## MODULE DESCRIPTION FORM

**DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING**

# ME929 Electrical Power Systems

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| **Module Registrar: Dr Nick Kelly** **nick@esru.strath.ac.uk** | **Taught To (Course): MSc Renewable Energy Systems and the Environment (compulsory), MSc Offshore Renewable Energy, MSc Advanced Mechanical Engineering / with Energy Systems / with Aerospace** | | |
| **Other Lecturers Involved:** | **Credit Weighting: 10** | **Semester: 1** | |
| **Assumed Prerequisites:** | **Compulsory/ optional/ elective class** | **Academic Level: 5** | **Suitable for Exchange: Y** |

**Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):**

| Lecture | Tutorial | Laboratory | Groupwork | External | Online | Project | Assignments | Private Study | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 10 | | | | | | 22 | 44 | 100 |

**Educational Aim**

This module aims to provide students with an understanding of the operation of modern electrical power systems featuring renewable and low carbon generation, along with the techniques to undertake a basic technical analysis of key electrical devices and systems.

**Learning Outcomes**

On completion of the module the student is expected to be able to:

LO1 Explain the basis of operation of modern electrical power systems incorporating renewable energy technologies and the consequences for the environment and energy security.

LO2 Apply complex numbers and fundamental analysis techniques such as Kirchoff's current and voltage laws to solve power flow problems and analyse equivalent circuits of electrical systems and devices.

**Syllabus**

The module will teach the following:

- The fundamentals of electrical power: direct current (DC) and voltage, alternating current (AC) and voltage. For AC systems: converting time varying, fixed frequency quantities to phasor form.
- The basics of circuit analysis: basic circuit elements (resistor, indictor and capacitor) and their effect on current and voltage in DC and AC systems.
- Power in DC and AC systems: looking at the concepts of real, reactive, apparent power and impedance.
- An overview of the demand for electricity, looking at the aggregate characteristics of electricity demand and giving a specific example of demand for electricity in a dwelling.
- An overview of electricity generation and distribution within the UK, along with a detailed review of the growth of renewable electricity generation.
- Microgeneration, storage and power conversion.
- The basics of electromagnetism, specifically focusing on how it underpins the operation of electrical equipment.

- An overview of electrical machines including the transformer, synchronous generator and induction machines (used as both motors and generators). For each, an equivalent circuit will be developed and used to illustrate the operational characteristics of these devices in power systems.

- Power conversion and protection in power systems.

**Assessment of Learning Outcomes**

**Criteria**

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 To assess the degree of understanding of the principles of power system operation and associated energy security and environmental issues, students will be asked to produce a technical report based around new developments in power systems, in areas such as the growth of renewables and microgeneration. This will be assessed based on:
C1 Evidence of significant additional study and use of material not delivered in class.
C2 Use of supporting material to fully explain the development and present form of a power system.
C3 A well-structured submission with good use of referencing.

LO1 Further, students will be required to answer short essay questions as part of the end-of module examination in which the students will be expected to:
C4 Explain the principles behind the operation of different electrical devices or systems.
C5 Correctly identify in which context it is appropriate to apply different types of electrical device.

LO2 In order to gauge the ability of students to apply analysis techniques introduced in class to basic electrical problems, students will be assessed in an end-of-module examination. This will be based on:
C1 The ability of the student to correctly solve basic problems in circuit analysis and power flow.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

**Principles of Assessment and Feedback**
*(within Assessment and Feedback Policy at: https://www.strath.ac.uk/staff/policies/academic/ )*

Assessment of student performance within the module will be based on a combination of a technical assignment and examination. The assignment will be used to gauge the student's understanding of the principles of operation of modern power systems and the challenges posed by the integration of renewable technologies. The examination will primarily assess the ability of the student to apply techniques introduced in class to basic technical problems associated with electrical power systems.

Multiple feedback mechanisms will be employed: an essay assignment will be returned to students with comments on performance. Additionally, clear guidance will be provided in class as to what constitutes an acceptable level of performance in the written assignment.

The tutorial class will also be used to provide feedback on the development of a student's technical analysis skills. This will be achieved through direct observation of a student's efforts to tackle technical problems followed by appropriate mentoring. Additionally, peer-peer feedback will be employed in that students will be expected to present to their peers on how they set about tackling a tutorial problem.

**Assessment Method(s) Including Percentage Breakdown and Duration of Exams**

| Examination | | | | Coursework | | Practical | | Project | |
|---|---|---|---|---|---|---|---|---|---|
| Number | Month(s) | Duration | ***Weighting*** | Number | ***Weighting*** | Number | ***Weighting*** | Number | ***Weighting*** |
| 1 | Dec | 2 hr | 70% | 1 | 30% | | | | |
| *LO1, LO2 | | | | *LO1 | | * | | * | |

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

**Coursework / Submissions deadlines (*academic weeks*):**
Wk 8

**Resit Assessment Procedures:**
2 hr examination in August diet

**PLEASE NOTE:**
**Students must gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-assessed during the August diet. This re-assessment will consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.**

**Recommended Reading**

*****Purchase recommended **Highly recommended reading *For reference**

*Wildi T, Electrical Machines Drives and Power Systems, International Edition, Prentice Hall, New Jersey.

Extra reading material provided on class Myplace page.

**Additional Student Feedback**
*(Please specify details of when additional feedback will be provided)*

| Date | Time | Room No |
|---|---|---|
| By Arrangement | By arrangement | JW814c |

Session: 2019/20

**Approved:**

**Course Director Signature:** ***E Henderson***

**Date of Last Modifications: 27/08/2019**

(Updated June 2019)

# MODULE TIMETABLE

| **Module Code:** | **ME929** | **Module Title:** | **Electrical Power Systems** |
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**Brief Description of Assessment:**

Technical analysis of emerging energy supply/demand paradigms in electrical power. Specific topic to be outlined in WK4 (30% of mark) Module Examination (70% of mark)

## Assessment Timing

Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment using the dropdowns provided. Dropdowns can be left blank. Add extra notes below the dropdowns.

**Please note: Timings can and will change, this should only be used as a guide.**

| **Semester One** | W&D Wk | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 | WK10 | WK11 | Exam Period |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Choose an item. Choose an item. | Choose an item. Choose an item. | Choose an item. Choose an item. | Choose an item. Choose an item. | Course work Set | Choose an item. Choose an item. | Choose an item. Choose an item. | Choose an item. | Course work Submit Choose an item. | Choose an item. Choose an item. | Choose an item. Choose an item. | Choose an item. Choose an item. | Exam |

| **Semester Two** | C&D Wk | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 | WK10 | WK11 | Exam Period |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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