Module Proforma

Approved, 2022.01

Summary Information

Module Code	5525USST
Formal Module Title	Electric machines, power systems and clean energy
Owning School	Engineering
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 5
Grading Schema	40

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Dante Matellini	Yes	N/A

Module Team Member

Contact Name	Applies to all offerings	Offerings

Partner Module Team

Contact Name	Applies to all offerings	Offerings

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
University of Shanghai For Science and Technology

Learning Methods

Learning Method Type	Hours
Lecture	22
Tutorial	11

Module Offering(s)

Offering Code	Location	Start Month	Duration
JAN-PAR	PAR	January	12 Weeks

Aims and Outcomes

Aims	This module is intended to achieve the following programme aims within the field of Electrical Engineering: To introduce the three-phase power system and transmission lines. To enhance knowledge and understanding of the broad scientific and technological principles underpinning operation of rotating electrical machinery and transformers. To develop understanding of the steady-state operating principles of single-phase, three-phase transformers, DC and AC rotating machines. To rehearse practical skills in the use of mathematical methods for modelling and analysing electric machines and power systems. To introduce the use of electric machines in clean energy applications such as Hydro power plants, pumped storage systems and Wind farms.

Learning Outcomes

After completing the module the student should be able to:

Code	Description
MLO1	State and apply to problems the laws of electromagnetism.
MLO2	Define the principles of electromechanical energy conversion.
MLO3	Present, analyse and evaluate steady-state operating characteristics of transformers, dc, induction and synchronous machines.

MLO4	Undertake modelling of various components of a power system as required for steady state power system analysis
MLO5	Apply power system component models in analysis of normal and faulted power system operation.

Module Content

Outline Syllabus
Fundamentals of electromagnetism: Force and torque in magnetic field, induced electromotive force. Inductance and magnetic circuits: self-inductance, mutual and leakage inductance; magnetic circuits and reluctance of the magnetic path, B-H curve of magnetic material, cores with air-gap. Induced electromotive force: induction in stationary systems with time varying fields and in systems with movable parts in time dependent and time independent fields. Losses in ferromagnetic materials. Electric machines and clean energy: Electromechanical energy conversion: motoring and generating, time-domain modelling, torque and average torque, types of machines, rotating field. Steady-state analysis of dc machines: types, circuits and equations, speed-torque curve. Steady-state analysis of induction machines: operating principle, equivalent circuit, phasor diagram, torque speed curve, losses and efficiency. Steady-state analysis of synchronous motors/generators: operating principles, active and reactive power, phasor diagrams, equivalent circuits, power and torque versus load angle curves. The use of synchronous generators and induction generators in Hydro and wind energy converters. Electric power systems: Impedance drop, voltage drop and voltage regulation. Modelling of power system components: load, transmission lines, cables and transformers. Per unit system. Symmetrical component theory, symmetrical impedance networks. Symmetrical and asymmetrical short circuit analysis.

Module Overview

Additional Information

It is expected that students taking this module have a solid understanding of basic circuit theory, including three-phase AC circuits.

General Notes

UNESCO Sustainable Development Goals

Quality Education
Affordable and Clean Energy
Decent Work and Economic Growth
Industry, Innovation and Infrastructure
Sustainable Cities and Communities
Responsible Consumption and Production
Climate Action

UK SPEC AHEP 4

CEng.
M1 Apply a comprehensive knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Much of the knowledge will be at the forefront of the particular subject of study and informed by a critical awareness of new developments and the wider context of engineering.
M2 Formulate and analyse complex problems to reach substantiated conclusions. This will involve evaluating available data using first principles of mathematics, statistics, natural science and engineering principles, and using engineering judgment to work with information that may be uncertain or incomplete, discussing the limitations of the techniques employed.
M3 Select and apply appropriate computational and analytical techniques to model complex problems, discussing the limitations of the techniques employed.
M4 Select and critically evaluate technical literature and other sources of information to solve complex problems.
M6 Apply an integrated or systems approach to the solution of complex problems.
M7 Evaluate the environmental and societal impact of solutions to complex problems (to include the entire lifecycle of a product or process) and minimise adverse impacts.
M18 Plan and record self-learning and development as the foundation for lifelong learning/CPD.

IEng.
B1 Apply knowledge of mathematics, statistics, natural science and engineering
principles to broadly-defined problems. Some of the knowledge will be informed by current developments in the subject of study.
B2 Analyse broadly-defined problems reaching substantiated conclusions using first principles of mathematics, statistics, natural science and engineering principles.
B3 Select and apply appropriate computational and analytical techniques to model broadly-defined problems, recognising the limitations of the techniques employed.
B4 Select and evaluate technical literature and other sources of information to address broadly-defined problems.
B7 Evaluate the environmental and societal impact of solutions to broadly-defined problems.
B8 Identify and analyse ethical concerns and make reasoned ethical choices informed by professional codes of conduct.
B13 Select and apply appropriate materials, equipment, engineering technologies and processes.
B18 Plan and record self-learning and development as the foundation for lifelong learning/CPD.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Learning Outcome Mapping
Portfolio	Tests	70	0	MLO1, MLO2, MLO3, MLO4, MLO5
Report	Report	30	0	MLO3, MLO4