University of Macau

Faculty of Science and Technology

Department of Electrical and Computer Engineering

Part A: Course Outline

Course Title:	Power System Analysis		
Course Code:	ELEC436	Year of Study:	4
Course Mode:	Theoretical with substantial laboratory/ practice content		
Compulsory/Elective:	Elective		
Course Prerequisites:	ELEC231 Circuit Analysis ELEC341 Electric Machines		
Prerequisite Knowledge	Circuit Analysis, Differential Equations and Linear Algebra		
Class/Laboratory Schedule:	2-hour lecturer, 2-hour simulation/tutorial per week		
Duration	One semester	Credit Units	4
Text Books and References:	[1] Power System Analysis, John Grainger, Jr.,William Stevenson, McGraw-Hill [2] Power System Analysis, H. Saadat, McGraw Hill		
Course Description:	The course provides students with essential knowledge in power systems required for its analysis. It includes per-unit system, line models, application of network matrices techniques, power flow calculation for the steady-state and analysis, power system fault analysis including: symmetrical components, symmetrical faults, and unsymmetrical faults and power system stability by introduction of swing equation.		
Topics Covered	1. Introduction to Power System 2. Parameters Calculation for Transmission Line/Cable 3. Transmission Line Models 4. Power Flow Analysis 5. Reactive Power Compensation/Power Factor Correction 6. Fault Analysis 7. Introduction to Power System Stability		
Course Objectives:	1. To introduce the characteristics of different transmission line models , steady state analysis and transient analysis of power systems [a, e, k] 2. To develop students with an understanding load flow calculation, active power and reactive power control in power system. [a,b,k] 3. To prepare the students to handle the un-symmetrical operations in power system.[a,k] 4. To develop students with an understanding short circuit calculation [a,b,e] 5. To provide the basic concept on power system stability to students [a,e]		
Course Assessment:	Quiz: 10% Notes+assignment: 10%		

<table>
<tr><td></td><td>Experiment + (oral or presentation): 30%
Final Exam. : 50%</td></tr>
<tr><td>Relationship to Program Objectives and Outcomes</td><td>This course primarily contributes to ECE program outcomes that develop students abilities to:
a. Ability to apply knowledge of mathematics, science and engineering.
e. Ability to identify, formulate and solve engineering problems.
k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

This course secondarily contributes to ECE program outcomes that develop students abilities to:
b. Ability to design and conduct experiments.</td></tr>
<tr><td>Course Contents and Relationship to Program Criteria:</td><td>
<table>
<tr><th>Week no.</th><th>Topics</th><th>Program Criteria</th></tr>
<tr><td>1</td><td>Introduction
History of power systems, basic components, importance of power systems, the impact to society, the main difficulties in power systems, new research trends, three phase circuit, per unit system</td><td>BS,ES,</td></tr>
<tr><td>2</td><td>Transmission Line Parameters Calculation and Current and Voltage Relations on a Transmission Line
Series and shunt parameters calculation for transmission line under different structures and materials, Line models to represent short line, medium line and long lines, Current and Voltage Relations on a transmission, reactive power compensation from point of view in line model</td><td>DIC, BS,ES DE,</td></tr>
<tr><td>2</td><td>The admittance model and network calculation
Admittance matrix, sub-admittance matrix for mutually coupled Branches, modification of admittance matrix when system changes, Node elimination</td><td>BS, ES, LA CV</td></tr>
<tr><td>3</td><td>Power Flow Analysis
Power flow problems, Netwon-Raphson method and decoupled power flow method. Introduction to optimal power flow, power-flow studies in system design and operation, active power and reactive power control, reactive power compensation reactive power compensation from point of view in system level</td><td>ES, LA,CV</td></tr>
<tr><td>3</td><td>Fault Analysis
Symmetrical faults, symmetrical components and sequence networks, unsymmetrical faults, the impacts on power system design and operation</td><td>ES, LA,CV</td></tr>
<tr><td>2</td><td>Stability Analysis
Rotor angle stability, swing equation, power angle equation, critical clearing time, equal area criteria, voltage stability and frequency stability</td><td>DIC, ES, D , CV</td></tr>
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</td></tr>
<tr><td>Contribution of Course to meet the professional component:</td><td>This course prepares students to work professionally in the area of power and power related fields. Students should be able to apply knowledge of mathematics and engineering, and identify formulas to solve power engineering problems.</td></tr>
<tr><td>Course Instructor(s):</td><td>Dr. Han Ying- Duo, Dr. Chi Kong Wong</td></tr>
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Prepared by:	Dr. Chi Kong Wong

Part B: General Course Information and Policies

Instructor: Dr. Chi Kong Wong Office: N314
Office Hour: Monday 3:30~5:30 p.m. or by appointment Phone: 4364
e-mail: ckwong@umac.mo

Programme Educational Objectives

1. **Problem Solving:** Graduates have the ability to think in a critical and evaluative manner and to consider a broad perspective, in order to solve technical and nontechnical problems.
2. **Leadership and Communication:** Graduates will provide effective leadership, act in an ethical manner and skills will include the ability to communicate well and to work successfully within diverse groups.
3. **Market Acceptance:** Graduates will have successful careers in the academic environment, industrial and government organizations.
4. **Technical Competence:** Graduates will be technically competent and have a thorough grounding in the fundamentals of math and science in electrical and computer engineering and experience in engineering design. They will be able to use modern engineering techniques, skills, and tools to fulfill societal needs.

Scale: 1 (Highest) to 4 (Lowest)

	Problem Solving	**Leadership and Communication**	**Market Acceptance**	**Technical Competence**
Power System	1	4	1	2

Remark:

- Objective for “Problem Solving” can be achieved by assignments, quiz, final examination.
- Objective for “Leadership and Communication” can be achieved by report writing and (oral examination/presentation). However, leadership training is not given by this course.
- Objective for “Market Acceptance” can be achieved by the course subject that is related to power system.
- Objective for “Technical Competence” can be achieved by using fundamentals of math and science in electrical and computer engineering

and experience in computer simulation.

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lower)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Power System Analysis		3	3		1	3	3	2	

Terms:

Probability and Statistics (PS), Differential and Integral Calculus (DIC), Basic Science (BS), Computer Science (CS), Engineering Science (ES), Differential Equation (DE), Linear Algebra (LA), Complex Variables (CV), Discrete Mathematics (DM)

Program Outcome Policy:

Course VS Course Outcomes

(H= Highly Related, S = Supportive, N = None)

Course	a	b	c	d	e	f	g	h	I	j	k	l
Power System Analysis	H	S	N	N	H	N	N	N	N	N	H	N

The electrical and computer engineering program outcomes are:

a. Ability to apply knowledge of mathematics, science and engineering.

b. Ability to design and conduct experiments.

c. Ability to design a system, component or process to meet desired needs.

d. Ability to function on multidisciplinary teams.

e. Ability to identify, formulate and solve engineering problems.

f. Understanding of professional and ethical responsibility.

g. Ability to communicate effectively.

h. Broad education necessary to understand the impact of engineering solutions in global and societal context.

i. Recognition of the need for and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

L. an ability to use the computer/IT tools relevant to the discipline along with an understanding

Curriculum Detail

ELEC436 Power System Analysis

Timetabled work in hours per week			No of teaching weeks	Total hours	No /Duration of exam papers	Max marks available from:	
Lecturer	**Tutor**	**Practice**				**Exams**	**Course**
2	1.5	0.5	14	56	2/5 hours	40	60

Term: 7th

Hours			Percentage content of					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
28	7/21	0	20	10	50	20	0	0

Design Elements

% of Design Content	Design Content in Course Work	Design Project	Design Content in Laboratories
20%	X	X	0%

Course Assessment Policy:

- Homework assignments will be given to students according to the course progress, no late submission is accepted. Zero mark will be given when homework is copied.
- Notes will be corrected, no late submission is accepted.
- 4 to 6 quizzes will be held during the semester.
- 2 experiments will be performed during the semester. Oral examination/presentation is required for the first experiment.
- 1 final exam will be performed.