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PRIFYSGOL GLYNDŴR WRECSAM
GLYNDŴR UNIVERSITY WREXHAM

MODULE SPECIFICATION FORM

Module Title:	**Electromagnetism and Fields**	Level:	**5**	Credit Value:	**10**

Module code: (if known) **ENG517**	Cost Centre: **GAEE**	JACS2 code: **H600**

Semester(s) in which to be offered: **1**	With effect from: **July 2015**

Office use only: To be completed by AQSU:	Date approved: **July 2015** Date revised: Version No: 1

Existing/New: **Existing**	Title of module being replaced (if any): N/A

Originating Academic area: **Engineering and Applied Physics**	Module Leader: **Y Vagapov**

Module duration (total hours) 100	**Status:**	**Free-standing 10-credit component comprising first half of ENG588 (Electromagnetism and Networks).**
Scheduled learning and teaching hours 36	core/option/elective (identify programme where appropriate):	
Independent study hours 64		
Placement hours 0		

Percentage taught by Subjects other than originating Subject (please name other Subjects):	**0%**

Programme(s) in which to be offered: **Enginering European Programme** (Non Award Bearing)	Pre-requisites per programme (between levels):	**None**

Module Aims:

To develop knowledge of the laws governing the behaviour of electric and electro-magnetic fields, and to relate the laws governing the fields to applications in a range of electrical and electronic engineering applications.

Expected Learning Outcomes

Knowledge and Understanding:
At the completion of this module, the student should be able to:

1. Analyse and solve problems relating to electric and electromagnetic fields by using vectors and by applying Gauss' law and Maxwell's equations; *(KS 3)*
2. Apply electromagnetic theory in practical 'real-life' situations;

Key skills for employability

1. Written, oral and media communication skills,
2. Leadership, team working and networking skills
3. Opportunity, creativity and problem solving skills
4. Information technology skills and digital literacy
5. Information management skills
6. Research skills
7. Intercultural and sustainability skills
8. Career management skills
9. Learning to learn (managing personal and professional development, self management)
10. Numeracy

Assessment: *Please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%).*

Assessment is by means of a portfolio of problem-solving activities and practical laboratory investigations exploring electrical networks and electromagnetic fields and devices. These may include, or be carried out by means of, computer simulations. The student will be required to submit a report at the end of each topic. Therefore, the student will be provided with feedback on each element of the assessment during the semester and able to monitor individual progress. An example is the design and modelling of a T-attenuator to match a source to an unlike load and comparing this technique with that of using an impedance-matching transformer.

(This corresponds to Assessment 1 of ENG588 - Electromagnetism and Networks.)

Assessment number (use as appropriate)	Learning Outcomes met	Type of assessment	Weighting	Duration (if exam)	Word count (if coursework)
Assessment One:	1, 2	Portfolio	100%		2000

Learning and Teaching Strategies:

The module will be delivered through lectures, tutorials, and practical laboratory exercises. The tutorials will be used for the solution of problems in an interactive situation.

Practical and theory work will be supplemented by simulation using appropriate modelling software.

Syllabus outline:

Electromagnetism and Electromechanical Energy

Conversion: Magnetic field, Force on current currying wire, Magneto-motive force, Magnetic circuits, Analogy between magnetic and electrical circuits, Assumptions to calculate magnetic circuit, Magnetic materials, air gap, Magnetisation curve and hysteresis, Hysteresis loss, Eddy current loss, Permanent magnet, Torque, Load, Rotational speed, Angular velocity, Mechanical power.

Faraday's laws: emf equations for induction; Inductance of single coils.

Transformers: Principles, Faraday's laws: emf equations for induction; Ideal transformer, Transformer ratio of turns, e.m.f. equation, Equivalent circuit, Referred parameters. A**pplications**: mains power, dc power supply units, instrument, impedance matching, radio/hf and audio drive applications.

Capacitors: Charge, Electric Field; Electric force, Potential gradient, E, D, permittivity, dielectric constant.

Propagation of E/M waves: EM regulations. Outline of need for EMC certification: Faraday cage and tests

Field theory

Electromagnetic theory: Vectors: components, algebra. Charge distributions/charge density, current, current density. Coulomb's law, electrical forces/superposition, calculation of charge distributions. Electric field: electric fields, charge geometry, point charges, multiple point charges, continuous charge distributions.

Laws: Gauss's flux law, the Gaussian surface. Divergence of a field, Gauss's law at a point, Maxwell's 1st equation. Curl of a field, Maxwell's 2nd law. **Electric Potential, Potential Difference and Electric Fields:** Electric potential, potential difference, energy/work and fields. Biot-Savart Law. Ampere's Law. Forces due to magnetic fields, Lorentz Force law, Magnetic Force on a current element. **Induced e.m.f and Maxwell's Equations:** Faraday's Law. Self and mutual inductances. Maxwell's Equations.

Simulation: Use numerical techniques and computer simulation to model electromagnetic field behaviour.

Bibliography:

Essential Reading

Bird, J. (2010) *Electrical Circuit Theory and Technology,* 4th Edn., Newnes.

Recommended Reading:

Chapman, S. J. (2011) *Electric Machinery Fundamentals*, 5th Edn., New York: McGraw-Hill.

Hughes, E. (2012) *Electrical and Electronic Technology*, 11th Edn, Prentice Hall.

Duffin W. J. (2001), *Electricity and Magnetism*, McGraw-Hill.

Ulaby F. T. (2005), *Electromagnetics for Engineers*, Pearson.

Schmitt R. (2002), *Electromagnetics explained: A handbook for wireless/RF, EMC & high-speed electronics*, Newnes.

Berube, R. (2004) *Computer Simulated Experiments for Electric Circuits Using Electronics Workbench Multisim* (3rd Edn), London, Prentice-Hall

'Mathworks' (2012), *Matlab and Simulink Student version 2012a*; Prentice Hall.

IEEE *Transactions on Electromagnetic Compatibility,* IEEE, Quarterly Journal.

IET *Microwave, Antennas & Propagation,* IET, Bi-monthly Journal.