INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

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

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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

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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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