INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION

Course Code	:	**A40411**			
Course Title	:	**ELECTROMAGNETIC THEORY AND TRANSMISSION LINES**			
Acadamic-year		**2015-16**			
Course Structure	:	Lectures	Tutorials	Practical's	Credits
		5	-	-	4
Course Coordinator	:	Ms.A.USHA RANI			
Team of Instructors	:	Ms. A. Usha Rani, Associate Professor. Mr. G.Nagendra Prasad, Associate Professor.			

I. COURSE OVERVIEW:

The course covers the basics of the electrostatic field—Gauss's law; boundary conditions; capacitance; Laplace's and Poisson's equations; energy, forces, and torques. The steady electric current. The magneto static field, vector potential; Ampere's and Biot-Savart laws; inductance; energy, forces, and torques. Quasi static fields; electromagnetic induction. It also deals with the propagation of Electromagnetic (EM) waves through guided and unguided media

II. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisites
UG	4	5	Mathematical background and Logical Thinking

III. MARKS DISTRIBUTION:

Sessional Marks (25 Marks)	University End Exam Marks	Total Marks
Mid Semester Test There shall be 3 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first unit of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be three assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).	75	100

IV. EVALUATION SCHEME:

Sl.No	Component	Duration(Hrs)	Marks
1	I Mid Examination	1hr 20 min	20
2	I Assignment	--	5
3	II Mid Examination	1hr 20min	20
4	II Assignment	--	5
5	End Semester Examination	3hr	75

V. COURSE OBJECTIVES:

This course has the basics of electric and magnetic fields such as different charge densities, flux (electric and magnetic), scalar and vector potentials, emf, mmf, and capacitance induced and propagation of EM waves through

- To introduce the concept of co-ordinate systems and types to analyze the motion of object and their applications in free space to student.
- To impart the knowledge of electric and magnetic fields in real time applications.
- To introduce the fundamental theory of electromagnetic waves in transmission lines and their practical applications.
- To study the propagation characteristics of electromagnetic wave in bounded and unbounded media.
- To calculate various line parameters by conventional and graphical methods

VI. COURSE OUTCOMES:

1. Upon successful completion of this course, the student will be able to understand and design the electrical machines based on the concept of electrostatics.
2. To generate modified equations for boundaries and Medias
3. To design the long time charge storage devices
4. To know the energy storage design of high magnetic field coils used in transformers, motors and generators
5. To understand and development of Maxwell's equation for dielectric and conducting media
6. To understand the design of long length transmission lines for point to point communications
7. To understand the design of high frequency transmission lines with low loss
8. To design impedance matching couplers

VII. HOW COURSE OUTCOMES ARE ASSESSED:

Program Outcomes		Level	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.	H	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.	N	
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	N	-

	considerations.		
PO 4	**Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	H	Assignments, 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.	N	Design Exercises
P0 6	**The Engineer And Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	N	--
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.	S	-
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**	N	-
PO 9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Design Exercises
PO 10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Document Preparation, Presentation
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.	S	Development of Mini Projects
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.	H	Exercises

N = None **S = Supportive** **H = Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		LEVEL	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.	H	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.	S	Tutorials
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.	S	Seminars and Projects

VIII. SYLLABUS

Unit – I

Electrostatics: Coulomb's law, Electric field Intensity, Fields due to different charge distributions, Electric Flux Density, Gauss law and its Applications, Electric Flux Density, Gauss law and its Applications,

Electric Potential, Relation Between E and V, Maxwell's Two equations for Electrostatic Fields, energy Density, Maxwell's Two equations for Electrostatic Fields, energy Density, Illustrative Problems.

Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation and Relaxation Time, Poisson's and Laplace's Equations, Capacitance- Parallel plate, Co-axial and Spherical capacitors, Illustrative Problems.

Unit-II

Magnetostatics: Biot-Savart Law, Ampere's circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's force Law, Forces due to Magnetic Fields, Ampere's force Law, Forces due to Magnetic Fields, Ampere's force Law, Inductances and Magnetic Energy, Illustrative Problems.

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer emf, Inconsistence of Ampere's Law and Displacement Current density, Maxwell's Equations indifferent Final Forms and Word Statements, Conditions at a boundary Surface: Dielectric-dielectric, dielectric-conductor Interfaces, Illustrative Problems.

Unit-III

EM Wave Characteristics-I: Wave Equations for conducting and Perfect Dielectric Media, Uniform Plane Waves-Definition, All Relations between E and H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors and Dielectrics-Characterization, Wave Propagation in good conductors and Good Dielectrics, Polarization, Illustrative Problems.

EM Wave Characteristics-II: Reflection and Refraction of Plane waves-Normal and Oblique Incidences for Perfect Dielectric, 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-I: Types, Parameters, Transmission line Equations, Primary and Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Losslessness/Low Loss Characterization, Distortion-Condition for Distortionlessness and Minimum Attenuation, Loading- Types of loading, Illustrative Problems.

Unit-V

Transmission Lines-II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR, UHF Lines as Circuit Elements, $\lambda/4$, $\lambda/2$ and $\lambda/8$ Lines- Impedance Transformations, Significance of Z_{min} and Z_{max} , Smith Chart-Configuration and Applications, Single and Double Stub Matching, Illustrative Problems.

Text Books:

1. Elements of Electromagnetic- Matthew N.o. Sadiku, 4thEd. Oxford Univ. Press.
2. Electromagnetic waves and Radiating Systems- E.C. Jordan and K.G. Balmain, 2ndEd., 2000, PHI.
3. Transmission lines and Networks- Umesh Sinha, Satya Prakashan, 2001, (Tech, India Publications), New Delhi.

Reference Books:

1. Engineering Electromagnetic- Nathan Ida, 2ndEd., 2005, Springer (India) Pvt. Ltd., New Delhi.
2. Engineering electromagnetic- William H. Hayt Jr. and John A. Buck, 7thEd., 2006, TMH.
3. Electromagnetic Field theory and Transmission Lines- G. Sashibushana Rao, Wiley India, 2013.

IX. COURSE PLAN

Unit NO	CLO's Number	Course Learning Objective	Lecture Number	Topics to be name	Reference
I	1	To design flux controlled motors and generators	1	Coulomb's law, Electric field Intensity	T1
			2	Fields due to different charge distributions	T1
			3-4	Electric Flux Density, Gauss law and its Applications	T1, T2
			5	Electric Potential, Relation Between E and V	T1,T2
	2	To analyze the Maxwell's electrostatic field equations	6-7	Maxwell's Two equations for Electrostatic Fields, energy Density	T1
			8	Illustrative Problems	T1
			9	Convection and Conduction Currents	T1
			10	Dielectric Constant, Isotropic and Homogeneous Dielectrics	T1
	3	To design long time charge boosters(chargers)	11	Continuity Equation and Relaxation Time	T1
			12	Poisson's and Laplace's Equations	T1
	4	Design of dielectric or synthetic capacitors	13	Capacitance- Parallel plate, Co-axial and Spherical capacitors	T1
			14	Illustrative Problems	T1
II	5	To know the energy storage design of high magnetic filed coils used in transformers ,motors and generators OR magnetic coupled devices	15-16	Biot-Savart Law, Ampere's Law and Applications	T1
			17	Magnetic Flux Density	T1
			18	Maxwell's Two Equations for Magneto static fields	T1
			19	Magnetic Scalar and Vector Potentials	T1
			20	Forces due to Magnetic Fields, Ampere's force Law	T1
			21	Inductances and Magnetic Energy	T1
			22	Illustrative Problems	T1
III	6	Design of ac and dc motors and generators	23	Maxwell's Equations (Time Varying Fields), Faraday's Law and Transformer EMF	T1
			24	Inconsistence of Ampere's Law and Displacement Current density	T1
			25	Maxwell's Equations indifferent Final Forms and Word Statements	T1
	7	To know the skin depth of materials	26	Conditions at a boundary Surface: Dielectric-dielectric, dielectric-conductor Interfaces	T1
			27	Illustrative Problems	T1
	8	To understand the media characteristics	28	Wave Equations for conducting and Perfect Dielectric Media	T1
			29	Uniform Plane Waves-Definition, All Relations between E and H	T1
			30	Sinusoidal Variations	T1
			31	Wave Propagation in Lossless and Conducting Media	T1

	9	To understand the material characteristics	32	Conductors and Dielectrics-Characterization	T1,T2
			33	Wave Propagation in good conductors and Good Dielectrics	T1,T2
	10	To understand the wave motion in guided and un guided media	34	Polarization and types	T1
			35	Illustrative Problems	T1
	11	To know the skin depth of materials	36	Reflection And Refraction of Plane Waves	T1
			37	Normal and Oblique Incidences for Perfect Conductor	T1
			38	Normal and Oblique Incidences for Perfect Dielectric	T1
			39	Brewster angle, Critical Angle	T1,T2
			40	Total Internal Reflection, Surface Impedance	T1
	12	To understand the behavior of EM signal	41	Poynting Vector, Poynting Theorem-Applications	T1,T2
			42	Power Loss in Plane Conductor	T1
			43	Illustrative Problems	T1
IV	13	Design of transmission lines and to understand characteristics	44	Constants Types,	T3
			45-46	Transmission line Equations, Primary and Secondary Parameters	T1,T3
			47-48	Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities	T3
			49	Infinite Line Concepts	T1, T3
			50	Losslessness/Low Loss Characterization	T3
			51-52	Distortion-Condition for Distortionlessness and Minimum Attenuation	T3
			53	Loading, Types of loading	T1, T3
			54	Illustrative Problems	T3
V	14	Design of electronic and electrical circuits	55-56	and OC Lines	T3
			57	Reflection Coefficient, VSWR	T3
			58	UHF Lines as Circuit Elements	T3
	15	Design and understanding of antenna elements like dipoles and its behavior	59-60	$\lambda/4$, $\lambda/2$ and $\lambda/8$ Lines- Impedance Transformations	T1, T3
	16	To achieve the impedance matching	61	Significance of Z_{min} and Z_{max}	T3
			62	Smith Chart-Configuration and Applications	T1,T3
	17	Design of couplers	63-64	Single and Double Stub Matching	T1,T3
			65	Illustrative Problems	T3

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

Course Objectives	Program Out Comes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	H			S			H		S				H	S	
II		S		H					S		H			S	
III	S								S	S				S	
IV		H		S			S					S		S	S
V	H				S		S		S			S		S	S

S = Supportive **H = Highly Related**

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

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	H	S					S						H	S	
2		S					S		S						
3	S										H		S		
4									S						
5	S													H	
6		H		S						S			S		
7	S	S					S		S				S	S	

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