University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSCPHY201**				
Course Title	**ELECTROMAGNETICS AND TRANSIENT CURRENTS**				
Type of Course	**DSC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	Basics of electrostatics				
Course Summary	This course aims to provide a strong foundation to the principles of electrostatics and magnetostatics and equip the students to be familiar with the theoretical basis of electrodynamics. The course also provides hands on experience in handling different electrical circuits.				

BOOKS FOR STUDY:

1. Electrodynamics: David J Griffith, PHI, 3rd Edn.
2. Electricity and Magnetism:Murugesan, S.Chand & Co.
3. Electricity and Magnetism: K.K.Tiwari, S.Chand & Co. 4. Principles of lectromagnetics: Matthew N.O. Sadiku and S. V. Kulkarni, Oxford University Press, 6th Edn.

BOOKS FOR REFERENCE:

1. Electricity and Magnetism: E.M. Purcell, Berkley Physics course, Vol.2, MGH
2. Classical Electromagnetic Theory, Jack Vanderlinde, Second Edition, Kluwer Academic Publishers, 2004
3. Classical Electrodynamics: Walter Greiner, Springer International Edn.

4. Electricity and Magnetism: Muneer H. Nayfeh & Norton K. Bressel, John Wiley & Sons
5. Electricity and Magnetism: J.H. Fewkes & John Yarwood, University Tutorial Press
6. Electromagnetic waves and radiating systems: Jordan & Balmain, PHI
7. Electromagnetics: B.B.Laud, Wiley Eastern Ltd., 2ndEdn.
8. Introduction to electrodynamics: Reitz & Milford Addison Wesley
9. Electromagnetic theory fundamentals: Bhag Guru and Huseyin Hizirogulu, Cambridge University Press, 2nd Edn.
10. Electricity and Magnetism: D.C.Tayal, Himalaya Publishing Co.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**ELECTROSTATIC FIELD**	**9**	
	1	Coulomb's law, Electric field due continuous charge distribution	2	1
	2	Field lines, flux, Gauss's law, Divergence and Curl of electrostatic fields.	2	1
	3	Electric potential, Poisson's and Laplace's equations, Potential of a localized charge distribution.	2	1
	4	Work and Energy in Electrostatics: The work done to move a charge, Energy of a point charge distribution, The energy of a continuous charge distribution	2	1
	5	Electrostatic boundary conditions	1	1
II		**ELECTROSTATIC FIELD IN MATTER**	**9**	
	6	Polar and Nonpolar molecules, Induced dipole and polarizability. Alignment of polar molecules in uniform and nonuniform electric field.	2	2
	7	Polarization in a Dielectric Material, The field of a polarized object: Bound and Free Charges, Bound Charge Density, Physical interpretation of bound charges	3	2
	8	Electric displacement, Gauss's law in presence of dielectric.	2	1, 2
	9	Boundary conditions, Linear Dielectrics	2	2

III	**MAGNETOSTATICS**		**9**	
	10	Lorentz Force, Electric Current- surface current density, volume current density, Equation of continuity.	2	3
	11	The Biot- Savarts law, Applications-Magnetic field due to long wire and circular loop	2	3
	12	Magnetic flux, Gauss's law in magnetism, Divergence of B (Physical interpretation only)	1	3
	13	Ampere's circuital theorem, Curl of B (Physical interpretation only), Applications- Magnetic field due to Solenoid and Toroid	2	3
	14	Magnetic vector potential.	1	3
	15	Boundary conditions	1	3
IV	**ELECTROMAGNETIC INDUCTION**		**9**	
	16	Electromagnetic Induction, Faraday's law, Lenz's law, Motional e m f, Induced electric field	2	4
	17	Self - inductance and Mutual inductance, back e m f	1	4
	18	Maxwell's equation, correction of Ampere's circuital theorem,	2	4
	19	Waves in one dimension: Wave equation of electromagnetic waves in vacuum, propagation of electromagnetic waves through vacuum and linear dielectric media	3	5
	20	Monochromatic planes waves, Energy and Momentum in EM waves	1	5
V*	**TRANSIENT CURRENTS**		**9**	
	21	Growth and decay of current in LR Circuit	2	6
	22	Growth and decay of current in CR Circuit	2	6
	23	Measurement of high resistance by leakage	1	6
	24	Charging of a capacitor through LCR circuit.	2	6
	25	Discharging of a capacitor through LCR circuit.	2	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Potentiometer- Resistivity	6
2	Potentiometer –Calibration of ammeter	6
3	Carey Foster's Bridge-Resistivity	6
4	Carey Foster's Bridge-Temperature coefficient of resistance.	6
5	Mirror galvanometer-figure of merit.	6
6	BG- Absolute capacity of a condenser	6
7	Conversion of galvanometer into ammeter and calibration using digital Multimeter	6
8	Circular coil-Calibration of ammeter.	6
9	Absolute determination of m and B_h using box type and Searle's type vibration magnetometers	6
10	Searle's vibration magnetometer-comparison of magnetic moments.	6
11	Potentiometer – Calibration of high range voltmeter	6
12	Potentiometer - Reduction factor of TG	6
Part B* – At least One Experiment to be performed		
13	. Potentiometer –Calibration of low range voltmeter	6
14	Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem	6
15	Thermo emf- Measurement of thermo emf of thermocouple (Seebeck effect)	6
16	Circular coil-Study of earth's magnetic field using compass box.	6
17	Conversion of galvanometer into voltmeter and calibration using digital Multimeter.	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential and boundary conditions	U, Ap	PSO-1,2,3
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	U, Ap	PSO-1,2,3
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	U, Ap	PSO-1,2,3
CO-4	Recognize the concepts related to Faraday ‘s law, induced emf, Maxwell ‘s equations	U, Ap	PSO-1,2,3,5
CO-5	Compare the properties of electromagnetic waves in vacuum, and matter	U, Ap	PSO-1,2,3,6
CO-6	Analyse the growth and decay of current in various electrical circuits	U, An	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ELECTROMAGNETICS AND TRANSIENT CURRENTS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the principles of electrostatics and apply it to the solutions of	PSO-1,2,3	U, Ap, An	F, C	L	-

	problems relating to electric field and electric potential and boundary conditions					
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	PSO-1,2,3	U, Ap, An	C	L	-
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	PSO-1,2,3	U, Ap, An	C	L	-
CO-4	Recognize the concepts related to Faraday ‘s law, induced emf, Maxwell ‘s equations	PSO-1,2,3,5	U, Ap, An	F, C	L	-
CO-5	Compare the properties of electromagnetic waves in vacuum, and matter	PSO-1,2,3,6	U, Ap, An	C, P	L	-

CO-6	Analyse the growth and decay of current in various electrical circuits	PSO-1,2,3	U, Ap, An	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	3	3	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	3	3	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	3	3	2	-	1	-	-	2	-	-	-	-	-	-	-
CO-5	2	3	2	-	-	3	-	2	-	-	-	-	-	-	-
CO-6	2	3	2	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	✓
CO-6	✓	-	-	-