ELB045 - Electrical Power & Machines
Module Description

Principally taught by	Electronic & Electrical Engineering
Modular weight	10
ECTS Credit	5
Credit Level	5
Exam weighting	80
SAP Restriction	Some elements of assessment cannot be reassessed in SAP (Re-assessment involving laboratory work and coursework is not available during the Special Assessment Period.)
Prerequisite modules	None
Availability	Module is available to any student meeting pre-requisites, but numbers will be restricted and priority will be given to students for whom the module is listed in their Programme Regulations.
Responsible Examiner	Dr F. Gonzalez-Longatt
Delivery Period	Semester 2

1. Aims and Summary

(1) To give students a basic understanding of electrical technology as used in mechanical engineering applications.

(2) To introduce electrical machines and power systems and their practical applications, supported by practical analysis/synthesis methods of sufficient mathematical depth.

2. The intended learning outcomes are that on completion of this module the student should be able to:

At the end of the module the student should be able to:

(1) Knowledge and Understanding

Analyse ac circuits using complex numbers, and be able to use phasor diagrams in the analysis of ac power circuits and the analysis of three phase circuits. Understand how the transformers, induction motors, synchronous generators and dc motors work and be able to use them in industrial applications.

(2) Skills and Attributes

(i) Intellectual

Analyse complex electrical networks (ac and dc), and predict the performance of electrical machines. This ability is fundamental for the students with mechanical engineering background, to be able to handle electromechanical problems encountered in real life situations.

(ii) Practical

Test a single phase transformer to determine its equivalent circuit parameters and compare the theoretical results with practical results under load conditions. Know the safety precautions that need to be taken into account when testing electrical plant and equipment.

(iii) Transferable

- Test electrical plant equipment (transformers, motors, generators).
- Apply methods of ac circuit analysis to other more complex networks.
- Analyse of three phase power networks.
- Design electromechanical power conversion systems.
- Write technical reports.

3. Indicative Content

- Importance of electrical supplies;
- Impedance represented by complex numbers;
- Phasor notation;
- Calculating ac voltages and currents using phasor diagrams and complex numbers; Maximum power transfer;
- 3-phase AC circuits (balanced and unbalanced);
- Star-and Delta connected loads;
- Transformers;
- Transformer equivalent circuit;
- Principles of electrical machines;
- Torque generation;
- Direct Current motors and their control;
- Induction motors and their equivalent circuit;
- Speed control of induction motors;
- Maximum torque of induction motors,
- Single-phase induction motors;
- Synchronous motors and generators;
- Motion control:
- Torque, speed and position control.

4. Lecture Plan

Week	Beginning	Lecture plan	Notes / support session	Lecturer
1	03.02.13	LECTURE 1: Summary of DC Circuits LECTURE 2: Summary of DC Transients and Steady-State		FGL
2	10.02.13	LECTURE 3: Steady-state DC circuits with R, L, C LECTURE 4: Steady-state AC circuits with X_L, X_e and Z		FGL
3	17.02.13	LECTURE 5: AC Circuit Analysis and Resonance LECTURE 6: Thevenin's Equivalent Circuit (TEC) , DC and AC		FGL
4	24.02.13	LECTURE 7: Norton's Equivalent Circuit (NEC), DC and AC LECTURE 8: Maximum Power Transfer - DC and AC circuits		FGL
5	03.03.13	LECTURE 9: Single Phase Transformer LECTURE 10: Use of Transformer for Maximum Power Transfer		FGL
6	10.03.13	LECTURE 11: Equivalent circuit of a transformer LECTURE 12: Magnetic Circuit Analysis, Energy and Force Equations		FGL
7	17.03.13	LECTURE 13: Eddy Current and Hysteresis Losses LECTURE 14: Rotating Magnetic Field and Introduction to Induction Motors		FGL
8	24.03.13	LECTURE 15: Induction Motors and Their Torque Speed Characteristics LECTURE 16: DC Machines		FGL
9	28.04.13	LECTURE 17: Fundamentals of AC Generators LECTURE 18 Three Phase Circuits - Star Connection		FGL
10	05.05.13	LECTURE 19 Three Phase Circuits- Delta Connection LECTURE 20: Synchronous generator and Loads		FGL
11	12.05.13	LECTURE 21: Revisions		FGL
12	19.05.13	LECTURE 22: Solution of a Past Exam Paper		FGL

5. Essential Reading

Course notes and on-line resources

6. Teaching and Learning

Activity Type	Hours	Comments
Practical classes and workshops	4	
Tutorial	12	
Lecture	24	
Guided independent study	60	
TOTAL	**100**	

- **2 Lectures** and **1 tutorial** per week for 12 weeks.
- **4 hours of laboratories**.

Remaining 60 hours are for self-study, writing coursework and revision for examinations.

7. Assessment

Assessment Title	Weight	Assessment Type	Exam Semester	Exam length
Coursework	20%	Coursework		
Exam 1	80%	Exam	2	2 hrs
TOTAL	**100%**			

One two-hour written examination paper (80%) and one coursework laboratory report (20%).

8. Method of Feedback

1. **Feedback given to students in response to assessed work**
   The assessed coursework is a formal report which is submitted individually, based on the transformer experiment. The requirements of the formal report are discussed in detail during a lecture/tutorial period.

2. **Developmental feedback generated through teaching activities**
   All tutorial questions are solved in class and discussed in depth, during the tutorial periods. The solutions of the tutorial questions take place a week after the students have had enough time to attempt them on their own or in groups.

9. Recommended Reading

- BRADLEY, D. A. (David A.)., 1994. *Basic electrical power and machines*. Chapman and Hall.
- FRASER, C. J. (Charles J.), Milne, J. S., 1994. *Integrated electrical and electronic engineering for mechanical engineers*. McGraw-Hill.
- WARNES, L. A. A., 2002. *Electronic and electrical engineering: principles and practice* /. Palgrave Macmillan,.