University of Macau

Faculty of Science and Technology

Department of Electrical and Electronics Engineering

Part A: Course Outline

Course Title:	Electrical Machines		
Course Code:	ELEC341	Year of Study:	3
Compulsory/Elective:	Compulsory		
Course Prerequisites:	ELEC231 Circuit Analysis		
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 Hil		
Course Description:	This course introduces fundamental concepts and principles of operation of transformers and DC 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. Theory of electromechanical energy conversion 2. Concepts of fundamental torque equation, EMF equation and rotating fields 3. Principles of operation of transformers and DC machines 4. Fundamental characteristics of transformers and DC machines 5. The equivalent circuits and mathematical models of transformers and DC machines 6. Construction of transformers and DC machines		
Course Objectives:	• To introduce physical construction of transformers and DC machines [a,c, e] • To introduce voltages relationship between primary side and secondary side for different Yy and Dy three phase transformer structures [a, k] • To equip the students with basic experimental and modelling skills for transformers and DC machines. [a, e, k] • To prepare the students to apply the equivalent circuits and mathematical models of transformers and DC machine in different applications. [a, b, d, k] • To introduce the students the basic design consideration for		

	transformers and DC 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.

Week no.	Topics	Program Criteria
1	**Introduction to Transformers** Construction, Basic operating principle, Functions of transformers, Classifications of transformers, Basic structure of transformers, Rating of transformer	BS,ES,
2	**Single Phase Transformer Under No Load operation** Detail operating principle, EMF equations, Transformation ratio, Voltage equations in primary side and secondary side, eddy current, saturation and losses in the core, Phasor diagram and Equivalent circuit.	BS,ES, DE,CV
2	**Single Phase Transformer With Load operation** The relation among voltages and currents at primary side and secondary side, Parameters referred to HV/LV windings, Equivalent circuits, phasor diagram, Power flow within transformers, open circuit and short circuit tests and Determination of the Parameters in the Equivalent Circuit	BS, ES, DE, CV
3	**Three Phase Transformer** Construction, Vector groupings, Connections of 3-phase transformers Star, delta, zig-zag , Scott connection, characteristics of Y-Y, Dy and YD, introduction to 3rd harmonic phenomenon and unbalanced loading, parallel operation, auto-transformer;	ES, CV
3	**Introduction to DC Machines** Electromechanical energy conversion, torque equation, air-gap mmf, rotating fields, Fundamentals of D.C. machine, construction, armature windings : ring and drum windings, Simple lap and wave windings, interpoles, Chording, Equalizing, Generated voltage, Armature Reaction.	ES, CV,
2	**DC Motor and DC Generator** DC Motors: Principles of operation, production of torque, back emf, torque-current and torque-speed characteristics of motors, Methods of excitation – Self and separately excited generators – Starting of D.C. motors, Speed control of DC motor. DC Generators: Principles of operation, Type of D.C. generators.	ES,, CV

Contribution of Course to meet the professional component:	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. transformers and DC machines. Students should be able to apply knowledge of mathematics and engineering, and identify formulas to solve power engineering problems.
Course Instructor(s):	Dr. Chi Kong Wong
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

Program Criteria Policy:

Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Electrical Machines			3		1	3		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
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.