Common Collector configurations.		
AEC004.02	CLO 2	Understand the effect of coupling and bypass capacitances on frequency response of single stage amplifiers.	PO 1,PO2, PO12	2
AEC004.03	CLO 3	Analyse various BJT amplifier circuits and their frequency responses at low, mid and High frequencies.	PO1, PO 2, PO5	2
AEC004.04	CLO 4	Apply the usefulness of amplifiers using semiconductor devices in various real time circuit making.	PO 2, PO5	2
AEC004.05	CLO 5	Understand and Remember the concept of Bipolar Junction Transistor amplifiers at high frequencies.	PO1, PO5	2
AEC004.06	CLO 6	Analyse various high frequency parameters like Conductance's, resistances and Capacitances in Hybrid-π model.	PO 2, PO12	2
AEC004.07	CLO 7	Design RC, Transformer and Direct coupling techniques used in multi stage amplifiers and also Remember the differences between them.	PO 1, PO5, PO12	2
AEC004.08	CLO 8	Analyze various multistage amplifiers such as Darlington, Cascode (Common Emitter-Common Base) etc.	PO 1, PO5	2
AEC004.09	CLO 9	Design the tuned circuits used in single tuned amplifier, double tuned amplifiers and stagger tuned amplifiers.	PO 2, PO5, PO12	2
AEC004.10	CLO 10	Understand and Remember the conditions required by an electronic circuit using Bipolar Junction Transistor to act like an Oscillator.	PO 1, PO12	2
AEC004.11	CLO 11	Design various sinusoidal Oscillators like RC Phase shift, Wien bridge, Hartley and Colpitts oscillator for various frequency ranges.	PO 1, PO2	2
AEC004.12	CLO 12	Analyse the importance of positive feedback and negative feedback in connection in electronic circuits.	PO 1, PO2, PO12	2
AEC004.13	CLO 13	Analyze various types of feedback amplifiers like voltage series, current series, current shunt and voltage shunt.	PO 1, PO2, PO12	2
AEC004.14	CLO 14	Interpret the difference between small signal amplifiers and large signal amplifiers using Bipolar Junction Transistors.	PO 5, PO12	1
AEC004.15	CLO 15	Understand types of power amplifiers based on position of Quiescent or operating point on load lines and also understand its parameters.	PO 1	3
AEC004.16	CLO 16	Design different types of power amplifiers for practical applications of desired specifications like efficiency, output power,	PO 5	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		distortion etc.		
AEC004.17	CLO 17	Acquire experience in building and troubleshooting simple electronic analog circuits using Bipolar Junction Transistor.	PO 1, PO5	2
AEC004.18	CLO 18	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 1, PO5	2

3 = High; 2 = Medium; 1 = Low

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

CLO	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	3		
CLO 2	3	2										1	3		
CLO 3	3	2			1								3		
CLO 4		2			1										
CLO 5	3				1										2
CLO 6		1										3	3		
CLO 7	3				1							1	3		
CLO 8	1				1								3		
CLO 9		2			2							1	3		
CLO 10	3											1	3		
CLO 11	3	2													
CLO 12	2	3										2	3		2
CLO 13	3	2										1			
CLO 14					1							1	3		2
CLO 15	3														
CLO 16					3								3		2
CLO 17	2				1								3		2
CLO 18	3				1								3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 5	SEE Exams	PO 1, PO 2, PO 5,PO 12	Assignments	PO 1	Seminars	PO 2
Laboratory Practices	PO 1	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

SINGLE STAGE AMPLIFIERS AND FREQUENCY RESPONSE :

Classification of amplifiers, overview of analysis of a transistor amplifier circuit using h-parameter, Millers theorem and its dual, design of Single stage RC coupled amplifier using bipolar junction transistor, low frequency response of bipolar junction transistor amplifier, analysis at low frequency, effect of coupling and bypass capacitor.

UNIT – II

HIGH FREQUENCY RESPONSE OF AMPLIFIER :

The hybrid-π common emitter transistor model, hybrid π conductance and capacitance, effect of coupling and bypass capacitors, common emitter short circuit current gain, current gain with resistive load, alpha, beta cut-off frequencies, gain bandwidth product ,emitter follower at high frequencies.

UNIT – III

MULTI STAGE AMPLIFIERS AND TUNED AMPLIFIERS :

Multistage amplifier: Different coupling schemes used in amplifiers, RC coupled amplifiers, transformer coupled amplifiers and direct coupled amplifiers, analysis of cascaded RC coupled bipolar junction transistor amplifiers, cascode amplifiers, Darlington pair.

Tuned amplifiers: introduction, Q - factor, small signal tuned amplifier, effect of cascading single tuned amplifiers on bandwidth, stagger tuned amplifiers, stability of tuned amplifiers.

UNIT – IV

FEEDBACK AMPLIFIERS AND OSCILLATORS :

Feedback amplifiers: Concept of feedback, classification of feedback amplifiers, general characteristics of negative feedback amplifiers, analysis of voltage series, voltage shunt, current series and current shunt feedback configurations, problems;

Oscillators: Classification of oscillator, conditions for oscillations, RC phase shift oscillator, generalized analysis of LC oscillations, Hartley and Colpitts oscillators, Wien - bridge and crystal oscillators, stability of oscillators.

UNIT – V

LARGE SIGNAL AMPLIFIERS:

Classification, class A large signal amplifiers, transformer coupled class A audio power amplifiers, efficiency of class A amplifier, class B amplifier, efficiency of class B amplifier,

class B push-pull amplifier, complementary symmetry class B push-pull amplifier, distortion in power amplifiers, thermal stability and heat sinks.

TEXT BOOKS:

1	Jacob Millman , Christor C Halkias, ―Integrated Electronics‖, Tata McGraw Hill, 1st Edition, 2008.
2	Sedra A.S., K.C. Smith, ―Micro Electronic Circuits‖, Oxford University Press, 6th Edition, 2013.
3	Donald A Neamen, ― Electronic Circuits Analysis and Design‖ , Tata McGraw Hill , 3 rd Edition, 2007.

REFERENCES:

1	David A. Bell ―Electronic Devices & Circuits‖ 5th Edition,. Oxford university press, 7 th Edition, 2009
2	S.Salivahna, N. Suresh kumar, ―Electronic circuit analysis‖, McGraw-Hill Education, 1 st Edition, 2011.
3	Robert L. Boylestad, Louis Nashelsky, ―Electronic Devices and Circuits Theory‖, Pearson education, 9 th Edition, 2008
4	K. Lal Kishore, ―Electronic Circuit Analysis‖, BS Publications,1st Edition, 2004.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1-3	Describe Classification of amplifiers, overview of analysis of a transistor amplifier circuit using h-parameter.	CLO 1, CLO 2	T1:22.5 R1:2.3
4-6	Understand Millers theorem and its dual, design of Single stage RC coupled amplifier using bipolar junction transistor	CLO 2	T1:22.5 R1:2.4
7-9	Recall low frequency response of bipolar junction transistor amplifier, analysis at low frequency, effect of coupling and bypass capacitor..	CLO 2	T1:22.6 R1:2.6
10-14	Describe The hybrid-π common emitter transistor model, hybrid π conductance and capacitance	CLO 3	T1:22.7 R1:4.4
15-16	Understand the effect of coupling and bypass capacitors.	CLO 2	T1:22.7 R1:4.10
17-20	Describe common emitter short circuit current gain, current gain with resistive load, alpha, beta cut-off frequencies.	CLO 5, CLO 6	T1:22.8 R1:4.15
21-23	Describe gain bandwidth product ,emitter follower at high frequencies	CLO 6	T1:22.9 R1:5.4
24-27	Understand multistage amplifier: Different coupling schemes used in amplifiers, RC coupled amplifiers, transformer coupled amplifiers and direct coupled amplifiers	CLO 7, CLO 8	T1:22.9 R1:5.8
28-30	Analysis of cascaded RC coupled bipolar junction transistor amplifiers, cascode amplifiers, Darlington pair..	CLO 7	T1:23.10 R1:6.8
31-34	Describe tuned amplifiers introduction, Q - factor, small signal tuned amplifier, effect of cascading single tuned amplifiers on bandwidth, stagger tuned amplifiers, stability of tuned amplifiers.	CLO 9	T1:23.10 R1:6.13
35-38	Identify feedback amplifiers: Concept of feedback, classification of feedback amplifiers, general characteristics of negative feedback amplifiers, analysis of voltage series, voltage shunt	CLO 10, CLO 11	T1:23.9 R1:7.5
39-41	Distinguish current series and current shunt feedback configurations, problem	CLO 12	T1:23.10 R1:7.5
41-43	Understand oscillators: Classification of oscillator, conditions for oscillations, RC phase shift oscillator	CLO 10	T1:23.10 R1:8.1
44-46	Describe generalized analysis of LC oscillations, Hartley and Colpitts oscillators, Wien - bridge and crystal oscillators, stability of oscillators.	CLO 12	T1:23.1 R1:9.2
47-50	Explain efficiency of class A amplifier, class B amplifier, efficiency of class B amplifier, class B push-pull amplifier	CLO 13, CLO 14	T1:23.1 R1:9.4

Lecture No	Topics to be covered	CLOs	Reference
51-60	Describe complementary symmetry class B push-pull amplifier, distortion in power amplifiers, thermal stability and heat sinks	CLO 15	T1:23.1 R1:9.9

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 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 5	PSO 3

Prepared by:
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HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ANALOG COMMUNICATIONS**				
Course Code	**AEC005**				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms.L.Shruthi, Assistant Professor, ECE				
Course Faculty	Dr.P.Munisamy, Professor, ECE Ms.G.Ajitha, Assistant Professor, ECE Ms.P.Saritha, Assistant Professor, ECE Ms.L.Shruthi, Assistant Professor, ECE				

I. COURSE OVERVIEW:

This subject is concerned with the theory of systems for the conveyance of information. The transmission of information-bearing signal over a band pass communication channel, such as telephone line or a satellite channel usually requires a shift of the range of frequencies contained in the signal to another frequency range suitable for transmission. A shift in the signal frequency range is accomplished by modulation. This subject introduces the definition of modulation, need of modulation, types of modulation- AM, PM and FM, Various types of AM, spectra of AM, bandwidth requirements, Generation of AM & DSB-SC, detection of AM & DSB-SC, and power relations.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHS011	III	Mathematical Transform Techniques

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Analog Communications	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.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab related exercises
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Design Exercises.

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	Seminar
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.	2	Lab related exercises
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop skills for analyzing different type's signals in terms of their properties such as energy, power, and correlation and apply for analysis of linear time invariant systems.
II	Analyze various techniques of generation and detection of amplitude modulation, frequency modulation, and phase modulation signals.
III	Differentiate the performance of AM, FM, PM systems in terms of Power, Bandwidth and Signal-to-Noise Ratio.
IV	The major objectives of this subject are for the students to establish a firm foundation for the understanding of telecommunication systems and evaluate analog Communication system in terms of the complexity of the transmitters and receivers.

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
AEC005.01	CLO 1	Discuss the modeling of idealized signals and analyze the periodic signals with the help of Fourier Transform..	PO 1, PO 2	3
AEC005.02	CLO 2	Discuss about the system and their classifications based on properties and derive the transfer function of linear time variant and invariant system.	PO 1, PO 2	3
AEC005.03	CLO 3	Understand and analyze the concept of convolution and correlation of signals.	PO 1, PO 2	3
AEC005.04	CLO 4	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.	PO 2	2
AEC005.05	CLO 5	Understand the time domain, frequency domain description and power relations of amplitude modulation, various techniques of generation and detection of AM. Noise in AM.	PO 1, PO 2	3
AEC005.06	CLO 6	Analyze the time domain, frequency domain description of Double Side Band Suppressed Carrier (DSB SC), various generation techniques and detection techniques of DSB SC, Noise in DSB SC.	PO 1, PO 2	3
AEC005.07	CLO 7	Understand the time domain, frequency domain description of amplitude modulation single side band modulated wave, various techniques of generation and detection of SSB, Noise in SSB SC.	PO 2	3
AEC005.08	CLO 8	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.	PO 1	3
AEC005.09	CLO 9	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems.	PO 2	3
AEC005.10	CLO 10	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.	PO 1	3
AEC005.11	CLO 11	Understand the concepts of narrow band frequency modulation, wide band frequency modulation and pre emphasis and de emphasis circuits in FM.	PO 1	3
AEC005.12	CLO 12	Discuss the generation of frequency modulation waves by direct method and indirect method and detection methods like balanced frequency discriminator, foster seeley discriminator, phase locked loop etc.,	PO 1	3
AEC005.13	CLO 13	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.	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
AEC005.14	CLO 14	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.	PO 1, PO 2	3
AEC005.15	CLO 15	Understand the concept of sampling and its types, and analyze the graphical and analytical proof for band limited signals.	PO 2	3
AEC005.16	CLO 16	Apply the concept of analog communication to understand and analyze real time applications.	PO 4	2
AEC005.17	CLO 17	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											3	2	
CLO 2	3	3											3	2	
CLO 3	3	3											3	2	
CLO 4	2														
CLO 5	3	3											3	2	
CLO 6	3	3											3	2	
CLO 7		3											3	2	
CLO 8	3														
CLO 9		3													
CLO 10	3												3	2	
CLO 11	3														
CLO 12	3														
CLO 13	3												3	2	
CLO 14	3	3													
CLO 15		3													
CLO 16					2										

CLO 17					2										

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 5	SEE Exams	PO 1, PO 2, PO 5	Assignments	PO 1	Seminars	PO 2
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	**SIGNAL ANALYSIS AND LTI SYSTEMS**
Classification of signals and study of Fourier transforms for standard signals, definition of signal bandwidth; Systems: Definition of system, classification of systems based on properties, linear time invariant system , impulse, step, sinusoidal response of a linear time invariant system, transfer function of a linear time invariant system, distortion less transmission through a linear time invariant system; system bandwidth; Convolution and correlation of signals: Concept of convolution, graphical representation of convolution, properties of convolution; Cross correlation ,auto correlation functions and their properties, comparison between correlation and convolution	
Unit-II	**AMPLITUDE AND DOUBLE SIDE BAND SUPPRESSED CARRIER MODULATION**
Introduction to communication system, need for modulation, frequency division multiplexing; Amplitude modulation, definition; Time domain and frequency domain description, single tone modulation, power relations in amplitude modulation waves; Generation of amplitude modulation wave using ,square law and switching modulators; Detection of amplitude modulation waves using square law and envelope detectors; Double side band modulation: Double side band suppressed carrier time domain and frequency domain description; Generation of double side band suppressed carrier waves using balanced and ring modulators; Coherent detection of double side band suppressed carrier modulated waves; Costas loop; Noise in amplitude modulation, noise in double side band suppressed carrier.	
Unit-III	**SINGLE SIDE BAND MODULATION AND VESTIGIAL SIDE BAND MODULATION**
Frequency domain description, frequency discrimination method for generation of amplitude modulation single side band modulated wave; time domain description; Phase discrimination method for generating amplitude modulation single side band modulated waves; Demodulation of single side band waves. Noise in single side band suppressed carrier; Vestigial side band modulation: Frequency description, generation of vestigial side band modulated wave; Time domain description; Envelope detection of a vestigial side band modulation wave pulse carrier; Comparison of amplitude modulation techniques; applications of different amplitude modulation systems.	
Unit-IV	**ANGLE MODULATION**
Basic concepts, frequency modulation: Single tone frequency modulation, spectrum analysis of sinusoidal frequency modulation wave, narrow band frequency modulation, wide band frequency modulation, transmission bandwidth of frequency modulation wave, phase modulation, comparison of frequency modulation and phase modulation; Generation of frequency modulation waves, direct frequency modulation and indirect frequency modulation, detection of frequency modulation waves: Balanced frequency discriminator, Foster Seeley discriminator, ratio detector, zero crossing detector,	

phase locked loop, comparison of frequency modulation and amplitude modulation; Noise in angle modulation system, threshold effect in angle modulation system, pre-emphasis and de-emphasis.	
Unit-V	**RECEIVERS AND SAMPLING THEORM**
Receivers: Introduction, tuned radio frequency receiver, super heterodyne receiver, radio frequency amplifier, mixer, local oscillator, intermediate frequency amplifier, automatic gain control; Receiver characteristics: Sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency, fidelity; Frequency modulation receiver, amplitude limiting, automatic frequency control, comparison with amplitude modulation receiver; Sampling: Sampling theorem, graphical and analytical proof for band limited signals, types of sampling, reconstruction of signal from its samples.	
Text Books:	
1. B.P. Lahti, "Signals, Systems and Communications", BS Publications, 5th Edition, 2009. 2. S. S. Haykin, "Communication Systems", Wiley Eastern, 2nd Edition, 2006. 3. Taub, Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 4th Edition, 2013	
Reference Books:	
1. B.P. Lathi, "Communication Systems‖, BS Publication", 2nd Edition, 2006. 2. John G. Proakis, Masond, Salehi, "Fundamentals of Communication Systems", PEA, 1st Edition, 2006 3. George Kennedy, Bernard Davis, "Electronics and Communication System", Tata McGraw Hill , 5th 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
1-2	Understand the signal analysis.	CLO 1	T3: 1.2 to 1.2.3
3-7	Understand the Fourier transform and its properties.	CLO 1	T3 :1.2.4 to 1.4.8
8-11	Classification of the linear systems.	CLO 2	TI:1.1 to 2.5
12-14	Understand the concept of convolution and correlation.	CLO 3	TI :1.1 to 2.5
12-14	Explain the communication system and need for modulation.	CLO 4	T3:1.1 to 1.1.6
15-17	Study the amplitude modulation systems and compare DSBSC and AM.	CLO 5	T3 :3.2 to 3.3.4
18-19	Study the generation and demodulation techniques of AM and DSBSC	CLO 5	T3 :3.2 to 3.3.4
20-21	Analyze the calculation of power and noise.	CLO 6	R1 :3.3, T3- 8.3 to 8.4
22-23	Understand the single side band modulation	CLO 7	T3 :3.4
24-28	Explain the generation of SSB-SC	CLO 8	T3 :3.4.1 to3.4.2, T3 –8.2.
28-32	Study the demodulation of SSB-SC and Power relations.	CLO 8	T3 :3.4.1 to3.4.2, T3 –8.2.
33-35	Understand generation & detection of VSB	CLO 9	T3 :3.5.1 to 3.5.2
36-38	Analyze the importance of the angle modulation.	CLO 10	T3 : 4.1 to 4.3.4
39	Understand the concepts of narrow band frequency modulation, wide band frequency modulation	CLO 11	T3 :4.4 to 4.4.5, T2 – 2.14
40-43	Understand the of generation frequency modulation.	CLO 12	T3 :4.4 to 4.4.5, T2 – 2.14

Lecture No	Topics to be covered	CLOs	Reference
44-45	Study the detection of frequency modulation	CLO 12	T3 :4.4 to 4.4.5, T2 – 2.14
46-48	Analyze the importance of pre emphasis and de emphasis circuits in FM.	CLO 11	T3 :9.1 to 9.5.2
49- 50	Understand the importance of receivers in broadcasting system.	CLO 13	R3 :6.1
51-54	Analyze the characteristics of the receiver	CLO 14	R3:6.2 to 6.4.6
55-60	Understand the sampling operation is basic to digital signal processing and digital communications.	CLO 15	T2:6.2 to 6.3

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

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Design of FM radio using NI USRP 2901.	Seminars	PO 1	PSO 1
2	Simulation of analog modulation and demodulation schemes using NI LABVIEW.	Seminars / NPTEL	PO 5	PSO 1
3	Observe the frequency domain representation of analog modulation waveforms using spectrum analyzer.	NPTEL	PO 2	PSO 1
4	Observe the receiver frequency domain representation using spectrum analyzer.	Seminars	PO 2	PSO 1

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**PULSE AND DIGITAL CIRCUITS**				
Course Code	AEC006				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. B Naresh, Assistant Professor				
Course Faculty	Ms. J Swetha, Assistant professor Ms. N Anusha, Assistant professor Mr. S Lakshmana Chary, Assistant professor Mr. B Naresh, Assistant professor				

I. COURSE OVERVIEW:

The course will make them learn the basic concepts of linear and non linear wave shaping circuits with their design and applications in detail. It provides the analysis and applications of different multivibrator circuits and they will be able to design multivibrator circuits. This course intended to describe the basic operating principle, sampling gates and time base generator circuits. They learn the applications of sweep circuits and multivibrators in synchronization methods, and analysis of logic families. It provides a platform for advanced courses like Linear Integrated Circuits and VLSI design. Greater Emphasis is placed on the use of multivibrators and logic families.

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
Pulse and Digital 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	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.	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	**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.	1	Seminar
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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Be proficient in the use of linear and non linear wave shaping circuits for sinusoidal, pulse and ramp inputs.
II	Construct various multivibrators using transistors, and design sweep circuits and sampling gates.
III	Evaluate the methods to achieve frequency synchronisation and division using uni-junction transistors, multivibrators and symmetric circuits.
IV	Realize logic gates using diodes and transistors and distinguish between various logic families.

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
AEC006.01	CLO 1	Understand the response of high pass RC and low pass RC circuits to different non sinusoidal inputs with different time constants and identify RC circuit's applications.	PO 1 PO 2	2
AEC006.02	CLO 2	Understand the various clipper circuits using switching components like diodes, transistors and design various clipper circuits with and without reference voltages.	PO 1 PO 2	2
AEC006.03	CLO 3	Formulate clamping circuit theorem and design practical clamping circuits by understanding the different diode clamper circuits.	PO 1	3
AEC006.04	CLO 4	Illustrate the Bistable multi with various triggering methods and apply design procedures to different bistable multivibrator circuits.	PO 5	2
AEC006.05	CLO 5	Evaluate triggering points, hysteresis width of Schmitt trigger circuit and also design practical Schmitt trigger circuit.	PO 2	2
AEC006.06	CLO 6	Analyze the Monostable, Astable multivibrator circuits with applications and evaluate time, frequency parameters.	PO 5	3
AEC006.07	CLO 7	Understand the different types of sampling gates with operating principles using diodes, transistors and also evaluate various parameters of sampling gates.	PO 1	3
AEC006.08	CLO 8	Implement different methods to generate time base waveforms using various sweep circuits like Bootstrap and Miller circuits.	PO 1	2
AEC006.09	CLO 9	Apply the various time base generator circuits in applications like cathode ray oscilloscope and television circuits.	PO 1	2
AEC006.10	CLO 10	Understand the concept of frequency division, synchronization and pulse synchronization of various Relaxation circuits.	PO 1	3
AEC006.11	CLO 11	Analyze the frequency division with sweep circuits and various relaxation circuits like Astable multi, Monostable multi circuits.	PO 1	1
AEC006.12	CLO 12	Implement the synchronization of different sweep circuits with symmetrical signals and sinusoidal signals.	PO 5	1
AEC006.13	CLO 13	Understand and analyze the different bipolar, unipolar logic families like DTL, RTL, DCTL, TTL, MOS and CMOS.	PO 1 PO 12	2
AEC006.14	CLO 14	Understand the specifications of logic families such as propagation delay, fan in, fan out, noise immunity and compare various logic families.	PO 1	3
AEC006.15	CLO 15	Understand and analyze the tri state logic and interfacing of transistor transistor logic and complementary metal oxide semi conductor logic families.	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	POs												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		
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											3			
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	WAVE SHAPING CIRCUITS
Linear wave shaping circuits: High pass RC and low pass RC circuits, response to impulse and pulse inputs with different time constants, high pass RC circuit as a differentiator, low pass RC circuit as an integrator, switching characteristics of diode; Non-linear wave shaping circuits: Clipping circuits, diode clippers, shunt clippers, series clippers, clipping at two independent levels; Clamping circuits: Clamping theorem.	
Unit-II	**MULTIVIBRATORS**
Multivibrators: Introduction, classification; Bistable multivibrator: Fixed bias, self bias, unsymmetrical triggering, symmetrical triggering; Schmitt trigger: Upper trigger point, lower trigger point, hysteresis, applications of Schmitt trigger; Monostable multivibrator: Collector coupled, triggering of monostable Multivibrator. Astable multivibrator: Collector coupled, voltage to frequency converter.	
Unit-III	**SAMPLING GATES AND TIME BASE GENERATORS**
Sampling gates: basic operating principle of sampling gate, uni and bi directional sampling gates. Time base generators: General features of a time base signal; Methods of generating a time base waveform: Exponential sweep circuits, sweep circuit using uni junction transistor, Miller sweep circuit and Bootstrap sweep circuit. Bootstrap sweep circuit.	
Unit-IV	**SYNCHRONIZATION AND FREQUENCY DIVISION**
Synchronization and frequency division: Pulse synchronization of relaxation devices, frequency division with sweep circuits, other astable relaxation circuits, synchronization of astable multivibrator, monostable relaxation circuits as dividers, stability of relaxation dividers; Synchronization of a sweep circuit with symmetrical signals: Sinusoidal synchronization signals and sine wave frequency division with a sweep circuit.	
Unit-V	**DIGITAL LOGIC FAMILIES**
Bipolar logic families: RTL, DTL, DCTL, HTL, TTL, ECL, MOS, and CMOS logic families, tristate logic; Interfacing of CMOS and TTL families.	
Text Books:	
1. Anand Kumar, "Pulse and Digital Circuits, PHI learning", 2nd Edition,2005. 2. David A.Bell,"Solid State Pulse Circuits",PHI learing,4th Edition. 3. David J.Comer,"Digital Logic State Machine Design",Oxford UniversityPress,3rd Edition,2008.	
Reference Books:	
1. Ronald J.Tocci,"Fundamentals of Pulse and Digital Circuits", PHI learning,3rd Edition,2008. 2. Millman J.Taub, "Pulse,Digital and Switching Waveforms",Tata McGrawHill,2nd Edition ,2007.	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1-7	Understand the response of high pass RC and low pass RC, circuits with step, pulse and square inputs.	CLO 1	T1-1.1 to 1.4
8	Understand the diode switching times.	CLO 2	T1-3.1 to 3.3
9-12	Understand the clipper circuits with reference levels using diode.	CLO 2	T1-2.1
13-16	Understand the diode clamper circuits and formulate clamping circuit theorem.	CLO 3	T1–2.2 R2-8.1
17-20	Discuss the Bistable multi with triggering methods.	CLO 4	T1-4.1 to 4.9
21-24	Evaluate triggering points, hysteresis width of Schmitt trigger circuit.	CLO 5	T1- 4.10

Lecture No	Topics to be covered	CLOs	Reference
25-28	Understand the Monostable multi circuits with applications.	CLO 6	T1-4.11 to 4.14
29-31	Understand the Astable multi circuits and evaluate time, frequency parameters.	CLO 6	T1-4.15 to 4.17
32-36	Discuss the different types of sampling gates using diodes, transistors.	CLO 7	T1-7.1 to 7.9 R2-17.1
37-41	Illustrate the different methods to generate time base waveforms using sweep circuits.	CLO 8	T1-5.1 to 5.7
42-43	Understand the bootstrap and miller sweep circuits and applications.	CLO 8 CLO 9	T1-5.8 to 5.11
44-46	Understand the concept of frequency division and synchronization.	CLO 10	T1-6.1 to 6.2 R2-19.1
47-49	Understand the frequency division with sweep circuits and various relaxation circuits.	CLO 11	T1-6.3 to 6.5
50-51	Illustrate the synchronization of different sweep circuits with symmetrical signals and sinusoidal signals	CLO 12	T1-6.6
52-55	Understand and analyze the different bipolar logic families.	CLO 13	T1-9.3 to 9.7
56-57	Explain the specifications of logic families, and compare various logic families.	CLO 14	T1-9.1
58-60	Understand and analyze the tri state logic and interfacing of logic families.	CLO 15	T1-9.3

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

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Design oscillators using multivirator.	Seminars	PO 1	PSO 1
2	Analyze how the frequency synchronization is applicable 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

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ELECTRONICS AND COMMUNICATION AND ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTROMAGNETIC THEORY ANDTRANSMISSION LINES**				
Course Code	AEC007				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr.S.Peddakrishna,Professor				
Course Faculty	Dr.P.Ashok Babu,Professor & HOD Mrs.A.Usha Rani,Assistant Professor Mr.Murali Krishna, Assistant Professor				

I. COURSE OVERVIEW:

The course will make them learn the basic concepts of electric field, magnetic field and their behavior in 3D-Coordinate systems. Starting from electrostatics and magneto statics they will learn to understand basic law's that has a specified relation to derive Maxwell's equations. They will be able to derive electromagnetic wave equations by using Maxwell's equations. They will learn to understand the behavior of transmission lines and their applications to wave propagation. This course provides a platform for advanced courses like antennas and propagation, microwave engineering. Greater Emphasis is placed to understand the waves travelling through co-axial cables, optical fibre cables.

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
Electromagnetic Theory and Transmission Lines	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, 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	Exercises
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Development of Mini Projects

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.	2	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an entrepreneur.	1	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the 3D vector co-ordinate systems and electromagnetic field concepts.
II	Analyze the importance of Maxwell's equations in electromagnetic theory and wave propagation.
III	Study the propagation characteristics of electromagnetic waves at boundary.
IV	Demonstrate the ability to compute various parameters for transmission lines using smith chart and classical theory.

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
AEC007.01	CLO 1	Understand the different types of 3D co-ordinate systems, scalars and vectors, physical significance of divergence, curl and gradient.	PO 1	3
AEC007.02	CLO 2	Illustrate the concepts of coloumb's law and gauss's law to different charge distributions	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
		like point charge, line charge, surface charge and volume charge. Analyze its applications.		
AEC007.03	CLO 3	Understand the applications of Laplace's and Poisson's equations to solve problems on capacitance of different charge distributions.	PO1, PO 2, PO 4	2
AEC007.04	CLO 4	Illustrate the physical significance of Biot-Savart's law and Ampere's Circuit law for different current distributions and analyze its applications.	PO 2, PO 4	2
AEC007.05	CLO 5	Evaluate the physical interpretation of Maxwell's equations and applications for various fields like antennas and wave guides.	PO 1, PO 4	2
AEC007.06	CLO 6	Derive the boundary conditions between different media like dielectric to conductor, conductor to free space.	PO 2	2
AEC007.07	CLO 7	Analyze and apply the Maxwell's equations to derive electromagnetic wave equations for different media.	PO 2, PO4	2
AEC007.08	CLO 8	Understand the behavior of electromagnetic waves incident on the interface between two different media.	PO 1	2
AEC007.09	CLO 9	Formulate and analyze problems in different media such as lossy, lossless with boundaries using uniform plane waves.	PO 2	2
AEC007.10	CLO 10	Understand the significance of transmission lines and its types, derive their primary constants and secondary constants.	PO 1	3
AEC007.11	CLO 11	Understand the concept of attenuation, loading, and analyze the loading technique to the transmission lines.	PO 1, PO 2	2
AEC007.12	CLO 12	Understand the design of various transmission lines with respect to distortion, loss, impedance matching, and VSWR and reflection coefficient.	PO 1	2
AEC007.13	CLO 13	Summarize the impedance transformation for different lengths such as $\lambda/4,\lambda/2,\lambda/8$ transmission lines.	PO 2	2
AEC007.14	CLO 14	Understand the design of ultra high frequency transmission lines for different applications by using single and double stub matching techniques.	PO 1	2
AEC007.15	CLO 15	Formulate and analyze the smith chart to estimate impedance, VSWR, reflection coefficient, OC and SC lines.	PO 2	2
AEC007.16	CLO 16	Apply the concept of electromagnetic fields to understand and analyze land mobile communications.	PO 1,PO 2	2
AEC007.17	CLO 17	Acquire the knowledge and develop capability to succeed 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		
CLO 2	2	2											1		
CLO 3	3	1		1									1		
CLO 4		2		1										2	
CLO 5	1			2											2
CLO 6		2											3		
CLO 7		2		1									1		
CLO 8	2												1		
CLO 9		2											2		
CLO 10	3												1		
CLO 11	2	2													
CLO 12	2												2		1
CLO 13		2													
CLO 14	2												1		2
CLO 15		2													
CLO 16	2	2											3		1
CLO 17	2			2									1		2

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	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	ELECTROSTATICS
Coulomb's law, electric field intensity, fields due to different charge distributions; Electric flux density, gauss law and its applications; Scalar electric potential; Energy density, illustrative problems; Convection and conduction currents; Dielectric constant, isotropic and homogeneous dielectrics; Continuity equation and relaxation time, conductivity, power absorbed in conductor, Poisson's and laplace's equations; Capacitance; Method of images; Illustrative problems.	
Unit-II	**MAGNETOSTATICS**
Magneto statics: Biot-savart law; Ampere's circuital law and applications; Magnetic flux density; Magnetic scalar and vector potentials; Forces due to magnetic fields; Ampere's force law; Magnetic boundary conditions; Inductances and magnetic energy; Illustrative problems. Maxwell's Equations (Time Varying Fields**):** Faraday's law; Inconsistency of ampere's law for Time Varying Fields and definition for Displacement Current density; Maxwell's equations in differential form, integral form and word Statements; Conductors and dielectrics-characterization; Loss Tangent	
Unit-III	**UNIFRORM PLANE WAVES**
Uniform Plane Waves: Wave equations for conducting and perfect dielectric media; Relation between E and H; Wave propagation in lossless and conducting media; Intrinsic Impedance; Skin Depth; Polarization, Illustrative Problems. Reflection/Refraction of Plane Waves: Reflection and refraction at normal incidence, reflection and refraction at oblique incidence; Standing waves; Brewster angle, critical Angle, total internal reflection, surface impedance; Poynting vector& poynting theorem-applications; Power Loss in plane conductor; Illustrative problems.	
Unit-IV	**TRANSMISSION LINES CHARACTERISTICS**
Transmission lines characteristics: Types; Transmission line Parameters; Transmission line Equations; Characteristic Impedance, propagation constant; Phase and group velocities; Infinite line concepts, Loss less /low loss transmission line characterization; condition for distortion less and minimum attenuation in transmission lines; Loading- types of loading; Illustrative problems.	
Unit-V	**UHF TRANSMISSION LINES AND APPLICATIONS**
UHF Transmission Lines& Applications: Input impedance relations; SC and OC Lines; Reflection coefficient, VSWR; UHF Lines as Circuit Elements, λ/4, λ/2 and λ/8 Lines- impedance transformations, significance of Zmin and Zmax ; Smith chart-configuration and applications; Single and double stub matching; Illustrative problems.	
Text Books:	
1. Matthew N.O. Sadiku, - Elements of Electromagnetics, Oxford University Press, 4th Edition. 2. E.C. Jordan and K.G. Balmain, – Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2004.2. 3. Umesh Sinha, Satya Prakasan, - Transmission Lines and Networks, , 2nd Edition, 2001.	
Reference Books:	
1. Nathan Ida - Engineering Electromagnetic, Springer India Pvt. Ltd, 2nd Edition, 2005. 2. William H. Hayt Jr. and John A. Buck, - Engineering Electromagnetic, TMH, 7th Edition, 2016. 3. G.Sashibushana Rao -Electromagnetic Field theory and Transmission Lines, Wiley India, 2013. 4. John D. Ryder,-Networks, Lines and Fields, PHI, 2nd Edition, 1999.	

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	Understand the different types of 3D co-ordinate systems, curl and gradient.	CLO 1, CLO 2	T1-1.1 to 1.4 T1-2.1 to 2.5 R2-1.8 to1.9

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
4-6	Illustrate the concepts of coloumb's law and gauss's law to different charge.	CLO 2	T1-3.1 to 3.8 R2- 1.8 to 1.9
7-9	Understand the applications of Laplace's and Poisson's.	CLO 2	T1-4.3 to 4.4 ,4.6,4.7 R2-7.1
10-14	Illustrate the Biot-Savart's law and Ampere's Circuit law for different current distributions.	CLO 3	T1-6.1 to 6.7
15-16	Derive the boundary conditions between different media like dielectric to conductor, conductor to free space.	CLO 2	T1-7.1 to 7.2, 4.8,7.6,7.8
17-20	Evaluate the physical interpretation of Maxwell's equations.	CLO 5, CLO 6	T1-8.2 to 8.5
21-23	Derive electromagnetic wave equations for different media.	CLO 6	T1-9.2 to 9.3
24-27	Understand the EM waves incident on the interface between two different media.	CLO 7, CLO 8	T1- 9.4
28-30	Formulate and analyze problems in different media such as lossy, lossless with boundaries using uniform plane waves.	CLO 7	T1-9.7 to 9.8
31-34	Formulate and analyze problems in different media using uniform plane waves.	CLO 9	T1-9.5
35-38	Understand the behavior of electromagnetic waves.	CLO 10, CLO 11	T1- 9.6 R2-10.6
39-41	Understand the significance of transmission lines and its types.	CLO 12	T3-1.1 to1.8
41-43	Understand the design of various transmission lines.	CLO 10	T3 - 1.9 to 1.17
44-46	Understand the concept of attenuation, loading.	CLO 12	T3-5.4 to 5.10
47-50	Formulate and analyze the smith chart to estimate OC and SC lines.	CLO 13, CLO 14	T3 -3.5 to3.8
51-55	Summarize the impedance transformation for different lengths transmission lines.	CLO 15	T3-2.1 to 7.2
56-60	Understand the design of transmission lines for different applications by using stub matching technique.	CLO 15	T3-6.6 to 6.8, T1-6.12to 6.14

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	3D co-ordinate systems and classifications	Seminars	PO 1	PSO 1
2	Waveguides and its types, modes, applications	Seminars / NPTEL	PO 4	PSO 1
3	Microchip transmission lines	Guest lectures	PO 2	PSO 1

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**CONTROL SYSTEMS**				
Course Code	AEE009				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. Kaul, Professor				
Course Faculty	Dr. K Nehru, Professor Mr. N Nagaraju, Assistant Professor Mr. M L RaviTeja, Assistant Professor				

I. COURSE OVERVIEW:

The course will make them learn the basic fundamentals of modeling and control of linear time invariant systems. Component modeling and servomechanisms which play major part in speed and position control systems. Starting from a problem statement they will learn to design a dynamic control system for a given specification. They will be able to analyze open loop and closed loop systems in time and frequency domains. They will learn to design different types of controllers and their simulation techniques using available software platforms.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS011	III	Mathematical Transform Techniques	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 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" are drawn from each unit of the syllabus. 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 theoretical concepts and derivation capabilities.
50 %	To test the analytical and problem solving skills.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks of which 25 marks for problem solving and 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
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	Lectures, 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.	2	One minute videos
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Lectures

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:** The 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.	2	Seminars
PSO 2	**Problem-Solving Skills:** The 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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Organize modelling and analysis of electrical and mechanical systems.
II	Evaluate systems by applying block diagrams, signal flow graphs to study the time response.
III	Demonstrate the analytical and graphical techniques to study the stability to design the control system.
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	Understand the concept of open loop and closed loop systems with real time examples.	PO 1	3
AEE009.02	CLO 2	Derive the mathematical model for electrical and mechanical systems using differential equations.	PO 1	2
AEE009.03	CLO 3	Identify the equivalent model for electrical and mechanical systems using force voltage and force current analogy.	PO 1, PO 12	2
AEE009.04	CLO 4	Discuss the block diagram reduction techniques and effect of feedback in open loop and closed loop systems.	PO 3	3
AEE009.05	CLO 5	Evaluate the transfer function of signal flow graphs using Mason's gain formula and apply standard test signals for transient analysis.	PO 3	2
AEE009.06	CLO 6	Evaluate steady state errors and error constants for first and second order systems by using step, ramp and impulse signals.	PO 1, PO 9	1
AEE009.07	CLO 7	Apply Routh Hurwitz stability criterion to find the necessary and sufficient conditions for stability.	PO 3	3
AEE009.08	CLO 8	Analyze and apply the design procedures of root locus for stability and discuss the effect of poles and zeros on stability.	PO 3	2
AEE009.09	CLO 9	Implement controllers using proportional integral, proportional derivative and proportional integral derivative controllers.	PO 1, PO 12	2
AEE009.10	CLO 10	Understand the concept of frequency domain and discuss the importance of resonant frequency, resonant peak and bandwidth on stability.	PO 1, PO 9	2
AEE009.11	CLO 11	Evaluate the performance of stability using bode plot; polar plot and nyquist plot and calculate the gain crossover frequency and phase crossover frequency.	PO 3	1
AEE009.12	CLO 12	Analyze the gain margin and phase margin for higher order systems and demonstrate the correlation between time and frequency response.	PO 3	2
AEE009.13	CLO 13	Understand the concept of state, state variables and derive the state models from block diagrams.	PO 1	3
AEE009.14	CLO 14	Apply state space design techniques for modeling and control system design. Formulate and solve state-variable models of linear systems.	PO 1	2
AEE009.15	CLO 15	Apply analytical methods to system models: controllability, observability, and stability. Design a lag, lead and lag lead networks for stability improvement.	PO 1	1

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
AEE009.16	CLO 16	Applications of the principles of communication engineering and digital signal processing.	PO 9, 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:

(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												3		
CLO 3	3											1	2		
CLO 4			3												
CLO 5			2										1		
CLO 6	1								1						
CLO 7			3												
CLO 8			2										3		
CLO 9	3											2			
CLO 10	2								2				2		
CLO 11			1										1		
CLO 12			2										2		
CLO 13	3														
CLO 14	2												2		
CLO 15	1														
CLO 16									3			3	3		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 3, PO 9, PO 12	SEE Exams	PO 1, PO 3, PO 9, PO 12	Assignments	PO 1, PO 3	Seminars	PSO 1
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 AND MODELLING OF PHYSICAL SYSTEMS**
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**
Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedback systems, 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 system, time response specifications, steady state errors and error constants.	
Unit-III	**STABILITY ANALYSIS AND CONTROLLERS**
Concept of stability: Necessary and sufficient conditions for stability, Routh's and Routh Hurwitz stability criterions. 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. Controllers: Proportional, derivative and proportional derivative, proportional integral and PID controllers.	
Unit-IV	**FREQUENCY DOMAIN ANALYSIS**
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 response.	
Unit-V	**STATE SPACE ANALYSIS AND COMPENSATORS**
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, lag lead networks.	
Text Books:	
1. J. Nagrath, M. Gopal, "Control Systems Engineering", New Age International Publications, 3rd Edition, 2007. 2. K. Ogata, "Modern Control Engineering", Prentice Hall, 4th Edition, 2003. 3. N. C. Jagan, "Control Systems", BS Publications, 1st Edition, 2007.	
Reference Books:	
1. A. Anand Kumar, "Control Systems", PHI Learning, 1st Edition, 2007. 2. S Palani, "Control Systems Engineering", Tata McGraw Hill Publications, 1st Edition, 2001. 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	Course Learning Outcomes (CLOs)	Reference

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-5	Understand the different type of control systems.	CLO 1	T1:1.1
6-8	Analyze differential equations and mathematical model of control system.	CLO 2	T1:1.7
9-11	Identical transfer functions of mechanical and electrical systems.	CLO 3	T1:1.7
12-15	Understand the block diagram reduction techniques.	CLO 4	T1:2.1
16-18	Analyze the characteristics of feedback system and understand the concepts of servomotor.	CLO 4	T1:2.8
19-21	Apply Mason's gain formula to derive the transfer function using signal flow graph.	CLO 5	T1:3.7
22-24	Analyze time response for test signals in system.	CLO 6	T1:3.5
25-32	Apply time domain specifications to find steady state error and error constants.	CLO 6	T1:4.1
33-35	Understand the concepts of stability and apply Routh's Hurwitz criterions to find stability of the system.	CLO 7	T1:5.1
36-38	Apply root locus technique to examine the stability of the system.	CLO 8	T1:5.3
39-42	Analyze the effect of poles and zeros in transfer function and design controllers using PI, PD and PID controllers.	CLO 9	T1:5.3
43-44	Understand the concepts of stability in frequency domain.	CLO 10	T1:5.3
45-46	Apply the graphical method for determining the stability of a control system.	CLO 11	T1:6.1
47-49	Evaluate the transfer function using gain and phase margin.	CLO 12	T1:5.7
50-53	Understand the state variables and its models.	CLO 13	T1:6.1
54-57	Analyze different state models from block diagrams of the system. And controllability, observability of system model.	CLO 14	T1:7.1
58-60	Design a lag, lead and lag lead controllers and discuss the properties of state transition matrix.	CLO 15	T1:7.3

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

S No	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	Control systems with real time examples.	Guest Lectures	PO 9	PSO 1
2	Time response analysis of feedback systems with transportation lag.	Seminars / NPTEL	PO 1	PSO 1
3	Design of digital controllers.	NPTEL	PO 3	PSO 1

Prepared by:
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HOD, ECE

V SEMESTER

INSTITUTE OF AERONAUTICAL ENGINEERING

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ELECTRONICS AND COMMUNICATION 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	**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.	-	-
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.	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

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL COMMUNICATIONS**				
Course Code	AEC009				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. J. Siva Ramakrishna, Assistant Professor				
Course Faculty	Ms. G. Mary Swarna Latha, Assistant Professor Mr. K. Sudhakar Reddy, Assistant Professor				

I. COURSE OVERVIEW:

The course will make them to understand various digital modulation techniques and source coding techniques. Demonstrate the ability to analyze base band transmission and pulse shaping schemes. Interpret the concept of linear block codes and convolution codes. Understand the principle of general transform domain approach and the concept of Viterbi algorithm. Further, it emphasis the knowledge on various pulse modulation schemes.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC005	IV	Analog communications	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital Communications	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	Lab related experiments
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	Design 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	Mini Project

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 and 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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awarness and environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real world applications using optimal resources as an Enterpreneur.	2	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the different digital modulation techniques.
II	Discuss the importance of error detection and correction codes and use them in the presence of the channel.
III	Describe and analyze the methods of transmission of digital data using baseband and carrier modulation techniques.
IV	Decompose codes separately into source codes and channel codes and develop competency in modelling and analyzing communication system elements.

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
AEC004.01	CLO 1	Understand the basic concepts of pulse amplitude modulation (PAM), pulse position modulation (PPM) and pulse width modulation (PWM).	PO 1, PO2, PO12	2
AEC004.02	CLO 2	Describe the advantages and disadvantages of digital communication systems and remember the concept of pulse code modulation technique.	PO 1,PO2, PO12	2
AEC004.03	CLO 3	Understand the concept of sampling, quantization and coding.	PO1, PO 2, PO5	2
AEC004.04	CLO 4	Understand and remember the concept of amplitude shift keying modulation and demodulation.	PO 2, PO5	2
AEC004.05	CLO 5	Analyze the frequency shift keying modulator, coherent and non-coherent frequency shift keying detectors.	PO1, PO5	2
AEC004.06	CLO 6	Describe the difference between binary phase shift keying ad quadrature phase shift keying techniques.	PO 2, PO12	2
AEC004.07	CLO 7	Understand the concept of baseband transmission and various line coding formats used in digital communication systems.	PO 1, PO5, PO12	2
AEC004.08	CLO 8	Describe the significance of pulse shaping to reduce inter-symbol interference in digital communications.	PO 1, PO5	2
AEC004.09	CLO 9	Understand the operation of raised cosine filter and eye patterns of various ASK, PSK and FSK digital modulation techniques.	PO 2, PO5, PO12	2
AEC004.10	CLO 10	Understand and Remember the concept of mutual information and entropy in information theory.	PO 1, PO12	2
AEC004.11	CLO 11	Design various mathematical modeling schemes for communication channel and determine their channel capacity.	PO 1, PO2	2
AEC004.12	CLO 12	Analyze various spread spectrum modulation schemes such as direct sequence spread spectrum and frequency hopping spread spectrum.	PO 1, PO2, PO12	2
AEC004.13	CLO 13	Analyze the significance of linear block codes and convolution codes in digital communications.	PO 1, PO2, PO12	2
AEC004.14	CLO 14	Interpret the difference between Block codes and binary cyclic codes.	PO 5, PO12	1
AEC004.15	CLO 15	Understand various types approaches such as time domain approach and transform domain approach for implementation of convolution codes.	PO 1	3
AEC004.16	CLO 16	Design different types of error detection and correction techniques for linear block	PO 5	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		codes and convolution codes.		
AEC004.17	CLO 17	Acquire experience in building and troubleshooting simple digital communication system using digital modulation and demodulation techniques.	PO 1, PO5	2
AEC004.18	CLO 18	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 1, PO5	2

3 = High; 2 = Medium; 1 = Low

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

CLO	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	3		
CLO 2	3	2										1	3		
CLO 3	3	2			1								3		
CLO 4		2			1										
CLO 5	3				1										2
CLO 6		1										3	3		
CLO 7	3				1							1	3		
CLO 8	1				1								3		
CLO 9		2			2							1	3		
CLO 10	3											1	3		
CLO 11	3	2													
CLO 12	2	3										2	3		2
CLO 13	3	2										1			
CLO 14					1							1	3		2
CLO 15	3														
CLO 16					3								3		2
CLO 17	2				1								3		2
CLO 18	3				1								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	Seminars	PO 2
Laboratory Practices	PO 2	Student Viva	-	Mini Project	PO 12	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

UNIT – I

PULSE DIGITAL MODULATION:

Pulse Modulation**:** Analog pulse modulation, Types of pulse modulation; PAM (Single polarity, double polarity); Generation & demodulation of PWM; Generation and demodulation of PPM; Introduction: Elements of digital communication systems, advantages and disadvantages of digital communication systems, applications; Pulse Digital Modulation: Elements of PCM; Sampling, quantization and coding; Quantization error, non-uniform quantization and companding; Differential PCM (DPCM);Adaptive DPCM; Delta modulation and its drawbacks; Adaptive delta modulation; Comparison of PCM and DM systems; Noise in PCM and DM systems.

UNIT – II

DIGITAL MODULATION TECHNIQUES:

Digital Modulation Techniques**:** Introduction, ASK modulator, coherent ASK detector, non-coherent ASK detector, FSK, bandwidth and frequency spectrum of FSK, non-coherent FSK detector, coherent FSK detector; BPSK, coherent BPSK detection; QPSK; DPSK, DEPSK; Optimal reception of digital signal**:** Baseband signal receiver; Probability of error; Optimum filter; matched filter, probability of error using matched filter; Probability of error for various line encoding formats; Correlation receiver; Calculation of probability of error for ASK, FSK, BPSK.

UNIT – III

BASE BAND TRANSMISSSION AND PULSE SHAPING:

Base Band Transmission**:** Requirements of a line encoding format, Various line encoding formats: Unipolar, Polar, Bipolar; Scrambling techniques: BZ8S, HDB3, computation of power spectral densities of various line encoding formats.

Pulse Shaping: Inter symbol interference; pulse shaping to reduce ISI; Nyquist‘s criterion; Raised cosine filter; Equalization; Correlative level coding; Duo-binary encoding, modified duo –binary coding; Eye diagrams for ASK,PSK,FSK; Cross Talk.

UNIT – IV

INFORMATION THEORY AND SOURCE CODING:

Information Theory: Information, entropy, conditional entropy; Mutual information; Channel capacity; Various mathematical modeling of communication channels and their capacities; Hartley Shannon law; Tradeoff between bandwidth and S/N ratio; Source coding: Fixed length and variable length Source Coding Schemes, Huffman coding; Source coding to increase average information per bit; Lossy source coding; Spread spectrum modulation: Use of spread spectrum; Direct sequence spread spectrum (DSSS); Code division multiple access using DSSS, frequency hopping spread spectrum; PN-Sequences: Generation and characteristics; Synchronization in spread spectrum systems.

UNIT – V

LINEAR BLOCK CODES AND CONVOLUTION CODES:

Linear Block Codes: Introduction to error control coding; Matrix description of linear block codes, error detection and error correction capabilities of linear block codes; Hamming code; Binary cyclic codes algebraic structure, encoding, syndrome calculation and decoding; Convolution Codes: Introduction, Encoding of convolution codes; Time Domain Approach; Transform Domain Approach; General approach; State, Tree And Trellis Diagram; Decoding using Viterbi Algorithm; Burst Error Correction: Block Interleaving and convolution interleaving.

TEXT BOOKS:

1. Herbert Taub, Donald L. Schilling , "Principles of Communication Systems", TMH, 3rd edition,2008
2. K. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley & Sons, 2nd Edition, 2005.
3. Simon Haykin, "Digital communications", John Wiley, 3rd Edition,2005.

REFERENCES:

1. John Proakis, "Digital Communications", TMH, 2nd Edition 1983.
2. B.P.Lathi, "Modern Analog and Digital Communication", Oxford reprint, 3rd Edition, 2004
3. Singh, Sapre, "Communication Systems Analog and Digital", TMH, 2nd Edition, 2004.

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	CLOs	Reference
1-3	Analog pulse modulation, Types of pulse modulation; PAM (Single polarity, double polarity); Generation & demodulation of PWM; Generation and demodulation of PPM	CLO 1, CLO 2	T1-5.2 to 5.3
4-6	Advantages and disadvantages of digital communication systems, applications; Pulse Digital Modulation: Elements of PCM; Sampling, quantization and coding; Quantization error, non-uniform quantization and companding;	CLO 2	T1-5.4 to 5.5
7-9	Differential PCM (DPCM);Adaptive DPCM; Delta modulation and its drawbacks; Adaptive delta modulation; Comparison of PCM and DM systems; Noise in PCM and DM systems.	CLO 2	T1- 5.6, T1-12.3, T2-3.12 and T2-3.8
10-14	Amplitude Shift Keying generation and detection, Frequency Shift Keying generation and detection	CLO 3	R2-13.3, T1-6.3
15-16	Binary Phase Shift Keying, Quadrature Phase Shift Keying and Differential eEncoder Phase shift Keying generation and detection.	CLO 2	T1-11.4, R3-9.2 to 9.4
7-20	Calculation of probability of error for Amplitude Shift Keying, Frequency Shift Keying and Binary Phase Shift Keying.	CLO 5, CLO 6	R2-9.10 to 9.14
21-23	Various line encoding formats: Unipolar, Polar, Bipolar; Scrambling techniques	CLO 6	R3-8.7, T1-5.5
24-27	BZ8S, High Density Bipolar level 3, computation of power spectral densities of various line encoding formats.	CLO 7, CLO 8	R3-8.7, T1-5.5
28-30	Inter symbol interference; pulse shaping to reduce ISI; Nyquist's criterion; Raised cosine filter; Equalization.	CLO 7	T3-4.4 to 4.5
31-33	Correlative level coding; Duo-binary encoding, modified duo –binary coding;	CLO 9	T3-4.6
34-36	Eye diagrams for Amplitude Shift Keying, Phase Shift Keying and Frequency Shift Keying and Cross Talk in communication.	CLO 10, CLO 11	T3- 4.11 to T1- 5.2.3

Lecture No	Topics to be covered	CLOs	Reference
37-39	Information, entropy, conditional entropy; Mutual information; Channel capacity; Various mathematical modeling of communication channels and their capacities; Hartley Shannon law. Problems on information.	CLO 12	T3-9.2, T3-9.6, T3-9.7, T3-9.8,T1-13.3
40-42	Source coding: Fixed length and variable length Source Coding Schemes, Huffman coding; Source coding to increase average information per bit; Lossy source coding.	CLO 10	T1-13.7, R3-11.1 to 11.7
43-45	Use of spread spectrum; Direct sequence spread spectrum (DSSS); Code division multiple access using DSSS, frequency hopping spread spectrum; PN-Sequences: Generation and characteristics; Synchronization in spread spectrum systems.	CLO 12	T1-2.7, T1-15.4 to 15.6
46-48	Introduction to error control coding; Matrix description of linear block codes, error detection and error correction capabilities of linear block codes; Hamming code; Binary cyclic codes algebraic structure, encoding, syndrome calculation and decoding.	CLO 13, CLO 14	T1-13.9
49-52	Convolution Codes: Introduction, Encoding of convolution codes; Time Domain Approach; Transform Domain Approach.	CLO 15	R3-11
53-55	State, Tree And Trellis Diagram; Decoding using Viterbi Algorithm;	CLO14	T1-13.18
56-59	Burst Error Correction: Block Interleaving and convolution interleaving.	CLO15	T1-13.10

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 2	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 5	PSO 3

Prepared by:
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HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER ORGANIZATION**				
Course Code	AEC010				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. M Rakesh, Assistant Professor, CSE				
Course Faculty	Mr. E Sunil Reddy, Assistant Professor, IT Ms. A Soujanya, Assistant Professor, CSE Mr. N Rajashekar, Assistant Professor,CSE				

I. COURSE OVERVIEW:

This course introduces the principles of basic computer organization, CPU organization, and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, register transfer languages, arithmetic, logic and shift micro operations, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O organization of computer, parallel processing and inter process communication and synchronization. This course in reached to student by power point presentations, lecture notes, and assignment questions ,previous model question papers, multiple choice questions and question bank of long and short answers.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC002	III	Digital System Design	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Organization	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
PO1	**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
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	Seminar
PO3	**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	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:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	2	Seminar
PSO 2	**Software Engineering Practices:** The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.	2	-
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	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic structure and operation of a digital computer.
II	Understand the operation of the arithmetic unit including the algorithms &implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
III	Interpret the different types of control and the concept of pipelining.
IV	To study the different ways of communicating with I/O devices and standard I/O interfaces.
V	To study the hierarchical memory system including cache memories and virtual memory.

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
CAE010.01	CLO 1	Describe the various components like input/output units, memory unit, control unit, arithmetic logic unit connected in the basic organization of a computer.	PO1; PO2	3
CAE010.02	CLO 2	Describe various data representations and explain how arithmetic and logical operations are performed by computers.	PO2; PO3	2
CAE010.03	CLO 3	Understand instruction types, addressing modes and their formats in the assembly	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
		language programs.		
CAE010.04	CLO 4	Describe the implementation of fixed point and floating point addition, subtraction operations.	PO3	3
CAE010.05	CLO 5	Describe the various major algorithmic techniques (Robertson algorithm, booth's algorithm, non-restoring division algorithm.	PO1	3
CAE010.06	CLO 6	Describe the pipeline processing concept with multiple functional units.	PO2	3
CAE010.07	CLO 7	Understand the connections among the circuits and the functionalities in the hardwired control unit.	PO2	2
CAE010.08	CLO 8	Describe the design of control unit with address sequencing and microprogramming Concepts.	PO1	1
CAE010.09	CLO 9	Understand the functionality of super scalar processing and Nano programming.	PO1; PO3	2
CAE010.10	CLO 10	Understand the concept of memory hierarchy and different typed of memory chips.	PO2; PO3	3
CAE010.11	CLO 11	Understand the cache and virtual memory concept in memory organization.	PO1; PO3	2
CAE010.12	CLO 12	Describe the hardware organization of associate memory and understand the read and write operations.	PO3	3
CAE010.13	CLO 13	Understand the various bus control interfaces and system control interfaces.	PO1	2
CAE010.14	CLO 14	Describe the various interrupts (Vectored Interrupts, PCI interrupts, Pipeline interrupts).	PO3	3
CAE010.15	CLO 15	Understand the functionally of RISC and CISC processors..	PO1; PO3	2
CAE010.16	CLO 16	Possess the knowledge and skills for employability and to succeed in national and international level competitive examinations.	PO1; PO3	3
CAE010.17	CLO 17	Possess the knowledge and skills to design advanced computer architecture for current industry requirements	PO2; PO3	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											2		
CLO 2		3	1												
CLO 3		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 4			3												
CLO 5	3														
CLO 6		3											2	2	
CLO 7		2													
CLO 8		1												2	
CLO 9	1		3												2
CLO 10		2	3												
CLO 11	2		1										2		
CLO 12			3												2
CLO 13	2														
CLO 14			3											2	
CLO 15	2		1										2		
CLO 16	3		2												2
CLO 17		3	2												

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1; PO 2; PO 3	SEE Exams	PO 1; PO 2; PO 3	Assignments	PO3	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	INTRODUCTION
Computing and computers, evolution of computers, VLSI Era, System design, register level, processor level, CPU organization, data representation, fixed-point numbers, floating point numbers, instruction formats, instruction types, addressing modes.	

UNIT-II	DATA PATH DESIGN
Fixed Point Arithmetic, Addition, Subtraction, Multiplication and Division, Combinational and Sequential ALUs, Carry look ahead adder, Robertson algorithm, booth's algorithm, non restoring division algorithm, Floating Point Arithmetic, Coprocessor, Pipeline Processing, Pipeline Design, Modified booth's Algorithm.	
UNIT-III	**CONTROL DESIGN**
Hardwired control, micro programmed control, multiplier control unit, CPU control unit. Pipeline control, instruction pipelines, pipeline performance, superscalar processing, Nano programming.	
UNIT-IV	**MEMORY ORGANIZATION**
Random access memories, serial access memories, RAM interfaces, magnetic surface recording, optical memories, multilevel memories, cache & virtual memory, memory allocation, associative memory.	
UNIT-V	**SYSTEM ORGANIZATION**
Communication methods, buses, bus control, bus interfacing, bus arbitration, IO and system control, IO interface circuits, handshaking, DMA and interrupts, vectored interrupts, PCI interrupts, pipeline interrupts, IOP organization, operation systems, multiprocessors, fault tolerance, RISC and CISC processors, superscalar and vector processor.	
Text Books:	
1. John P. Hayes, _Computer architecture and Organization', Tata McGraw-Hill, 3rd Edition, 1998. 2. V Carl Hamacher, Zvonko G. Varanesic, Safat G. Zaky, ―Computer Organization‖, Tata McGraw-Hill Inc, 5th Edition, 1996.	
Reference Books:	
1. Morris Mano, ―Computer System Architecture‖, Prentice-Hall of India, 2000. 2. Paraami, ―Computer Architecture‖, BEH R002, Oxford Press. 3. P Pal Chaudhuri ―Computer organization and design‖, Prentice Hall, 2nd Edition, 2007.	

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	Computing and computers, Evolution of Computers, VLSI era	CLO 1	T1:1.1-1.3
4-6	System design, register level, processor level	CLO 2	T1:2.1-2.3
7	CPU organization, data representation, fixed-point numbers, floating point numbers	CLO 2	T1:3.1-3.2
8-14	Instruction formats, instruction types, addressing modes.	CLO 4	T1:3.3
11-12	Fixed Point Arithmetic, Addition, Subtraction, Multiplication and Division, Combinational and Sequential ALUs, Carry look ahead adder	CLO 4	T1:4.1-4.3
15-20	Robertson algorithm, booth's algorithm, non-restoring division algorithm, Floating Point Arithmetic.	CLO 7	T1:4.12
21-25	Coprocessor, Pipeline Processing, Pipeline Design, Modified booth's Algorithm.	CLO 9	T1:4.3
26-29	Hardwired control, micro-programmed control, multiplier control unit, CPU control unit. Pipeline control, instruction pipelines.	CLO 9	T1:5.1-5.3
30-35	Pipeline performance, Superscalar Processing, Nano-Programming.	CLO 11	T1:5.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
36-38	Random access memories, serial access memories, RAM interfaces, magnetic surface recording	CLO 11	T1:6.1
39-44	Optical memories, multilevel memories, cache & virtual memory, memory allocation, associative memory	CLO 11	T1:6.2
45-48	Communication methods, buses, bus control, bus interfacing, bus arbitration, IO and system control, IO interface Circuits.	CLO 9	T1:7.1-7.2
49-54	Handshaking, DMA and interrupts, vectored interrupts, PCI interrupts, and pipeline interrupts, IOP organization, operation systems.	CLO 14	T1:7.2
55-59	Multi processors, fault tolerance, RISC and CISC processors, superscalar and vector processor.	CLO 14	T1:7.3

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	Encourage students to solve real time applications and prepare towards competitive security mechanisms.	NPTEL	PO 2	PSO 1

Prepared by:
Mr. M Rakesh, Assistant Professor

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INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ANTENNAS AND PROPAGATION**				
Course Code	**AEC011**				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. A.Usharani, Assistant Professor, ECE				
Course Faculty	Dr. V.Sivanagaraju, Professor , ECE Dr. S. Peddakrishna ,Professor, ECE				

I. COURSE OVERVIEW:

Antennas have become increasingly important to our society until now they are indispensible. This course will cover the fundamentals of antenna, radiation phenomenon, loop antennas, dipole antennas, very high frequency (VHF), ultra-high frequency(UHF), and microwave antennas like Yagi - Uda, helical antenna, reflector antenna, micro strip antenna, lens antenna, antenna arrays broadside and end fire, antenna measurements to measure the antenna parameters, wireless communication maintained through ground, space and sky.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC007	IV	Electromagnetic Theory and Transmission Lines	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Antennas and Propagation	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	Design Exercises.

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.	2	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.	2	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	2	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Be Proficient in the radiation phenomena associated with various types of antennas and understand basic terminology and concepts of antennas along with emphasis on their applications.
II	Analyze the electric and magnetic field emission from various basic antennas with mathematical formulation of the analysis.
III	Explain radiation mechanism of different types of antennas and their usage in real time field.
IV	Justify the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

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
AEC011.01	CLO 1	Discuss about the radiation mechanism in single wire, double wire antennas and the current distribution of thin wire antenna.	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
AEC011.02	CLO 2	Discuss the different parameters of an antenna like radiation patterns, radiation intensity, beam efficiency, directivity and gain etc,.	PO 1	3
AEC011.03	CLO 3	Analyze the concept of antenna properties based on reciprocity theorem; evaluate the field components of quarter wave monopole and half wave dipole.	PO 2	3
AEC011.04	CLO 4	Understand the significance of loop antennas in high frequency range and its types; derive their radiation resistances and directivities.	PO 1	3
AEC011.05	CLO 5	Discuss the uniform linear arrays such as broadside array and end fire array, derive their characteristics.	PO 1	3
AEC011.06	CLO 6	Analyze the practical design considerations of horn antennas and monofilar helical antenna in axial and normal modes.	PO 2, PO 4	2
AEC011.07	CLO 7	Discuss the various types of Microwave antennas and analyze the design consideration of pyramidal horn.	PO 2, PO 4	2
AEC011.08	CLO 8	Analyze the concept of complementary in slot antennas using Babinet's principle and understand the impedance of slot antennas.	PO 4	2
AEC011.09	CLO 9	Understand the significance, features and characteristics of micro strip patch antennas, analyze the impact of different parameters on characteristics.	PO 2	3
AEC011.10	CLO 10	Understand and analyze the reflectors are widely used to modify the radiation pattern as a radiating element, its types.	PO 1	3
AEC011.11	CLO 11	Discuss various concepts related to antennas such as feed methods like front feed, rear feed, offset feed and aperture blockage.	PO 2	3
AEC011.12	CLO 12	Discuss various methods and techniques for experimental measurements of antennas such as pattern measurement, directivity measurement, gain measurement etc.	PO 4	2
AEC011.13	CLO 13	Understand the wave propagation through the complete study of the wave by the nature and characteristics of media during the wave travels.	PO 1	3
AEC011.14	CLO 14	Understand the space wave propagation focusing on field strength variation with distance and height, effect of earth's curvature, absorption and super refraction.	PO 1	3
AEC011.15	CLO 15	Analyze the structure of ionosphere and understand the sky wave propagation through refraction and reflection by ionosphere.	PO 2	3
AEC011.16	CLO 16	Apply the concept of antennas and propagation to understand and analyze real time applications.	PO 2	3
AEC011.17	CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	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												3		
CLO 2	2												2		
CLO 3	3													2	
CLO 4		2											1		
CLO 5		2											2		
CLO 6		1		1										2	
CLO 7				2										2	
CLO 8				2										1	
CLO 9		3											1		
CLO 10	2												1		
CLO 11		2											1		
CLO 12	2														
CLO 13	3												1		
CLO 14	2												1		
CLO 15		2												1	
CLO 16		3													1
CLO 17													1		2

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	Seminars	PO 1
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	ANTENNA BASICS AND THIN LINEAR WIRE ANTENNAS:
Antenna fundamentals: Introduction, radiation mechanism, single wire, 2 wires, dipoles, current distribution on a thin wire antenna; Antenna Parameters, radiation patterns, patterns in principal planes, main lobe and side lobes, beam widths, radiation intensity, beam efficiency, directivity, gain and resolution, antenna apertures, aperture efficiency, effective height; Antenna properties based on reciprocity theorem; Thin linear wire antennas: Retarded potentials; Radiation from small electric dipole, Quarter wave monopole and half wave dipole, current distributions, evaluation of field components; power radiated, radiation resistance, beam widths, directivity, effective area and effective height; Natural current distributions, fields and patterns of thin linear center-fed antennas of different lengths; Illustrated problems.	
Unit-II	**LOOP ANTENNAS AND ANTENNA ARRAYS**
Loop Antennas: Introduction, small loop; Comparison of Far fields of small loop and short dipole; Radiation resistances and directivities of small and large loops. Antenna Arrays: Point sources, definition, patterns; Arrays of 2 isotropic sources, different cases; Principle of pattern multiplication; Uniform linear arrays - Broadside arrays; End-fire arrays; EFA with increased directivity; Derivation of their characteristics and comparison; BSAs with non-uniform amplitude distributions; General considerations and Binomial arrays; Folded Dipoles and their characteristics; Arrays with parasitic elements, Yagi-Uda array, Helical antennas-Helical geometry, Helix modes, Practical design considerations for monofilar Helical antenna in axial and normal modes.	
Unit-III	**VHF,UHF AND MICROWAVE ANTENNAS**
VHF, UHF and Microwave Antennas: Horn antennas- Types, Fermat‘s principle, optimum horns, design considerations of pyramidal horns; Illustrative problems; Lens antennas: Introduction, geometry of Non-metallic dielectric lenses zoning, tolerances, applications; Slot antenna, its pattern, Babinet‘s principle and complementary antennas, impedance of slot antennas. Microstrip Antennas: Introduction, features, advantages and limitations; Rectangular patch antennas- geometry and parameters, characteristics of micro strip antennas, Impact of different parameters on characteristics.	
Unit-IV	**REFLECTOR ANTENNAS AND ANTENNA MEASUREMENTS**
Reflector Antennas: Introduction, flat sheet and corner reflectors; Paraboloidal reflectors: Geometry, pattern characteristics, feed methods, reflector types- Related features; Illustrative problems. Antenna measurements: Introduction, concepts, reciprocity near and far fields; Coordinate system, sources of errors patterns to be measured; Pattern measurement arrangement directivity measurement; Gain measurements: Comparison method, absolute and 3-antenna methods.	
Unit-V	**RADIO WAVE PROPAGATION**
Wave Propagation - I: Introduction, definitions, categorizations , general classifications, different Modes of Wave Propagation; Ground wave propagation: Introduction, plane earth reflections, space and surface waves, wave tilt, curved earth reflections; Space wave propagation: Introduction, field strength variation with distance and height, effect of earth‘s curvature, absorption, super refraction, M-Curves, duct propagation, scattering phenomena, tropospheric propagation, fading and path loss calculations; Wave propagation – II: Sky wave propagation: Introduction, structure of ionosphere, refraction and reflection of sky waves by ionosphere; Ray path, critical frequency, MUF, LUF, OF, virtual height and skip distance; Relation between MUF and skip distance; Multi-hop propagation.	
Text Books:	
1. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, Antennas and Wave Propagation‖, TMH, 4th Edition, 2010. 2. C.A. Balanis, ―Antenna Theory, John Wiley and Sons, 2nd Edition, 2001.	
Reference Books:	
1. E.C. Jordan, K.G. Balmain, Electromagnetic Waves and Radiating Systems‖, PHI, 2nd Edition,2000. 2. E.V.D. Glazier, H.R.L. Lamont, Transmission and Propagation‖, Her Majesty's Stationery Office, 1958. 3. F.E. Terman, Electronic and Radio Engineering‖, McGraw-Hill, 4th Edition, 1955. 4. K.D. Prasad, Satya Prakashan, Antennas and Wave Propagation‖, Tech India Publications, 1st Edition, 2001.	

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	Understand the Antenna basics	CLO 1	T1 – 2.1 to 2.2
6-10	Understand the Antenna parameters, properties	CLO 2	T1 – 2.3 to2.10
11-17	Evaluate the field components basic antennas	CLO 3	T1 – 6.2 to 6.4
18-20	Understand the far field differences in loop and dipole antennas	CLO 4	T1 – 7.1 to 7.7
21-25	Analyze the principle of pattern multiplication in arrays	CLO 5	T1 – 5.1 to5.12
26-29	Understand the operation of folded dipoles	CLO 6	R1 – 9.1 to 9.6
30-35	Analyze the importance of antennas in microwave region	CLO 7	T1 – 8.2 to8.4
35-38	Analyze the concept of complementary in slot antennas using Babinet's principle	CLO 8	T1 – 8.5 to8.10
39-40	Understand the operation of micro strip antennas	CLO 9	T1 – 14.1 to 14.3
41	Analyze the characteristics of micro strip antennas	CLO 9	T1 – 14.4 to 14.6
42-43	Evaluate the performance of reflector antennas	CLO 10	T1 – 9.1 to 9.3
44-45	Analyze the pattern characteristics and feed methods in reflector antennas	CLO 11	T1 – 9.5 to 9.9
46-50	Evaluate the measurements of antennas	CLO 12	T1 – 21.1 to 21.3
51-55	Analyze the categorizations of wave propagations	CLO 13	T1 – 22.1 to 22.3
56-58	Differentiate space and surface waves	CLO 14	T1 – 23.1 to 23.5, 24.2 to 24.14
59-60	Illustrate the concept of sky wave propagation	CLO 15	T1 – 25.1 to 25.6, 25.8

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

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Advanced communications.	Seminars / NPTEL	PO 1, PO 2	PSO 1
2	Design an antenna	Seminars / Guest Lectures / NPTEL	PO 2, PO 4	PSO 1

Prepared by:
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HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL IC APPLICATIONS USING VHDL**				
Course Code	AEC516				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. Vijay Vallabhuni, Associate Professor, ECE				
Course Faculty	Dr. K. Nehru, Professor, ECE Mr. D. Khalandar Basha, 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	AEC002	III	Electronic Devices and Circuits	4
UG	AEC103	IV	Digital System Design Laboratory	2

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital IC applications using VHDL	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 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.	3	Seminars and 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.	3	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.	3	Micro Project
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	Micro Project

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.	2	Seminars

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Familiarization of Digital Logic families and design of combinational circuits using digital ICs.
II	Design of sequential circuits using digital ICs strategy of digital circuits using VHDL Programming.
III	Acquire knowledge of memories like SRAM, DRAM memories construction, operation and timing diagrams.

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
CAEC516.01	CLO 1	Understand logic families of CMOS, TTL and ECL.	PO 1	2

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
CAEC516.02	CLO 2	Construct the circuits of CMOS basic gates like inverter, NAND, NOR, AOI and OAI logic with functionality verification.	PO 1, PO 3 PO 5	2
CAEC516.03	CLO 3	Construct the circuits of TTL logic family by understanding NAND, NOR gates with functionality verification.	PO 1	3
CAEC516.04	CLO 4	Identify the need of interfacing CMOS logic family with TTL logic family and interfacing TTL with CMOS logic.	PO 1	1
CAEC516.05	CLO 5	Understand the Static and dynamic electrical behavior of CMOS circuits.	PO 1	1
CAEC516.06	CLO 6	Understand the different design methods in VHDL.	PO 1	1
CAEC516.07	CLO 7	Acquire the basic constucts in VHDL programming.	PO 1	1
CAEC516.08	CLO 8	Understand the terms simulation and synthesis in the area of VLSI.	PO 1 PO 9	2
CAEC516.09	CLO 9	Familarization of basic combinational circuits viz decoders, encoders, multiplexers, demultiplexers, parity circuits.	PO 1	1
CAEC516.10	CLO 10	Familarization of basic arithmetic circuits for addition, subtraction and multiplication.	PO 1 PO 2	2
CAEC516.11	CLO 11	Distinguish between combinatorial and sequential circuits.	PO 1	1
CAEC516.12	CLO 12	Design sequential circuits like latches, flip-flops.	PO 1, PO 3 PO 5	3
CAEC516.13	CLO 13	Design sequential circuits like shift registers and counters.	PO 1, PO 3 PO 5	3
CAEC516.14	CLO 14	Understand synchronous design methodology	PO 1	1
CAEC516.15	CLO 15	Learns impediments to synchronous design	PO 1	1
CAEC516.16	CLO 16	Understand internal structure of SRAM and decoding mechanism	PO 1	1
CAEC516.17	CLO 17	Understand timing diagrams of SRAM for read and write operations	PO 1, PO 3 PO 9	2
CAEC516.18	CLO 18	Understand internal structure of DRAM	PO 1	1
CAEC516.19	CLO 19	Understand timing diagrams of DRAM for read and write operations	PO 1 PO 9	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
CLO 1	2														
CLO 2	3		1		2								2		
CLO 3	3												1		

CLO 4	1														
CLO 5	1														
CLO 6	1														
CLO 7	1														
CLO 8	1								2						
CLO 9	1														
CLO 10	1	2													
CLO 11	1												2		
CLO 12	1		3		3								3	2	
CLO 13	1		3		3								3	2	
CLO 14	1														
CLO 15	1														
CLO 16	1														
CLO 17	1		2						2				2		
CLO 18	1														
CLO 19	1								2				2		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 5 PO 9	SEE Exams	PO 1, PO 2 PO 3, PO 5 PO 9	Assignments	PO 1 PO 3	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	CMOS LOGIC AND BIPOLAR LOGIC AND INTERFACING:
Introduction to logic families, CMOS logic, CMOS steady state electrical behavior, CMOSdynamic electrical behavior, CMOS logic families; Bipolar logic, transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, emitter coupled logic, comparison of logic families, familiarity with standard 74XX and CMOS 40XX series-ICs – specifications.	
Unit-II	**THE VHDL HDL AND ITS ELEMENTS:**
Design flow, program structure, types and constants, functions and procedures, libraries and packages; The VHDL design elements: Structural design elements, data flow design elements, behavioral design elements, time dimension and simulation synthesis.	
Unit-III	**COMBINATIONAL LOGIC DESIGN USING VHDL:**
Decoders, encoders, three state devices, multiplexers and demultiplexers, Code Converters, EX-OR gates and parity circuits, comparators, adders and subtractors, ALUs, combinational multipliers. VHDL modes for the above ICs. Design examples (using VHDL) - Barrel shifter, comparators, floating-point encoder, dual parity encoder.	
Unit-IV	**SEQUENTIAL LOGIC DESIGN:**
Latches and flip-flops, PLDs, counters, shift register, and their VHDL models, synchronous design methodology, impediments to synchronous design.	
Unit-V	**MEMORIES**
ROMs: Internal structure, 2D-decoding commercial types, timing and applications; Static RAM: Internal structure, SRAM timing, standard SRAMS, synchronous SRAMS; Dynamic RAM: Internal structure, timing, synchronous DRAMs; Familiarity with component data sheets : Cypress CY6116, CY7C1006, specifications.	
Text Books:	
1. John F.Wakerly, "Digital Design Principles & Practices", 3rd Edition, 2005, PHI/ Pearson Education Asia. 2. J. Bhasker, "VHDL Primer", Pearson Education / PHI, 3rd Edition. Pearson Higher Education.	
Reference Books:	
1. Charles H. Roth Jr., "Digital System Design Using VHDL", PWS Publications, 1998. 2. Alan B. Marcovitz, "Introduction to Logic Design", TMH, 2nd Edition, 2005. 3. Stephen Brown, ZvonkoVransesic, "Fundamentals of Digital Logic with Verilog Design", TMH, 2003. 4. Cypress Semiconductors Data Book (Download from website). 5. K. Lalkishore, "Linear Integrated Circuit Applications", Pearson Educations 2005.	

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	Introduction to Logic Family, MOS transistor operation.	CLO 1	T1: 3.3
2	CMOS logic and voltage levels, CMOS Inverter.	CLO 1	T1: 3.3
3	CMOS NAND and NOR gates.	CLO 2	T1: 3.3.4
4	CMOS AOI, OAI logic.	CLO 2	T1: 3.3.7
5	CMOS AND & OR gates.	CLO 2	T1: 3.3.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
6	CMOS XOR and XNOR gates.	CLO 2	T1: 3.3.7
7	CMOS steady state electrical behavior, CMOS dynamic Electrical behavior.	CLO 5	T1: 3.4
8	CMOS logic families, Diode Logic.	CLO 4	T1: 3.8-3.9
9	TTL NAND Gate.	CLO 3	T1: 3.10
10	TTL NOR Gate, CMOS/TTL interfacing, Low voltage CMOS logic and interfacing.	CLO 4	T1: 3.10. 3.12
11	Emitter Coupled Logic, Comparison of logic families, Familiarity with standard 74XX and CMOS 40XX series-ICs-Specifications.	CLO 4	T1:3.14
12	Design flow, Program structure, types and constants.	CLO 6	R5: 8.5-8.6
13	Functions and Procedures, Libraries and packages.	CLO 6	R5: 8.5-8.6
14	Structural design elements with example.	CLO 7	T1: 6.1-6.2
15	Data flow design elements with example.	CLO 7	T1: 6.1-6.2
16	Behavioral design elements with example.	CLO 7	T1: 6.3
17	Time dimension and simulation synthesis.	CLO 8	T1: 6.3
18	74x139 Decoder and VHDL model.	CLO 9	T1: 5.4.3
19	74x138 Decoder and VHDL model.	CLO 9	T1: 5.4.4
20	74x148 encoders and VHDL model.	CLO 9	T1: 5.5.2
21	Three state devices and VHDL model.	CLO 9	T1: 5.6
22	Multiplexers and VHDL model.	CLO 9	T1: 5.7
23	Multiplexers and VHDL model.	CLO 9	T1: 5.7
24	Demultiplexers and VHDL model.	CLO 9	T1: 5.7
25	Code Converters and VHDL model.	CLO 9	T1: 5.7
26	EX-OR gates and parity circuits, comparators and VHDL model.	CLO 9	T1: 5.8, 5.9
27	HA, FA adders and FA using HA and VHDL model.	CLO 10	T1:5.10
28	CLA adder and VHDL model.	CLO 10	T1: 5.10
29	Subtractors, FS using FA and VHDL model, ALUs and VHDL model.	CLO 10	T1: 5.10
30	Combinational multipliers.	CLO 10	T1: 5.11
31	Combinational multipliers VHDL model.	CLO 10	T1: 5.11
32	Barrel shifter.	CLO 10	T1: 6.1.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
33	Barrel shifter VHDL model.	CLO 10	T1: 5.1.2
34	Comparators, floating-point encoder and VHDL model.	CLO 10	T1: 5.1.3
35	Dual parity encoder and VHDL model.	CLO 10	T1: 5.13
36	Latches & flip-flops and VHDL model.	CLO 11	T1: 7.2
37	Realization of Lathes and Flip Flops, PLD and VHDL model.	CLO 12	T1: 7.2
38	Synchronous counters and VHDL model.	CLO 13	T1: 8.4
39	Asynchronous counters and VHDL model.	CLO 13	T1: 8.4
40	Shift register and VHDL model.	CLO 13	T1:8.5
41	Synchronous design methodology and impediments to synchronous design.	CLO 14 CLO 15	T1:8.7-8.8
42	ROMs Internal structure.	CLO 16	T1:8.6
43	2D-decoding ROMs, Commercial types, timing and applications.	CLO 16	T1: 8.2 R5: 4.4
44	Static RAM internal structure.	CLO 16	T1: 8.2 R5: 4.4
45	SRAM timing Standard SRAMS, synchronous SRAMS.	CLO 17	T1: 8.9
46	Dynamic RAM internal structure.	CLO 18	R6: 4.5
47	DRAM timing.	CLO 19	T1: 8.12-8.13
48	Synchronous DRAMs Familiarity with Component Data Sheets – Cypress CY6116, CY7C1006, Specifications.	CLO 18	T1: 10.6

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

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Design of combinational applications.	Laboratory Practices, Project/ NPTEL	PO 1, PO 2, PO 5	PSO 1
2	Design of sequential applications.	Laboratory Practices, Project	PO 1, PO 2, PO 5	PSO 1
3	Design of memories.	Seminars/ NPTEL	PO 1	PSO 1

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ELECTRONICS AND COMMUNICATIONS 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	**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.	---	----
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:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	2	Guest lectures

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,	PO 2	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		measurement of demand and its forecasting .		
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						2
CLO5									3						2
CLO6											3				2
CLO7									3		3				2
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

ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE DESCRIPTOR

Course Title	**JAVA PROGRAMMING**				
Course Code	ACS552				
Programme	B.Tech				
Semester	VI	ECE | EEE			
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	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	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	Assignments/ Quiz
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	**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	Seminars
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.	2	Assignments
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	2	Assignments

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	3
ACS552.02	CLO 2	Explain the concept of class and objects with access control to represent real world entities.	PO 1	3
ACS552.03	CLO 3	Demonstrate the behavior of programs involving the basic programming constructs like control structures, constructors.	PO 2, PO 3	2
ACS552.04	CLO 4	Describe the concept of operators and variables, arrays, parameter passing.	PO 1	3
ACS552.05	CLO 5	Use overloading methodology on methods and constructors to develop application programs.	PO 2, PO 3	2
ACS552.06	CLO 6	Demonstrate the implementation of inheritance (multilevel, hierarchical and multiple) by using extend and implement keywords.	PO 2,PO 3	1
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 2,PO 3	1
ACS552.09	CLO 9	Illustrate different techniques on creating and accessing packages (fully qualified name and import statements).	PO 2, PO 3	2
ACS552.10	CLO 10	Understand the impact of exception handling to avoid abnormal termination of program using checked and unchecked exceptions.	PO 3	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 2, PO 3	2
ACS552.13	CLO 13	Understand and implement concepts on file streams and operations in java programming for a given application programs.	PO 2, PO 3	2
ACS552.14	CLO 14	Describe the backend connectivity process in java program by using JDBC drivers.	PO 1	3
ACS552.15	CLO 15	Develop java application to interact with database by using relevant software component (JDBC Driver).	PO 2, PO 3, PO 12	2
ACS552.16	CLO 16	Understand text, byte, and character input/output streams.	PO 1	3
ACS552.17	CLO 17	Demonstrate the import statement usage and built-in packages.	PO 1	3
ACS552.18	CLO 18	Understand the use of interrupting threads in the real world.	PO 2, PO 12	2
ACS552.19	CLO 19	Demonstrate the use of programming in the real world.	PO 3, PO 12	2
ACS552.20	CLO 20	Posses the knowledge and skills for employability and to succeed in national and international level competitive exams.	PO 2, PO 3, 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												3		
CLO 2	3												2		2
CLO 3		3	2												
CLO 4	3												3	2	
CLO 5		3	2												
CLO 6		2	3												
CLO 7	3														
CLO 8		2	1												
CLO 9		3	2												
CLO 10			2											2	
CLO 11	3														
CLO 12		2	2										3		
CLO 13		3	3										3	2	
CLO 14	3														
CLO 15		3	3									1		2	
CLO 16	3												3		
CLO 17	3														
CLO 18		2	3									2			2
CLO 19			3									2		2	2
CLO 20		2	3									2			3

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 1, PO 3	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	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 2
3	J Frame, JApplet, JButton, Applet applications	Assignments / Laboratory Practices	PO 2	PSO 2

Prepared by:
Ms. Y Harika Devi, Assistant Professor

HOD, ECE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL SIGNAL PROCESSING**				
Course Code	AEC012				
Programme	B.Tech				
Semester	VI	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. S. China Venkateswarlu, Professor, ECE				
Course Faculty	Dr. V. Padmanabha Reddy, Professor, ECE Dr. Manisha Guduri, Associate Professor, ECE Mr. V. Naresh Kumar, Assistant Professor, ECE Mr. T. Chiranjeevi, Assistant Professor, ECE				

I. COURSE OVERVIEW:

The present course covers the concepts and techniques of modern digital signal processing which are fundamental to all the signal/speech/image processing, applications. The course starts with a detailed overview of discrete-time signals and systems, representation of the systems by means of difference equations, and their analysis using Fourier and z-transforms. The notion of discrete Fourier transform is introduced, followed by an overview of fast algorithms for its computation. The methods for spectral analysis of discrete-time signals are discussed next, principal methods for design of FIR and IIR filters, followed by multi-rate signal processing and finite word length effects. While this course deals largely with the theory of DSP, we will use a powerful software package, MATLAB, to look at applications of this theory, particularly Fourier analysis and digital filter design.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AECB14	IV	Signals and Systems	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
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 and 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
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	Design Exercises
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary Settings.	1	Micro projects.
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	Seminars, Paper Presentations.
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	Development of Mini Projects

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.	2	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.	2	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	To provide background and fundamental material for the analysis and processing of digital signals and to familiarize the relationships between continuous-time and discrete-time signals and systems.
II	To study fundamentals of time, frequency and z-plane analysis and to discuss the inter-relationships of these analytic method and to study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.
III	To introduce a few real-world signal processing applications.
IV	To acquaint in FFT algorithm, multi-rate signal processing techniques and finite word length effects.

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
CAEC012.01	CLO 1	Understand how digital to analog (D/A) and analog to digital (A/D) converters operate on a signal and be able to model these operations mathematically.	PO 1, PO 2	3
CAEC012.02	CLO 2	Define simple non-periodic discrete-time sequences such as the impulse and unit step, and perform time shifting and time-reversal operations on such sequences.	PO 1, PO 2	3
CAEC012.03	CLO 3	Given the difference equation of a discrete-time system to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI systems.	PO 1, PO 2 PO 9	3
CAEC012.04	CLO 4	Given the impulse response of a causal LTI system, show whether or not the system is bounded-input/bounded-output (BIBO) stable.	PO 2, PO 5 PO 9, PO 12	3
CAEC012.05	CLO 5	Perform time, frequency and Z-transform analysis on signals.	PO 5, PO 10	2
CAEC012.06	CLO 6	From a linear difference equation of a causal LTI system, draw the Direct Form I and Direct Form II filter realizations.	PO 2, PO 12	3
CAEC012.07	CLO 7	Knowing the poles and zeros of a transfer function, make a rough sketch of the gain response.	PO 1, PO 5 PO 9, PO 12	2
CAEC012.08	CLO 8	Define the Discrete Fourier Transform (DFT) and the inverse DFT (IDFT) of length N.	PO 1, PO 2 PO 12	1
CAEC012.09	CLO 9	Understand the inter-relationship between DFT and various transforms.	PO 2, PO 3 PO 5, PO 9 PO 12	2
CAEC012.10	CLO 10	Understand the significance of various filter structures and effects of round-off errors.	PO 1, PO 9 PO 10, PO 12	2
CAEC012.11	CLO 11	Understand the fast computation of DFT and appreciate the FFT Processing.	PO 1 PO 2	3
CAEC012.12	CLO 12	Design of infinite impulse response (IIR) filters for a given specification.	PO 2, PO 9 PO 10, PO 12	2
CAEC012.13	CLO 13	Design of finite impulse response (FIR) filters for a given specification.	PO 1, PO 5 PO 12	1
CAEC012.14	CLO 14	Compare the characteristics of IIR and FIR filters.	PO 5 PO 12	1

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
CAEC012.15	CLO 15	Understand the tradeoffs between normal and multi rate DSP techniques and finite length word effects.	PO 2, PO 9 PO 12	1
CAEC012.16	CLO 16	Understand the signal interpolation and decimation, and explain their operation	PO 5	1
CAEC012.17	CLO 17	Explain the cause of limit cycles in the implementation of IIR filters.	PO 5, PO 10 PO 12	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
CLO 1	3	2											3		
CLO 2	3	2												1	
CLO 3	3	2							1				1	3	
CLO 4					2				1			1	1		1
CLO 5		2			3					1					2
CLO 6		2										3	2		
CLO 7	2				2				1			3	3		
CLO 8	1	1										1	1		
CLO 9	2	3			1				1			3			1
CLO 10	2								2	1		1	1		
CLO 11	3	2											1		
CLO 12		3							1	1		3	1		
CLO 13	1				1							1	3		
CLO 14					1							1	1		
CLO 15		1							1			1	1		
CLO 16					2								3		
CLO 17					1				3			1	1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4 PO 12,PO 9	SEE Exams	PO 1, PO 2 PO 3, PO 4 PO 12,PO 9	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	**REVIEW OF DISCRETE TIME SIGNALS AND SYSTEMS:**
Discrete time signal definition; Signal classification; Elementary signals; Transformation of elementary signals; Concept of digital frequency; Discrete time system definition; System classification; Linear time invariant (LTI) system; Properties of the LTI system; Time domain analysis of discrete time systems; Impulse response; The convolution sum; Methods of evaluating the convolution sum; Filtering using overlap-save and overlap-add method; Realization of digital filters: Concept of IIR and FIR filters; Realization structures for IIR and FIR filters using direct form-I and direct form-II, cascade, lattice and parallel.	
UNIT-II	**DISCRETE FOURIER TRANSFORM AND EFFICIENT COMPUTATION:**
Introduction to discrete time Fourier transform (DTFT); Discrete Fourier transform (DFT) definition; Properties of DFT; Linear and circular convolution using DFT; Fast-Fourier-transform (FFT): Direct computation of DFT; Need for efficient computation of the DFT (FFT algorithms); Radix-2 FFT algorithm for the computation of DFT and IDFT using decimation-in-time and decimation-in-frequency algorithms; General Radix-N FFT.	
UNIT-III	**STRUCUTRE OF IIR FILTERS:**
Analog filters: Butterworth filters; Chebyshev type-1 & type-2 filters; Analog transformation of prototype LPF to HPF/BPF/BSF. Transformation of analog filters into equivalent digital filters using impulse invariant method and bilinear transform method; Matlab programs of IIR filters.	
UNIT-IV	**SYMMETRIC AND ANTISYMMETRIC FIR FILTERS:**
Design of linear phase FIR filters windowing and frequency sampling methods; Equiripple linear phase FIR filters; Parks-McClellan algorithm and remez algorithm; Least-mean-square error filter design; Design of FIR differentiators; Matlab programs of FIR filters; Comparison of FIR & IIR.	
UNIT-V	**APPLICATIONS OF DSP:**
Multirate signal processing; Decimation; Interpolation; Polyphase structures for decimation and interpolation filters; Structures for rational sampling rate conversion; Applications of multirate signal processing for design of phase shifters, interfacing of digital systems with different sampling rates, sub band coding of speech signals. Analysis of finite word length effects: Representation of numbers; ADC quantization noise, coefficient quantization error, product quantization error, truncation & rounding errors; Limit cycle due to product round-off error; Round-off noise power; Limit cycle oscillations due to overflow in digital filters; Principle of scaling; Dead band effects.	
Text Books:	

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing, Principles, Algorithms and Applications, Prentice Hall, 4th Edition, 2007
2. Sanjit K Mitra, Digital signal processing, A computer base approach, McGraw-Hill Higher Education, 4th Edition, 2011.
3. Emmanuel C, Ifeacher, Barrie. W. Jervis, DSP-A Practical Approach, Pearson Education, 2nd Edition, 2002.
4. A.V. Oppenheim, R.W. Schaffer, Discrete Time Signal Processing, PHI, 2nd Edition, 2006.

Reference Books:

1. Li tan, Digital signal processing: fundamentals and applications, Elsevier Science &. Technology Books, 2nd Edition, 2008.
2. Robert J.schilling, Sandra. L.harris, Fundamentals of Digital signal processing using Matlab, Thomson Engineering, 2nd Edition, 2005.
3. Salivahanan, Vallavaraj, Gnanapriya, Digital signal processing‖, McGraw-Hill Higher Education, 2nd 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
1-5	List out the basic steps in DSP, Classify the Signals, Systems.	CLO 1 CLO 2	T1:2.1-2.3
6-8	Concept of Linear Convolution	CLO 3	T1:2.3,7.3
9-11	Time domain analysis of discrete time systems, Impulse response	CLO 4	T1:2.4
11-13	Describe the methods of Convolution Sum	CLO3	T1:2.3,7.3
14-15	Illustrate Structures for IIR and FIR systems	CLO 6	T1:2.5
16-21	Describe the signal analysis using DTFT, and Illustrate the DFT and its properties	CLO 8	T1:4.2 R1:3.1-3.2
21-25	Apply DFT for convolution of the signal	CLO 8	T1:7.2
26-30	Apply the DFT algorithm to Compute FFT in time domain, frequency domain and Compute the FFT using radix-N	CLO 10	T1:8.1.2 R2:4.5
31-35	Analyze the IIR filter design Approximations, Express Digital filters from analog filters	CLO 12	T1:10.3-10.4
36-40	Demonstration of the IIR filter design methods	CLO 12	T1:10.3-10.4
41-44	Demonstrate linear phase FIR Digital Filters using Windows, Discuss FIR Digital Filters using sampling method	CLO 13	T1:10.2.1-10.2.3
45-49	Express FIR filter design techniques., Distinguish between FIR and IIR filters	CLO 13	T1:10.2.4 R2:7.6
50-51	Explain Multirate Digital Signal processing, Express Decimation, interpolation	CLO 15	T1:11.1-11.5
52-53	Discuss Sampling rate conversion	CLO 15	T1:11.4
54-55	Demonstrate the applications of Multirate Digital Signal processing.	CLO 15	T1:11.9
56-57	Describe the quantization noise and Round-off noise	CLO 16	T1:9.4-9.6
58-60	Describe the Limit cycle oscillations and Dead band effects	CLO 17	T1:9.4-9.6

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

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Digital Filter Design.	Seminars / NPTEL	PO 2, PO 9 PO 10, PO 12	PSO 1
2	Multirate Digital Signal processing.	Seminars / Guest Lectures / NPTEL	PO1, PO5, PO 9 PO10, PO12	PSO 1

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**MICROPROCESSORS AND MICROCONTROLLERS**				
Course Code	AEC013				
Programme	B.Tech				
Semester	VI	ECE			
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	Dr. P Lakshmi Srinivasa Murthy, Professor Mr. D Khalandar Basha, Assistant Professor Mr. N Papa Rao, Assistant Professor				

I. COURSE OVERVIEW:

The course focuses on the architecture, programming of microprocessors, microcontrollers and also interfacing. The course includes architecture, addressing modes, instruction set of 8086 and 8051, minimum and maximum mode operation of 8086, Assembly language programming fundamentals, interfacing of static Ram, EPROM, DMA Controller, keyboard, display, 8279, stepper motor, A/D and D/A converter, 8259 interrupt controller, data transmission, 8251 USART, modes of timer operation of 8051, programming of real time control by using basic microcontroller. The knowledge derived from this course is useful in development of various projects and models in engineering and scientific professions.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC002	III	Digital System Design	4
UG	AEC010	V	Computer Organization	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Microprocessors and Microcontrollers	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	Mini Project
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	**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.	2	Seminars 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.	2	Quiz and Assignments
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Imbibe sound knowledge about architecture, instruction set and concepts of 8086 and 8051.
II	Demonstrate the ability to develop programmers for different applications using assembly language of 8086 and 8051.
III	Impart knowledge of different types of external peripherals like 8255,8259,8279,8251,8257
IV	Be proficient in Memory and I/O interfacing with 8086 and 8051.

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
AEC013.01	CLO 1	Understand the internal Architecture and different Modes of operation of popular 8086 microprocessors.	PO1	3
AEC013.02	CLO 2	Basic understanding of 8085 and 8086 microprocessors architectures and its functionalities.	PO2	2
AEC013.03	CLO 3	An ability to distinguish between RISC and CISC based microprocessors.	PO1	2
AEC013.04	CLO 4	Understand the importance of addressing modes and the instruction set of the processor which is used for programming.	PO2	1
AEC013.05	CLO 5	Understand and apply the fundamentals of assembly level programming of microprocessors.	PO2	3
AEC013.06	CLO 6	Design and develop 8086 Microprocessor based systems for real time applications using low level language like ALP.	PO3	3
AEC013.07	CLO 7	Ability to interface the external peripherals and I/O devices and program the 8086 microprocessor using 8255.	PO3	3
AEC013.08	CLO 8	Understand the memory organization and interrupts of processors helps in various system designing aspects.	PO3	2
AEC013.09	CLO 9	Identify the significance of serial communication in8086 with required baud rate	PO4	2
AEC013.10	CLO 10	An ability to distinguish between the serial and parallel data transfer schemes.	PO1 PO2	2
AEC013.11	CLO 11	Identify the significance of interrupts and interrupt service routines with appropriate illustrations.	PO1	2
AEC013.12	CLO 12	Develop the interfacing of universal synchronous asynchronous receiver transmitter 8251 with 8086 processor	PO3	3
AEC013.13	CLO 13	Ability to interface the programmable interrupt controller 8259 with 8086.	PO3	2
AEC013.14	CLO 14	Understand the internal Architecture and different modes of operation of popular 8051 microcontrollers.	PO3	2
AEC013.15	CLO 15	Basic understanding of 8051 microcontrollers functionalities.	PO1	3
AEC013.16	CLO 16	Understand the different addressing modes used in assembly language programming of microcontrollers.	PO1	2
AEC013.17	CLO 17	Write programs for arithmetic and logical computations using 8051 instruction sets.	PO4	3
AEC013.18	CLO 18	Construct, and develop of required delay circuits using timers of 8051 in the laboratory.	PO3	3
AEC013.19	CLO 19	Interfacing of physical elements using Digital and analog converters with microcontrollers.	PO3	3
AEC013.20	CLO 20	Assess and interface required memory to microcontrollers with appropriate memory mapping.	PO3	3
AEC013.21	CLO 21	Apply concept of microprocessors and microcontrollers to understand and analyze real time applications.	PO4	2
AEC013.22	CLO 22	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO12	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												3		
CLO 2		2											1	3	
CLO 3	2												2		
CLO 4		1												3	
CLO 5		3												3	
CLO 6			3											2	
CLO 7			3											2	
CLO 8			2										3		
CLO 9				2									1		
CLO 10	2	2												3	
CLO 11	2												2		
CLO 12			3											2	
CLO 13			2											2	
CLO 14			2										2		
CLO 15	3												3		
CLO 16	2												2		
CLO 17				3										2	
CLO 18			3											1	
CLO 19			3											1	
CLO 20			3										2		
CLO 21				2									1		
CLO 22															

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

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

XII. ASSESSMENT METHODOLOGIES-INDIRECT

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

XIII. SYLLABUS

UNIT – I : 8086 MICROPROCESSORS
Register organization of 8086, Architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special purpose activities, Minimum mode, maximum mode of 8086 system and timings, machine language instruction formats, addressing mode of 8086, instruction set of 8086,assembler directives and operators.
UNIT – II: PROGRAMMING WITH 8086 MICROPROCESSOR
Machine level programs, programming with an assembler, Assembly language programs, introduction to stack, stack structure of 8086/8088, interrupts and interrupt service routines. Interrupt cycle of 8086, non-mask able interrupt and mask able interrupts, interrupt programming.
UNIT – III: INTERFACING WITH 8086/88
Semiconductor memory interfacing, dynamic RAM interfacing, interfacing i/o ports, PIO 8255 modes of operation of 8255,interfacing to D/A and A/D converters, stepper motor interfacing, control of high power devices using 8255. Programmable interrupt controller 8259A, the keyboard /display controller8279, programmable communication interface 8251 USART, DMA Controller 8257.
UNIT – IV: 8051 MICROCONTROLLER
8051 Microcontroller – Internal architecture and pin configuration, 8051 addressing modes, instruction set, Bit addressable features. I/O Port structures, assembly language programming using data transfer, arithmetic, logical and branch instructions.
UNIT – V: SYSTEM DESIGNUSING MICROCONTROLLER
8051 Timers/Counters, Serial data communication and its programming, 8051 interrupts, Interrupt vector table, Interrupt programming. Real world interfacing of 8051 with external memory, expansion of I/O ports, LCD, ADC, DAC, stepper motor interfacing.

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	Basic understanding of 8085 and 8086 microprocessors architectures and its functionalities.	CLO 1	T2:1.2
6-10	Able to understand the importance of addressing modes and the instruction set of the processor which is used for programming.	CLO 4	T2:2.2
11-15	Analyze the importance of the instruction set of the processor which is used for programming.	CLO 4	T2:2.3
16-20	Discuss about the assembly language programming and of 8086 microprocessor.	CLO 5	T2:3.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
21-25	Understand the internal Architecture and different modes of operation of popular 8086 microprocessors.	CLO 2	T2:5.5
26-30	Ability to understand and apply the fundamentals of assembly level programming of microprocessors.	CLO 6	T2:3.3
31-33	Explain sorting and evaluation concepts of 8086 microprocessor.	CLO 12	T2:2.2
34-40	Ability to interface the external peripherals and I/O devices and program the 8086 microprocessor using 8255.	CLO 14	T2:5.1
41-45	Understand the concepts of interrupt and interrupt sub routines in 8086 microprocessor.	CLO 10	T2:4.3
46-49	Identify the significance of serial communication in 8086. Develop the interfacing of 8251 with 8086 processor.	CLO 13	T2:6.1
50-54	Analyze and understand the Interfacing of RS-232C and high speed buses.	CLO 15	R2:5.1
55-58	Understand and analyze the various advanced microprocessors internal architectures such as 80X86.	CLO 16	R2:5.3

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

S. No	Description	Proposed Actions	Relevance with POs	Relevance with PSOs
1	ALP for Microprocessors like 8086 and 80x86	Seminars / NPTEL	PO 1, PO 2, PO 5	PSO 1
2	Interfacing IO devices to various types of Microprocessors	Seminars / NPTEL	PO 2, PO 5, PO 9	PSO 1
3	Programming of all microprocessors by using ALP	Guest Lectures	PO 1, PO 5, PO 12	PSO 3

Prepared by:
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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRONIC MEASUREMENT AND INSTRUMENTATION**				
Course Code	AEC014				
Programme	B.Tech				
Semester	VI	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. K.Sudhakar Reddy, Assistant Professor				
Course Faculty	Mr. Mohd.khadir, Assistant Professor Ms. U.Dhanalaxmi,Assistant Professor Ms. K.Swathi, Assistant Professor Ms. K.S.Indrani, Assistant Professor				

I. COURSE OVERVIEW:

Electronic measurement and instrumentation is used for troubleshooting of electronic equipment, It is an essential requirement of Service sector industry. This course will help to develop skills to become professional technician with capability to measure electrical parameters using various electronic instruments like analog and digital instruments by learning this course students will able to know basics of various Instruments, transducers and working of electronic circuits used in electronic test and measuring instruments.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE002	II	Electrical Circuits	4
UG	AEC101	III	Electronic Devices and Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electronic Measurement 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.	2	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	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.	2	Lectures, Assignments, Exercises.
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Design and Lab related Exercises.

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.	2	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.	2	Lectures and Assignments.
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Acquire a sound understanding theory and performance characteristics of instruments and errors in measurement and apply to DC voltmeters, ammeters, ohmmeters.
II	Provide concepts and operation of different types of oscilloscopes and different signal generators and wave form analyzers.
III	Select different types of D.C and A.C bridges for measurement of passive components and physical parameters.
IV	Familiar with the working principle of different types of sensors and transducers.

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
AEC014.01	CLO 1	Analyze Block schematics of measuring systems, performance characteristics like accuracy, precision, resolution and the types of errors.	PO1	3
AEC014.02	CLO 2	Understand the analog measuring instruments its working of analog measuring instruments D' Arsonval movement.	PO2	2
AEC014.03	CLO 3	Discuss various types measuring range meters like DC and AC voltmeters ammeters.	PO3	2
AEC014.04	CLO 4	Understand of basic building of Cathode ray oscilloscopes and cathode ray tubes its specifications and applications.	PO1	3
AEC014.05	CLO 5	Illustrate the various types of special purpose oscilloscopes and discuss Lissajous figures, frequency measurement, phase measurement, CRO probes.	PO2	2
AEC014.06	CLO 6	Understand working principle of signal generators like AF and RF signal generators and Discuss the types of function generators.	PO1,PO3	2
AEC014.07	CLO 7	Understand the function of various types of signal analyzers and discuss the type like AF, HF wave analyzers.	PO1	3
AEC014.08	CLO 8	Understand the various wave analyzers heterodyne wave analyzers, harmonic distortion, spectrum analyzers, and power analyzers.	PO1	3
AEC014.09	CLO 9	Discuss various measurements using DC bridges for Wheat stone bridge, Kelvin bridge.	PO2,PO3	2
AEC014.10	CLO 10	Discuss various measurements using AC bridges, Maxwell, Hay, Schering, Wien, Anderson bridges, Wagner & ground connection.	PO2,PO3	2
AEC014.11	CLO 11	Understand transducers and its classifications and discuss strain gauges.	PO1	2
AEC014.12	CLO 12	Understand Force and displacement transducers, resistance thermometers, hotwire anemometers, LVDT, thermocouples, synchros.	PO3	2
AEC014.13	CLO 13	Discuss the types of transducers Piezoelectric transducers, variable capacitance transducers; Magneto strictive transducers	PO1,PO3	2
AEC014.14	CLO 14	Determine measurement of physical parameters Flow measurement, displacement meters, liquid level measurement, measurement of humidity and moisture.	PO3,PO4	2
AEC014.15	CLO 15	Illustrate the following: active and passive, primary and secondary transducers	PO1	1
AEC014.16	CLO 16	Illustrate the measurement of physical parameters of transducer like velocity, force, pressure, high pressure, vacuum level, temperature measurements	PO3,PO4	2
AEC014.17	CLO 17	Illustrate the measurement of vacuum level, temperature measurements	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	3												3		
CLO 2		2	1											2	
CLO 3	1		3										2	1	
CLO 4	3		2										1	2	
CLO 5	2	1	1											1	
CLO 6	1		3										1	2	
CLO 7	3												3		
CLO 8	3		2										3		
CLO 9		2	2	1										2	
CLO 10		2	2	1										2	
CLO 11	3		1										2	1	
CLO 12	1		2										1		
CLO 13	1		3										1	1	
CLO 14			2	2										1	
CLO 15	2												2		
CLO 16			2	2										2	
CLO 17			2	2										2	

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 3, PO 4	SEE Exams	PO 1,PO 3, PO 4	Assignments	PO 1,PO 4	Seminars	PO3
Laboratory Practices	PO 3,PO 4	Student Viva	PO 3,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	INTRODUCTION TO MEASURING INSTRUMENTS
Block schematics of measuring systems, performance characteristics, Static characteristics: Accuracy, resolution, precision, gauss error, types of errors, Dynamic characteristics : Repeatability, reproducibility, fidelity, lag; Analog measuring instruments: D' Arsonval movement, DC voltmeters and ammeter, AC voltmeters and current meters, ohmmeters, multimeters, meter protection, extension of range, digital voltmeters: Ramp type, staircase, dual slope integrating type, successive approximation type, specifications of instruments.	
Unit-II	**OSCILLOSCOPE**
Oscilloscopes: CRT, block schematic of CRO, time base circuits, delay lines, high frequency CRO considerations, applications, specifications, special purpose oscilloscopes: Dual trace, dual beam CROs, sampling oscilloscopes, storage oscilloscopes, digital storage CROs, Lissajous figures, frequency measurement, phase measurement, CRO probes.	
Unit-III	**SIGNAL GENERATOR AND SIGNAL ANALYZERS**
Signal Generators: AF and RF signal generators, sine and square wave generators, function generators: arbitrary waveform generator, sweep frequency generators, video signal generators, and specifications. Signal Analyzers: AF, HF wave analyzers, heterodyne wave analyzers, harmonic distortion, spectrum analyzers, power analyzers	
Unit-IV	**AC AND DC BRIDGES**
Measurements using DC and AC bridges: Wheat stone bridge, Kelvin bridge, AC bridges, Maxwell, Hay, Schering, Wien, Anderson bridges, Wagner & ground connection.	
Unit-V	**TRANSDUCERS**
Transducers: Classification, strain gauges, force and displacement, transducers, resistance thermometers, hotwire anemometers, LVDT, thermocouples, synchros; Piezoelectric transducers, variable capacitance transducers; Magneto strictive transducers, measurement of physical parameters: Flow measurement, displacement meters, liquid level measurement, measurement of humidity and moisture, velocity, force, pressure, high pressure, vacuum level, temperature measurements.	
Text Books:	
1. A.K.Sawhney,"Electrical and electronics measurements and instrumentation", 19th Edition, 2011. 2. H.S.Kalsi, "Electronic Instrumentation", TMH, 2nd Edition, 2004. 3. K. Lal Kishore, "Electronic Measurements and Instrumentation", Pearson Education,2nd Edition, 2010.	
Reference Books:	
1. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 1st Edition, 2007. 2. A.D. Helbincs, W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 56th 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
1-2	Describe Block schematics of measuring systems, performance characteristics, Static and Dynamic characteristics.	CLO 1	T1:2.2, T2:1.2-1.7 T2:2.10
3	Understand Analog measuring instruments: D'Arsonval movement	CLO 2	T1:2.4, T2:1.4
4-6	Discuss DC voltmeters and ammeter, AC voltmeters and current meters.	CLO 3	T2:1.12-1.13

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
7-9	Discuss ohmmeters, multimeters, meter protection, extension of range.	CLO 3	T1:2.3-2.4 T1:3.2 T2:2.3
10-11	Understand digital voltmeters: Ramp type, staircase, dual slope integrating type, Successive approximation type.	CLO 3	T1:3.3-3.4
12	Remember specifications of instruments.	CLO 3	T1:3.3-3.4
13	Explain the Oscilloscopes, CRT, block schematic of CRO	CLO 4	T1:2.3 T2: 6.10,3.2
14	Describe the functionalities of time base circuits, delay lines.	CLO 4	T1:11.1-11.5
15	Memorize the high frequency CRO considerations, applications, specifications.	CLO 4	T1:11.1-11.5
16-17	Discuss in detail about special purpose oscilloscopes, Dual trace, and dual beam CROs.	CLO 5	T1:4.8 T1:5.2-5.6
18	Discuss in detail about sampling oscilloscopes, Storage Oscilloscopes.	CLO 5	T1:4.8 T1:5.2 -5.6
19-20	Recognize digital storage CROs, Lissajous figures, and CRO probes.	CLO 5	T1:7.2
21	Understand the frequency measurement, phase measurement.	CLO 5	T1:7.2
22-23	Discuss in detail about the Signal Generators: AF and RF signal generators, sine and square wave generators.	CLO 6	T1:7.2
24	Define function generators, arbitrary waveform generator	CLO 6	T2:10.4
25-26	Describe the functionalities of Sweep frequency generators, Video signal generators and specifications.	CLO 6	T1:8.2 -8.5 T2:10.4
27-28	Describe the functionalities Signal Analyzers: AF, HF wave heterodyne wave analyzers,	CLO 7	T1:9.2-9.7
29-30	Describe the functionalities harmonic distortion, spectrum analyzers, power analyzers.	CLO 8	T1:10.1
31	Illustrate the Measurements using DC and AC bridges.	CLO 8	T1:10.2
32-33	Explain the operation of Wheat stone bridge, Kelvin bridge.	CLO 9	T1:10.2
34-35	Explain the operation of AC bridges, Maxwell, Hay bridges.	CLO 9	T1:10.3
36-37	Discuss Schering, Wien, and Anderson bridges.	CLO 10	T1:10.3
38	Understand Wagner bridge & ground connection.	CLO 10	T1:10.3
39-40	Classify Transducers, strain gauges, force and displacement transducers.	CLO 11	T3:3.12, 5.7, 5.10
41-42	Illustrate resistance thermometers, hotwire anemometers	CLO 11	T3:3.12, 5.7, 5.10
43-44	Explain LVDT, thermocouples, Piezoelectric transducers	CLO 12	T3:7.2
45-46	Understand variable capacitance transducers; Magneto strictive transducers,	CLO 13	T3:8.4
47-48	Understand measurement of physical parameters: Flow measurement, displacement meters, liquid level measurement,	CLO 14	T3:8.5
49-51	Understand Measurement of humidity and moisture, velocity measurements.	CLO 14	T1:2.2 T2:1.2-1.7 T2:2.10
52-53	Illustrate the following: active and passive, primary and secondary transducers	CLO 15	T1:2.2 T2:1.2-1.7 T2:2.10
54-56	Understand force, Pressure, high pressure measurements.	CLO 16	T1:2.2 T2:1.2-1.7 T2:2.10
57-60	Understand Measurement of vacuum level, temperature measurements.	CLO 17	T1:2.4 T2:1.4

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

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	To introduce students to monitor, analyze and control any physical system.	Seminars / NPTEL	PO2, PO3	PSO1,PSO2
2	To provide a student a knowledge to design and create novel products and solutions for real life problems.	Seminars / NPTEL	PO2, PO3	PSO2
3	To introduce students a knowledge to use modern tools necessary for electronic projects.	Seminars / NPTEL	PO1, PO4	PSO2

Prepared by:
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INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**SATELLITE COMMUNICATION**				
Course Code	AEC522				
Programme	B.Tech				
Semester	VI	ECE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. V. Sivanagaraju, Professor, ECE				
Course Faculty	Dr. V. Sivanagaraju, Professor, ECE				

I. COURSE OVERVIEW:

Satellites form an essential part of telecommunications worldwide. This Course will cover the fundamentals of Satellite communications, LEO satellites, MEO satellites, GEO satellites, and orbits. Transponders on communication satellites, link budget calculations, multiple access techniques and the propagation of radio waves through the earth's atmosphere. This course also covered the growth of VSAT systems and internet packet communications in satellite.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC009	V	Digital communications	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Satellite 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 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 and 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
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.	-	-
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.	1	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Be Proficient in the concept of Satellite communication and understand placement of communication satellite in GEO.
II	Analyze the Satellite link budget and explain the satellite subsystems like telemetry, tracking and command system.
III	Discuss the different types of multiple access techniques in communication satellites.
IV	Understand the concept of VSAT systems and packet switching in satellites.

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
CAEC522.01	CLO 1	Discuss the different satellite systems like Low earth orbit (LEO), Medium earth orbit (MEO) and Geo synchronous earth orbit (GEO).	PO 1 PO 2	2
CAEC522.02	CLO 2	Understand how the satellite is locating with	PO 1	2

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
		respect to earth and orbital perturbations due to earth's oblateness, moon and sun.	PO 2	
CAEC522.03	CLO 3	Understand the satellite sub systems like Telemetry, tracking and command system, power system, satellite antenna equipment, communications subsystem and transponders	PO 1 PO 2 PO 4	2
CAEC522.04	CLO 4	Analyze the design of satellite links for a specified C/N with and without frequency Re-use and link budget.	PO 1 PO 4	2
CAEC522.05	CLO 5	Discuss the propagation effects like atmospheric absorption, cloud attenuation, troposphere and ionospeheric scintillation and low angle fading.	PO 1 PO 4	2
CAEC522.06	CLO 6	Discuss the effects of rain, rain induced attenuation, rain induced cross polarization and interference.	PO 1 PO 2	2
CAEC522.07	CLO 7	Analyze the various multiple access techniques used in communication satellites like FDMA, TDMA and CDMA.	PO 2 PO 4	1
CAEC522.08	CLO 8	Analyze the concept of demand assignment multiple access (DAMA), types of demand assignment and characteristics.	PO 1 PO 4	2
CAEC522.09	CLO 9	Understand the significance of Spread Spectrum Multiple Access (SSMA), Direct sequence CDMA (DS-CDMA) or DS spread spectrum transmission and reception.	PO 2 PO 4	1
CAEC522.10	CLO 10	Understand and analyze the Earth Station technology transmitters, receivers, antennas, tracking systems, terrestrial interface, power test methods and lower orbit considerations.	PO 2 PO 4	1
CAEC522.11	CLO 11	Analyze the Very Small Aperture Terminal (VSAT) network architecture, access control and multiple access selection.	PO 1 PO 2	2
CAEC522.12	CLO 12	Analyze the constellation design of Non Geostationary Orbit (NGSO) coverage, frequency bands, delay and throughput.	PO 1 PO 2 PO 4	2
CAEC522.13	CLO 13	Understand the message transmission by FDMA using M/G/1 queue and message transmission by TDMA using pure aloha.	PO 2 PO 4	1
CAEC522.14	CLO 14	Apply the error control coding for digital satellite links like block codes and convolution codes.	PO 1 PO 4	2
CAEC522.15	CLO 15	Evaluate the future satellite communication systems and introduction to satellite laser communication.	PO 1 PO 2	2
CAEC522.16	CLO 16	Apply the concept of satellite communication to understand and analyze real time applications.	PO 4	2
CAEC522.17	CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 2 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:

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											3		
CLO 2	3	2											3		
CLO 3	3	2		1									3		
CLO 4	3			1											
CLO 5	3			1											1
CLO 6	3	2											3		
CLO 7		2		1									3		
CLO 8	3	2											3		
CLO 9		2		1									3		
CLO 10		2		1									3		
CLO 11	3	2		1											
CLO 12	3	2		1											1
CLO 13	3	2													
CLO 14	3			1											1
CLO 15	3	2													
CLO 16				1									3		
CLO 17		2		1											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	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	COMMUNICATIONS SPACECRAFT AND ORBITS:
Overview of present and future trends of satellite communications introduction to satellite systems: Low earth orbit (LEO); Medium earth orbit (MEO); Geo synchronous earth orbit (GEO); Geostationary earth orbit (GEO); Orbital mechanics: Orbital elements; Locating the satellite with respect to the earth; Coverage angle; Slant range; Inclined orbits; Orbital perturbations due to earth's oblateness and moon and sun; Eclipse of GEO satellite; Sun transit outage.	
Unit-II	**SPACE SEGMENT:**
Placement of a communication satellite in GEO satellite sub systems: Telemetry, tracking and command system, power system, satellite antenna equipment, communications subsystem and transponders, TWT amplifier operation, satellite frequency bands and allocations; Satellite link: Basic transmission theory, system noise temperature and G/T ratio, basic link analysis, design of satellite links for a specified C/N with and without frequency Re-use , link budget; Propagation effects: Introduction, atmospheric absorption, cloud attenuation, troposphere and ionospeheric scintillation and low angle fading; Effects of rain: Rain induced attenuation, rain induced cross polarization interference.	
Unit-III	**COMMUNICATION SATTELLITE ACCESS SYSTEMS:**
Multiple Access: Frequency division multiple access (FDMA), Time division multiple access (TDMA), frame structure, burst structure, satellite switched TDMA, on-board processing, demand assignment multiple access (DAMA), types of demand assignment, characteristics. Code Division Multiple Access (CDMA) / Spread Spectrum Multiple Access (SSMA); Direct sequence CDMA (DS-CDMA) or DS spread spectrum transmission and reception, adjacent channel interference, inter modulation, handover, satellite diversity.	
Unit-IV	**EARTH STATION AND VSAT SYSTEMS TECHNOLOGY:**
Earth Station: Transmitters, receivers, antennas, tracking systems, terrestrial interface, power test methods, lower orbit considerations; VSAT (Very Small Aperture Terminal) Systems: Overview of VSAT systems, VSAT network architecture, access control, and multiple access selection. NGSO constellation design: Orbits, coverage, frequency bands, delay and throughput, non geostationary orbit (NGSO) constellation design and problems.	
Unit-V	**SATELLITE PACKET COMMUNICATION:**
Message transmission by FDMA: M/G/1 queue, message transmission by TDMA, pure aloha, satellite packet switching, slotted aloha, packet reservation, tree algorithm; Error control for digital satellite links: Error control coding, block codes, convolution codes, implementation of error detection on satellite links. Overview of future satellite communication systems, introduction to satellite laser communication, data relay communication satellites, satellite mobile services, applications.	
Text Books:	
1. Dennis roddy, ―Satellite Communications, 4th Edition, 2004. 2. Pratt. Bostian, Allnutt, ―Satellite Communications, Wiley India, 2nd Edition, 2006. 3. Gérard Maral, ―Satellite Communication Systems, 1993. 4. Tri T. Ha, Digital Satellite Communications 2nd edition, TMH, 1990.	
Reference Books:	
1. Rappaport T.S., ―Wireless communications, 2nd Edition, Pearson Education, 2010. 2. Bruce Elbert, ―Introduction to Satellite Communications, 1987. 3. M Richharia, Satellite Communication Systems 2nd edition, MacMillan, 2005.	

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	Describe the overview of present and future trends of satellite communications.	CLO 1	T2:1.3 to 1.4

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
2-3	Introduction to Low earth orbit (LEO), Medium earth orbit (MEO), Geo synchronous earth orbit (GEO), Geostationary earth orbit (GEO) systems.	CLO 1	TI:3.8 R3: 2.2 to 2.3
4-6	Recall orbital mechanics: Orbital elements, Locating the satellite with respect to the earth, Coverage angle, Slant range, Inclined orbits.	CLO 2	T2:2.1 to 2.2 R3: 2.4 to 2.6
7-10	Analyze the orbital perturbations due to earth‘s oblateness and moon and sun, Eclipse of GEO satellite, Sun transit outage.	CLO 2	T2:2.3 to 2.6
11-13	Understand the satellite sub systems like TTC & M, power systems, antennas and communications subsystems.	CLO 3	T2:3.1 to 3.5
14-17	Apply the basic transmission theory to satellite link, system noise temperature, G/T ratio, basic link analysis link and budget.	CLO 4	T2:4.1 to 4.4 & 4.7
18-20	Understand the Propagation effects and the effects of rain.	CLO 5 CLO 6	T2:8.1 to 8.4
21-24	Recognize the purpose of multiple access like Frequency division multiple access (FDMA), Time division multiple access (TDMA), satellite switched TDMA and demand assignment multiple access (DAMA).	CLO 7 CLO 8	T2:6.1 to 6.5 R3: 8.1 to 8.4
25-27	Analyze the Code Division Multiple Access.	CLO 9	T2:6.8 R3: 8.5
28-29	Understand the earth station technology.	CLO 10	T2:10.1 to10.5
30-32	Analyze the Very Small Aperture Terminal (VSAT) Systems.	CLO 11	T2:9.1 to 9.5
33-35	Analyze the constellation design of non geostationary orbit (NGSO).	CLO 12	T2:10.4 to 10.6
36-39	Understand the message transmission by FDMA.	CLO 13	T4:8.2 to 8.7
40-43	Apply the error control coding for digital satellite links.	CLO 14	T2:7.3 to 7.6
44-45	Evaluate the future satellite communication systems.	CLO 15	R3:12.3 to 12.5

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

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Satellite communications.	Guest Lectures	PO 1, PO 2, PO 4	PSO 3
2	Design a model of spacecraft.	Seminars / NPTEL	PO 2, PO 4	PSO 1
3	Understand the launch of space vehicle.	NPTEL/ Industrial visit	PO 2	PSO 1

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	WIRELESS COMMUNICATION AND NETWORKS				
Course Code	AEC524				
Programme	B.Tech				
Semester	VI	ECE			
Course Type	ELECTIVE				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. U Soma Naidu, Assistant Professor, Department of ECE				
Course Faculty	Mr. U Soma Naidu, Assistant Professor, Department of ECE				

I. COURSE OVERVIEW:

This course is intended to stress the fundamentals of wireless communications and network engineering that are important to any wireless communication system. It introduces cellular mobile radio systems, performance criteria, design, operations and various generations of mobile systems. It covers various types of multiple access techniques and LAN Techniques. This course describes cell coverage for signal and traffic, Generations of mobile networks, different protocols and mobile data systems and their analysis. This course explains different frequency management and channel assignment techniques. This course also deals with handoff, dropped calls and cell splitting.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEC005	IV	Analog Communications	4
UG	AEC009	V	Digital Communications	4
UG	AEC010	V	Computer Organization	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Wireless Communication and Networks	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
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	Seminars.

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.	1	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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	1	Guest lectures

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand fundamental treatment of wireless communications and the Cellular Concept-System Design, Fundamental concepts like frequency reuse, Radio Wave Propagation Basic Propagation Mechanisms and Diffraction Models.
II	Understand the concept of frequency reuse and be able to apply it in the design of mobile cellular system.
III	Understand the various modulation schemes and multiple access techniques that are used in wireless communications.
IV	Remember the analytical perspective on the design and analysis of the traditional and emerging wireless networks and discuss the nature of and solution methods to the fundamental problems in wireless networking.

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
AEC524.01	CLO 1	Understand the principles and fundamentals of wireless communications.	PO 1	2
AEC524.02	CLO 2	Demonstrate cellular system design concepts in wireless mobile communication networks.	PO 1	2
AEC524.03	CLO 3	Understand the fundamental Radio Wave Propagation Mechanisms.	PO 1	2
AEC524.04	CLO 4	Analyze perspective on Fundamentals of Equalization and Mobile Radio Propagation Multipath Measurements.	PO 2	2
AEC524.05	CLO 5	Analyze various multiple access schemes and techniques used in wireless communication.	PO 2	2
AEC524.06	CLO 6	Discuss the Parameters of Mobile Multipath Channels and Types of Small-Scale Fading-Fading effects.	PO 1	2
AEC524.07	CLO 7	Examine the perspective on Fundamentals of Equalization, Linear Equalizers, Non-linear Equalization.	PO 2	2
AEC524.08	CLO 8	Study and understand the Diversity Techniques and RAKE Receiver in Radio Propagation.	PO 1	2
AEC524.09	CLO 9	Demonstrate wireless local area networks and their specifications in communication system.	PO 1	2
AEC524.10	CLO 10	Understand the analytical perspective on the design and analysis of the traditional and emerging wireless networks	PO 2 PO 3	2
AEC524.11	CLO 11	Discuss the nature of and solution methods to the fundamental problems in wireless networking.	PO 2	2
AEC524.12	CLO 12	Understand the architecture of the various wireless wide area networks such as GSM, IS-95, GPRS and SMS.	PO 1	2
AEC524.13	CLO 13	Understand the operation of the various wireless wide area networks such as GSM, IS-95, GPRS and SMS.	PO 1	2
AEC524.14	CLO 14	Understand the existing and emerging wireless standards in wireless wide area networks	PO 1	2
AEC524.15	CLO 15	Examine the emerging techniques OFDM and its importance in the wireless communications.	PO 2	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE CHIEVEMENT 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												1		
CLO 2	3												1		
CLO 3	3												1		
CLO 4		3													
CLO 5		2											2		
CLO 6	2														
CLO 7		2													1
CLO 8	3														
CLO 9	2												1		
CLO 10		2	1										1		
CLO 11		1													
CLO 12	2														
CLO 13	2														
CLO 14	2												1		
CLO 15		2													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

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

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

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

XIII. SYLLABUS:

UNIT-I	THE CELLULAR CONCEPT SYSTEM DESIGN FUNDAMENTALS
Introduction, frequency reuse, channel assignment strategies, handoff strategies; Prioritizing handoffs, practical handoff considerations, interference and system capacity; Co-channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reducing interference, trunking and grade of service, improving coverage & capacity in cellular systems; Cell splitting, sectoring.	
UNIT-II	**MOBILE RADIO PROPAGATION**
Large-Scale Path Loss: Introduction to radio wave propagation, free space propagation model, relating power to electric field, the three basic propagation mechanisms; Reflection: Reflection from dielectrics, Brewster angle, reflection from prefect conductors, ground reflection (Two-Ray) mode; Diffraction Fresnel zone geometry, knife-edge diffraction model, multiple knife-edge diffraction, scattering, outdoor propagation models; Longley-Ryce model, Okumura Model, Hata Model, PCS extension to hata Model, Walfisch and Bertoni model, wideband PCS microcell model, indoor propagation models-partition losses (Same Floor), partition losses between floors, log-distance path loss model, ericsson multiple breakpoint model, attenuation factor model, signal penetration into buildings, ray tracing and site specific modeling	
UNIT-III	**CELLULAR SYSTEM DESIGN FUNDAMENTALS**
Small-scale fading and multipath: Small scale multipath propagation; Factors influencing small scale fading, Doppler shift, impulse response model of a multipath channel; Relationship between bandwidth and received power, small; Scale multipath measurements; Direct RF pulse system, spread spectrum sliding correlator channel sounding, frequency domain channels sounding, parameters of mobile multipath channels; Time dispersion parameters. Coherence Bandwidth, Doppler spread and coherence time, types of small - Scale fading; Fading effects due to multipath time delay spread, flat fading, frequency selective fading, fading effects due to Doppler Spread-Fast fading, slow fading, statistical models for multipath fading channels; Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, simulation of Clarke and Gans Fading model, level crossing and fading statistics, two-ray Rayleigh fading model.	
UNIT-IV	**EQUALIZATION AND DIVERSITY**
Introduction, fundamentals of equalization, training a generic adaptive equalizer, equalizers in a communication receiver, linear equalizers, non-linear equalization; Decision feedback equalization (DFE), maximum likelihood sequence estimation (MLSE) equalizer, algorithms for adaptive equalization; Zero forcing algorithm, least mean square algorithm, recursive least squares algorithm; Diversity techniques; Derivation of selection diversity improvement, derivation of maximal ratio combining improvement, practical space diversity consideration; Selection diversity, feedback or scanning diversity, maximal ratio combining, equal gain combining, polarization diversity, frequency diversity, time diversity, RAKE receiver.	
UNIT-V	**WIRELESS NETWORKS**
Introduction to wireless networks, advantages and disadvantages of wireless local area networks, WLAN topologies, WLAN standard IEEE 802.11, IEEE 802.11 medium access control, comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, wireless PANs, Hipper LAN, WLL.	
Text Books:	
1. Theodore .S. Rapport, ―Wireless Communications‖, Pearson Education, 2 nd Edition, 2010. 2. Upen Dalal, "Wireless communication", oxford University press, 2 3. Kaveh Pahlvan, Prashant Krishnamurthy, "Principle of wireless networks", A United Approach‖, Pearson Education, 2004. 4. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.	
Reference Books:	
1. P.Nicopolitidis, M.S. Obaidat, G.I.Papadimitria, A.S. Pomportsis,"Wireless Networks" John Wiley & sons, 1st Edition, 2003. 2. Vijay K Garg,"Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian Reprint). 3. Mark Ciampa Jorge Olenewa, "wireless communication and Networking", IE, 2009. 4. X.Wang, H.V.Poor ,Wireless communication system, Pearson Education, 2004. 5. Jochen Schiller,"Mobile Communication", Pearson Education, 2nd Edition, 2003.	

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, Frequency Reuse.	CLO 1	T1-3.1-3.2
2	Channel Assignment Strategies, Handoff Strategies.	CLO 2	T1-3.3-3.4
3	Prioritizing Handoffs, Practical Handoff Considerations.	CLO 2	T1-3.3-3.4
4	Interference and system capacity -Co channels Interference and system capacity.	CLO 3	T1-3.5
5	Channel planning for Wireless Systems.	CLO 4	T1-3.5
6	Adjacent Channel interference, Power Control for Reducing interference.	CLO 4	T1-3.5
7	Trunking and Grade of Service.	CLO 6	T1-3.6
8	Improving Coverage & Capacity in Cellular Systems.	CLO 6	T1-3.7
9	Large-Scale Path Loss: Introduction to Radio Wave Propagation.	CLO 7	T1-4.2
10	The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics	CLO 8	T1-4.4
11	Brewster Angle, Reflection from prefect conductors.	CLO 8	T1-.5.1,4.5.2
12	Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry.	CLO 9	T1-4.6
13	Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering.	CLO 7	T1-4.7
14	Outdoor Propagation Models- Longley- Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model.	CLO 9	T1-4.10
15	Walfisch and Bertoni Model, Wideband PCS Microcell Model.	CLO 10	T1-4.10.6
16	Indoor Propagation Models-Partition losses (Same Floor).Partition losses between Floors.	CLO 12	T1-4.11
17	Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model.	CLO 10	T1-5.1.1
18	Signal penetration into buildings, Ray Tracing and Site Specific Modeling.	CLO 11	T1-5.1.1
19	Small Scale Multipath propagation- Factors influencing small scale fading, Doppler shift.	CLO 11	T1-.1.1,5.1.2
20	Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power.	CLO 6	T1-5.2
21	Small-Scale Multipath Measurements- Direct RF Pulse System.	CLO 6	T1-5.3
22	Spread Spectrum Sliding Correlator Channel Sounding.	CLO 7	T1-5.3.2
23	Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters.	CLO 7	T1-5.3.3,5.4
24	Coherence Bandwidth, Doppler Spread and Coherence Time.	CLO 6	T1-5.4.2
25	Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading.	CLO 7	T1-5.5
26	Frequency selective fading. Fading effects Due to Doppler Spread-Fast fading	CLO 5	T1-5.11
27	Slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading.	CLO 4	T1-5.11
28	Spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model.	CLO 7	T1-5.11
29	Level crossing and fading statistics, Two- ray Rayleigh Fading Model.	CLO 8	T1-5.11
30	Introduction, Fundamentals of Equalization.	CLO 7	T1-7.1,7.2
31	Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver.	CLO 7	T1-7.3,7.4
32	Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE).	CLO 7	T1-7.6,7.7
33	Maximum Likelihood Sequence Estimation (MLSE) Equalizer.	CLO 9	T1-7.7.2
34	Algorithms for adaptive equalization ,	CLO 9	T1-7.8
35	Zero forcing algorithm, least mean square algorithm, recursive	CLO 10	T1-7.8.1,8.2

Lecture No	Topics to be covered	CLOs	Reference
	least squares algorithm;		
36	Diversity techniques; Derivation of selection diversity improvement,	CLO 10	T1-7.10,11
37	Derivation of maximal ratio combining improvement, practical space diversity consideration;	CLO 10	T1-7.10.2-3
38	Selection diversity, feedback or scanning diversity,	CLO 11	T1-7.10.3
39	Maximal ratio combining, equal gain combining,	CLO 11	T1 7.10.3.3
40	Polarization diversity, frequency diversity, time diversity, RAKE receiver.	CLO 12	T1-7.10.
41	Introduction to wireless networks, advantages and disadvantages of wireless local area networks	CLO 12	R3-P184
42	WLAN topologies, WLAN standard IEEE 802.11	CLO 13	R3-P185
43	IEEE 802.11 medium access control,	CLO 13	R3-P191
44	Comparison of IEEE 802.11 a,b,g and n standards	CLO 14	R3-P190
45	IEEE 802.16 and its enhancements, Wireless PANs, Hipper LAN, WLL.	CLO 14	R3-P191

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Encourage students to solve real time applications and prepare towards competitive examinations.	Guest Lectures	PO 1	PSO 1
2	Analyze the wireless communication networks	Seminars / NPTEL	PO 2	PSO 1
3	Formulate the communication standards applicable to real time applications.	NPTEL	PO 2	PSO 1

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