University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Advanced Topics on Electrical Machines		
Course Code:	ELEC331	Year of Study:	3
Compulsory/Elective:	Elective		
Course Prerequisites:	ELEC341 Electric Machines		
Prerequisite Knowledge	Circuit Analysis, Differential Equations, electromagnetism		
Class/Laboratory Schedule:	3-hour lecturer, 3-hour experiment/tutorial per week		
Duration	One semester	Credit Units	4.5
Text Books and References:	[1] Electric Machinery Fundamentals, Stephen J. Chapman, McGraw-Hill [2] Electric Machinery , A. E. Fitzgerald, Charles Kingsley Jr., and Stephen Umans, McGraw Hill		
Course Description:	This course introduces fundamental concepts and principles of operation of synchronous machines and induction machines to the students and equips the students with basic experimental and modelling skills for handling problems associated with the above two devices..		
Topics Covered	1. Review of theory of electromechanical energy conversion, concepts of fundamental torque equation, EMF equation and rotating fields 2. AC Machinery Fundamentals 3. Construction, Principles of operation, Fundamental characteristics, the equivalent circuits and mathematical models of synchronous machines and induction machines. 4. Measuring synchronous generator model parameters 5. Parallel Operation of AC generators 6. Synchronous generator Transients 7. Starting synchronous and induction motors. 8. Induction motor torque-speed characteristics and its speed control. 9. Power and torque in induction motor		
Course Objectives:	• To introduce physical construction of synchronous machines and induction machines [a, c, e] • To explore the students the requirement for paralleling synchronous generators and the behavior of synchronous generators operated in parallel.[a, e, k] • To equip the students with basic experimental and modelling skills for synchronous machines and induction machines [a, b, k] • To prepare the students to apply the equivalent circuits and		

	mathematical models of synchronous machine and induction machine in different applications. [a, b, d, k] • To introduce the students the basic design consideration for of synchronous machines and induction machines. [a, c]
Course Assessment:	Quiz :10% Projects : 35% Test: 25% Final Exam. : 30%
Relationship to Program Objectives and Outcomes	This course primarily contributes to EEE 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 EEE program outcomes that develop students abilities to: 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.

<table>
<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>2</td><td>AC Machinery Fundamentals
A simple loop in a uniform magnetic field, The Rotating Magnetic Field, Magnetomotive Force and Flux Distribution on AC Machines, Induced Voltage in AC Machines, Induced Torque in an AC Machines</td><td>DIC, BS,ES, DE,</td></tr>
<tr><td>4</td><td>Synchronous generators
Construction, The Speed of Rotation, The Internal Generated Voltage, The Equivalent Circuit, The Phasor Diagram, Power and Torque in Synchronous Generator, Measuring Synchronous Generator Model Parameters, The Synchronous Generator Operating Alone, Parallel operation of AC Generators, Synchronous Generator Ratings</td><td>BS, ES,CV</td></tr>
<tr><td>2</td><td>Synchronous motors
Basic principle, steady state operation, Effect of load changes, Effect of field current changes on a synchronous motor, Synchronous motor as a power factor correction, starting synchronous motors,</td><td>ES, CV</td></tr>
<tr><td>3</td><td>Induction motors
Motor Construction, Basic Induction Motor Concepts, The Equivalent Circuit, Powers and Torque in Induction Motor, Induction Motor Torque-Speed Characteristics, Variations in Induction Motor Toque-Speed Characteristics, Starting Induction Motors Speed Control of Induction Motor, Determining Circuit Model Parameters</td><td>BS,ES, CV,</td></tr>
<tr><td>2</td><td>Synchronous Generator Models for Fault Analysis
Transient due to Short circuit, Flux Linkage Conservation, Development of Mathematical Models for Fault Analysis.</td><td>ES, DE, CV,</td></tr>
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</td></tr>
<tr><td>Contribution of Course to meet the professional component:</td><td>This course equips students to understand the principles, construction, basic design consideration, characteristics, equivalent circuit and mathematical models of two important devices in EEE field, i.e. synchronous machines and induction machines. 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. Chi Kong Wong</td></tr>
<tr><td>Prepared by:</td><td>Dr. Chi Kong Wong</td></tr>
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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

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Advanced Topics on Electrical Machines		4	3		1	4		3	

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
Advanced Topics on Electrical Machines	H	S	S	S	H	N	N	N	N	N	H

The electrical and electronics 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.

Course Assessment Policy:

- Homework assignments will be given to students according to the course progress
- 3 Quizzes will be held during the semester.
- 2 projects will be performed during the semester.
- 1 test and 1 final exam will be performed.