Stellenbosch University Faculty of Engineering

Module Framework

This document should be read with the following documents: Stellenbosch University Calendar Parts 1 and 11, Faculty of Engineering Assessment Rules[1], Faculty of Engineering General Stipulations for Undergraduate Modules[1]

Module: 43915 **Energy Systems 424** 2017	Lecturer(s): Prof. HJ Vermeulen, Room: E319, vermeuln@sun.ac.za Internal moderator: Dr. JM Strauss	Approved by Programme Coordinator:  Date: 26 January 2017

1. Assessment Details

- Major assessment dates and venues are provided at firga.sun.ac.za and mymaties.com
- Note that awarding a pass mark is subject to meeting each the ECSA Exit Level Outcomes assessed in this module, as stated in Faculty of Engineering's Assessment Rules

Calculation of final marks (according to formulas in the Faculty of Engineering's Assessment Rules):

Assessment Method: Flexible: w_{SM} = 10%; w_{A1} = 40%; w_{A2} = 50%

SM=average(Tut tests, class test and assignments), A1=test during test week, A2=test in first examination period

Note that both A1 and A2 are compulsory.

2 Language of Tuition

- The language of tuition in this module is according to the Faculty's approved Language Implementation Plan. Please refer to the website of the Engineering Faculty for the particulars.

2. Module Objectives

Aim: To master the basic aspects of power flow, fault calculations, protection, dynamic stability and high voltage technology as applicable to electrical power systems.

A student who has successfully completed this module can:

- Compile and solve the power flow equations of power networks.
- Perform symmetrical fault calculations for power systems.
- Perform unsymmetrical fault calculations for power systems.
- Determine the performance of current transformers.
- Calculate coordinated trip times for an overcurrent protection system for a radial network.
- Design a differential protection system for a power transformer.
- Calculate the power angle of a synchronous machine during a system disturbance using the swing equation.
- Determine the stability of a power system using the equal area criteria.
- Explain the operation of high voltage test equipment and test procedures.
- Explain high voltage phenomena such as discharges and flashovers.
- Design simple high voltage insulation systems.
- Safely perform high voltage measurements and tests in a laboratory.

3. Module Content and Schedule

Prescribed handbook: J.D. Glover, M.S. Sarma and T.J. Overbye, *Power System Analysis and Design,* Fifth Edition.
Notes: J.P. Holtzhausen and W.L. Vosloo, High Voltage Engineering

Week	Topic	Contact Session/Assignments
1	Power flow	Tutorial
2	Power flow	Tutorial
3	Symmetrical faults	Tutorial

[1] Available on SUNLearn for modules offered by Faculty of Engineering, in the block titled "General Programme Information" on the left-hand side

4	Unsymmetrical faults	Tutorial
5	Unsymmetrical faults	Tutorial
6	Power system protection	Tutorial
7	Power system stability	Tutorial
	Test week	
	Recess	
8	Power system stability	Tutorial
9	Electrical breakdown in gases, solid and liquid dielectrics.	Tutorial
10	Electrical breakdown in gases, solid and liquid dielectrics.	Practical 1
11	Generation of high voltages, test procedures and measurements.	Tutorial
12	Design of high voltages systems, electostatic fields and stress control.	Practical 2
13	Overvoltages and insulation coordination.	Tutorial

4. ECSA Knowledge Area Credits

Mathematical Science	Basic Science	Engineering Science	Design and Synthesis	Complementary Studies
0	0	12	3	0

Engineering Science:
Content: Power system analysis and design concepts, including high voltage engineering.
Assessment: Assessed in tests.
Design and Synthesis:
Content: Design of an overcurrent protection system; design of a simple power system using computer software.
Assessment: Assessed in tests and assignments.

5. ECSA Exit Level Outcomes

ELO 1. Problem solving: Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.	
How is the Outcome Assessed?	Assessment is by way of the Flexible Assessment system in the Faculty of Engineering, with a final mark calculated from two tests and assignments and/or tutorials and/or practicals.
What is Satisfactory Performance?	Using the assessment material and opportunities, the student must show that he/she applied a systematic problem solving method to a complex engineering problem which required specialized engineering knowledge at a level consistent to that which a graduate would participate in an employment situation shortly after graduation. In his approach, the student must show that he/she understands and can follow a systematic technique which includes the following steps: • analysis of the problem; • identification of the criteria for an acceptable solution, necessary information, and required engineering skills and knowledge; • generation and formulation of possible approaches to the solution of the problem; • modelling, analyses and evaluation of possible solution(s) and selection of the best solution; • formulation and presentation of the solution in an appropriate form.
What is the consequence of unsatisfactory performance?	Unsatisfactory performance in assessment 2 combined with the semester mark grants access to assessment 3; unsatisfactory performance in assessment 3 leads to a final mark < 50 and the student must repeat the module.
ELO 2. Application of scientific and engineering knowledge: Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality to solve complex engineering problems.	
How is the Outcome Assessed?	Assessment is by way of the Flexible Assessment system in the Faculty of Engineering, with a final mark calculated from two tests and assignments and/or tutorials and/or practicals.
What is Satisfactory Performance?	Using the assessment material and opportunities, the student must show that he/she has applied mathematical, scientific and engineering knowledge systematically to a problem at a level consistent to that which a graduate would participate in an employment situation shortly after graduation. The student must show that he/she: • Used mathematical techniques and/or numerical analysis and/or statistical knowledge and methods on engineering problems by: a. applying formal analysis and modelling of engineering components, systems or processes;

	b. communicating concepts, ideas and theories with the aid of mathematics; c. reasoning about and conceptualizing engineering components, systems or processes using mathematical concepts; d. and/or dealing with uncertainty and risk through the use of probability and statistics. • used physical laws and knowledge of the physical world as a foundation for the engineering sciences and the solution of engineering problems by: a. applying formal analysis and modelling of engineering components, systems or processes using principles and knowledge of the basic sciences; b. reasoning about and conceptualising engineering problems, components, systems or processes using principles of the basic sciences. • Used the techniques, principles and laws of engineering science at a fundamental level and in at least one specialist area to: a. identify and solve open-ended engineering problems; b. identify and pursue engineering applications; and/or work across engineering disciplinary boundaries through cross disciplinary literacy and shared fundamental knowledge.
What is the consequence of unsatisfactory performance?	Unsatisfactory performance in assessment 2 combined with the semester mark grants access to assessment 3; unsatisfactory performance in assessment 3 leads to a final mark < 50 and the student must repeat the module.
ELO 3. Engineering Design: Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.	
	n/a
ELO 4. Investigations, experiments and data analysis: Demonstrate competence to design and conduct investigations and experiments.	
	n/a
ELO 5. Engineering methods, skills and tools, including Information Technology: Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.	
	n/a
ELO 6. Professional and technical communication: Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.	
	n/a
ELO 7. Sustainability and Impact of Engineering Activity: Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment.	
	n/a
ELO 8. Individual, Team and Multidisciplinary Working: Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.	
	n/a
ELO 9. Independent Learning Ability: Demonstrate competence to engage in independent learning through well-developed learning skills.	
	n/a
ELO 10. Engineering Professionalism: Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.	
	n/a
ELO 11. Engineering Management: Demonstrate knowledge and understanding of engineering management principles and economic decision-making.	
	n/a

6. Other Module Specific Information

- All tutorials and practicals are compulsory. This rule also applies for students who redo the subject.
- Tutorial periods can be used for unannounced tests.
- All tutorial and practical tasks and assignments must be handed in on schedule.
- A student who misses any assessment opportunity (e.g. tutorial, practical, report, assignment, test, etc.) without a valid excuse can be assigned a flexible assessment mark of less than 50%, irrespective of any calculated mark.
- Unannounced tests can be conducted in the course of the semester. These tests can contribute to the assessment mark.
- Approved pocket calculators may be used in tests and examinations.

- No written or electronically stored information may be brought into test or examination venues and consulted.