Subject Description Form

Subject Code	EE2001 / EE2001A / EE2001B
Subject Title	Applied Electromagnetics
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To introduce to students the physical laws that govern the electromagnetic phenomena commonly encountered in electrical engineering systems. 2. To familiarise students with the techniques for solving problems in electromagnetics. 3. To provide students the foundation of electromagnetic field theory required for pursuing the EE programme.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand that electromagnetism is based on Maxwell’s equations. Interpret the physical meaning and phenomena behind Maxwell’s equations. Know the meanings of physical quantities of electromagnetism and their basic relationships. b. Analyse electromagnetic phenomena related to electrical engineering systems by selecting the most appropriate laws/theorems/solution techniques. c. Have hands-on experience in electromagnetic measurements.
Subject Synopsis/ Indicative Syllabus	1. ***Static fields***: Electrostatics: Electric fields, Coulomb's law, Gauss's law, potential, capacitance and energy storage. Magnetostatics: Biot-Savart law, magnetic fields, Ampere's circuital law. Force on a current-carrying conductor, Lorentz force. 2. ***Time-varying fields***: Faraday's Law and Lenz's Law; self-inductance, mutual inductance and stored energy. 3. ***Mathematical preliminaries***: Vectors analysis and coordinate systems. The operators grad, div and curl. Concept of line, surface and volume integrals. Stokes's and divergence theorems. 4. ***Maxwell's equations and EM waves***: Maxwell’s equations in integral form as a restatement of fundamentals. Differential form. The continuity equation. The displacement current. The wave equation, plane polarized wave, velocity of propagation and energy flows. 5. ***Material media***: Dielectric material: dipole, polarisation, permittivity and capacitors. Ferromagnetism: magnetisation curve, permeability, hysteresis and saturation. Boundary conditions. Magnetic circuits: magneto-motive force, reluctance and permeance. 6. ***Solution of static field problems***: Numerical and computer-based methods. Estimation of conductance, inductance, capacitance and field quantities from field plots. **Laboratory Experiments:** Field plotting using resistance and impedance networks. Field plotting using the Electrolytic tank. Field plotting using the resistive paper.

Teaching/ Learning Methodology	Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on analysis and practical applications are gained through experiments and using software, in which the students are expected to solve problems with critical and analytical thinking. Experiments are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and to look for relevant information. Software is used to help the students to understand the physical meanings of mathematical equations.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	✓	✓	
Tutorials	✓	✓	
Experiments	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	✓	✓	
2. Class Test	18%	✓	✓	
3. Assignment	12%	✓	✓	
4. Laboratory performance & report	10%	✓	✓	✓
Total	100%			

It is a fundamental subject of electromagnetics. The outcomes on physical concepts and analysis are assessed by the usual means of examination, assignment and test whilst those on analytical skills and problem-solving techniques, as well as technical reporting and teamwork, are evaluated by experiments, software application and the reports.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory preparation/report	9 Hrs.
▪ Self-study	57 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, 8th Edition, Boston: McGraw Hill, 2012.
2. N. N. Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education International, 2006.
3. F. T. Ulaby and U. Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education International, 2015.
4. F. T. Ulaby, Electromagnetics for Engineers, Pearson Education International, 2005.
5. K.E. Lonngren, etc., Fundamentals of Electromagnetics with Matlab, 2nd Edition, Scitech Publishing, Inc., 2007.