Module Specification

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Module Code	ENG5AK
Module Title	Power, Distribution and System Design
Level	5
Credit value	20
Faculty	FAST
HECoS Code	101354
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
FdEng Industrial Engineering (Electrical and Automation)	Core
BEng (Hons) Industrial Engineering Design (Electrical and Electronic)	Core

Pre-requisites

N/A

Breakdown of module hours

Learning and teaching hours	20hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	16 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	36 hrs
Placement / work based learning	0 hrs
Guided independent study	164 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	Sept 2019
With effect from date	September 2022

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Date and details of revision	30/01/20 admin update of derogation 12/8/20 Temporary change to assessment for 2020/21 post Covid. 22/9/21 Temporary change to assessment extended for 21/22 Sept 22: Assessment update in Engineering revalidation, addition of FdEng Industrial Engineering (Electrical and Automation)
Version number	5

Module aims

The module aims to provide students with an understanding of the operation of power electronic systems/devices and electrical machinery including the appropriate analytical techniques to undertake the design and evaluation of power electronics and electrical machines applications.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Analyse operation of electrical power systems for the modern industry including generation, transmission and distribution and its impact on the environment.
2	Apply appropriate analysis techniques and design methods to develop, assess and optimise the electrical power systems and devices.
3	Use the power engineering equipment and components to install, test and maintain electrical power systems.
4	Apply appropriate calculation methods to analyse electrical circuits used in power engineering applications.

In addition to the module learning outcomes, students will also cover the following accreditation of higher education programme (AHEP) fourth edition learning outcomes: F1, F2, F5 & F12 for FdEng Industrial Engineering (Electrical and Automation) and C1, C2, C5 & C12 for BEng (Hons) Industrial Engineering Design (Electrical and Electronic).

Assessment

Indicative Assessment Tasks:
This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment 1 - The theoretical aspects of the module content will be assessed by means of an in-class test. (2 hours) This will be closed book and the students will be expected to recall formulae necessary for calculations. The in-class test will involve the application of appropriate formulae in order to determine solutions relating to generation and distribution of electrical energy including efficiency, reliability and economical aspects.

Assessment 2 – This assessment is a portfolio of practical laboratory investigations and problem-solving activities exploring all topics of electrical power systems. The laboratory

investigations involve appropriate circuit design, use of instrumentation and data collection relating to an analysis of performance of electrical power system. The portfolio should cover the broad concepts along with the depth of study relating to a particular electrical power system.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1, 2	In-class test	50%
2	3, 4	Portfolio	50%

Derogations

A derogation from regulations has been approved for this module which means that whilst the pass mark is 40%, each element of assessment requires a minimum mark of 30% for the module to be passed overall.

Learning and Teaching Strategies

Lectures - presentation of theory, facts and concepts, relating to electrical power engineering in order to convey critical information. Interaction or active learning should be implemented to develop an understanding of principles and concepts and stimulate discussion.

Tutorials – Close interaction with students ensuring that the work presented during lectures has been understood, with specific help being given in order to overcome any learning problems, should they occur.

Laboratory works – Practical experiments performed in order to demonstrate electrical power engineering principles being applied.

The module is taught through a combination of lectures and workshops. An active and inclusive approach is used to engage learners in the topics and will involve individual, group work and flipped learning experiences aligned to the university's Active Learning Framework (ALF). The approach offers students a flexible and adaptive learning experience that can accommodate a range of options that includes both on campus learning and remote learning where appropriate.

The Moodle VLE and other on-line materials and resources will be available to support learning. ALF offers a balance between the classroom elements and digitally enabled activity incorporating flexible and accessible resources and flexible and accessible feedback to support learning.

Indicative Syllabus Outline

Electromagnetism and Electromechanical Energy Conversion: Magnetic field, Magneto-motive force, Magnetic circuits, Assumptions to calculate magnetic circuit, Magnetic materials, Magnetisation curve and hysteresis.

Transformers: Principles of operation, Ideal transformer, Transformer ratio of turns, e.m.f. equation, Equivalent circuit, Referred parameters, Determination of transformer parameters, Copper and core losses, Power flow diagram, Efficiency.

Three Phase Systems: Generation of three-phase e.m.fs, Star and delta connected loads, Balanced and unbalanced three phase systems, Three phase transformers, Star and delta connection of three phase transformer windings.

Synchronous Generators: Construction, Operation, Per phase equivalent circuit, Phasor diagram, Excitation, Losses, Power flow diagram, Efficiency, Voltage regulation, External characteristics, Synchronous generator tests, Performance under different power factor conditions, Operation on infinite busbars.

Transmission and Distribution: Types of transmission/distribution lines, Losses in transmission line; Impedance and Equivalent circuit of transmission/distribution line.

Electrical Power System Protection: Per unit system of measurement. Equivalent circuits of the electrical power system components; Short circuit fault development; Balanced short circuit calculations.

Power Factor in Electrical Power Systems: Active, reactive and apparent powers; Leading, lagging and unity power factor; Measurement of power and power factor in three-phase systems, Methods of power factor improvement.

Electricity Generation and Tariffs: Power plants, Economics of electricity supply, Cost of electricity, Structure of tariffs, Maximum demand and Load factor.

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

B. M. Weedy, *Electric Power Systems.* 5th Ed. Chichester: Wiley, 2012.

Other indicative reading

J. Bird, *Electrical Circuit Theory and Technology.* 7th Ed. Oxon: Routledge, 2022.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas.

Core Attributes

Engaged
Enterprising
Creative
Ethical

Key Attitudes

Commitment
Curiosity
Resilience
Confidence

Adaptability

Practical Skillsets

Digital Fluency
Organisation
Leadership and Team working
Critical Thinking
Emotional Intelligence
Communication