

University of Macau  
Faculty of Science and Technology  
Department of Electrical and Computer Engineering

**Part A: Course Outline**

Course Title:	Electric Drive		
Course Code:	ECEB 358	Year of Study:	3 or 4
Course Mode:	Theoretical with substantial laboratory/practice content		
Compulsory/Elective:	Elective		
Course Prerequisites:	ECEB 220 Electric Machine, ECEB354 Power Electronics,		
Prerequisite Knowledge	Circuit Analysis, Power Electronics, Electric Machine		
Duration	One semester	Credit Units	3
Text Books and References:	[1] “Electric Drives---An Integrative Approach”, Ned Mohan, MNPERE. [2] “A first course on electrical drives”, S. K. Pillai, New Age International		
Course Description:	This course will describe the structure of Electric Drive Systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc. This course will cover the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives, the operation of dc motor drives to satisfy four-quadrant operation to meet mechanical load requirements, design torque, speed and position controller of motor drives, space vectors control, speed control of induction motor drives in an energy efficient manner using power electronics, the power quality issues in powering electric drives.		
Topics Covered	<ol style="list-style-type: none"> <li>1. Introduction to Electric Drive Systems</li> <li>2. Switch-Mode Power Electronics and Electro-Mechanical Energy Conversion</li> <li>3. DC Motors and Feedback Controller</li> <li>4. AC Machines and Space Vectors</li> <li>5. MNAC Drives and Synchronous Machines</li> <li>6. Induction Machines</li> <li>7. Reluctance Drives</li> <li>8. Energy Efficiency, Economics and Power Quality Issues</li> </ol>		
Course Objectives:	<ol style="list-style-type: none"> <li>1. To introduce to students the theory and applications of electric drive systems with high efficiency and relatively low maintenance cost., [a, e]</li> <li>2. To develop students with an understanding of the characteristics of modern electric drive systems for different applications, [a, b, c, e, k, l]</li> </ol>		

Course Assessment:	<p>Homework and Quiz :20%</p> <p>Laboratory/Practice/Simulation: 30%</p> <p>Mid-term Exam. : 20%</p> <p>Final Exam. : 30%</p>																								
Relationship to Program Objectives and Outcomes	<p>This course primarily contributes to ECE program outcomes that develop students abilities to:</p> <p>a. Ability to apply knowledge of mathematics, science and engineering. e. Ability to identify, formulate and solve engineering problems.</p> <p>This course secondarily contributes to ECE program outcomes that develop students abilities to:</p> <p>b. Ability to design and conduct experiments. c. Ability to design a system, component or process to meet desired needs. k. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice. l. Ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.</p>																								
Course Contents and Relationship to Program Criteria:	<table border="1" data-bbox="469 1055 1503 1413"> <thead> <tr> <th data-bbox="469 1055 564 1128">Week no.</th> <th data-bbox="564 1055 1326 1128">Topics</th> <th data-bbox="1326 1055 1503 1128">Program Criteria</th> </tr> </thead> <tbody> <tr> <td data-bbox="469 1128 564 1173">2</td> <td data-bbox="564 1128 1326 1173">Introduction to Electric Drive Systems</td> <td data-bbox="1326 1128 1503 1173">ES ,CS</td> </tr> <tr> <td data-bbox="469 1173 564 1218">2</td> <td data-bbox="564 1173 1326 1218">Review and Understanding of Switch-Mode Power Electronics</td> <td data-bbox="1326 1173 1503 1218">DIC, ES</td> </tr> <tr> <td data-bbox="469 1218 564 1263">2</td> <td data-bbox="564 1218 1326 1263">DC Motors and Feedback Controller Design</td> <td data-bbox="1326 1218 1503 1263">DIC, ES, CS,</td> </tr> <tr> <td data-bbox="469 1263 564 1308">2</td> <td data-bbox="564 1263 1326 1308">AC Motors and Space Vectors</td> <td data-bbox="1326 1263 1503 1308">ES, CS, CV</td> </tr> <tr> <td data-bbox="469 1308 564 1352">2</td> <td data-bbox="564 1308 1326 1352">PM AC Drives and Synchronous Machines</td> <td data-bbox="1326 1308 1503 1352">ES, CS, CV</td> </tr> <tr> <td data-bbox="469 1352 564 1397">2</td> <td data-bbox="564 1352 1326 1397">Induction Motor Drives</td> <td data-bbox="1326 1352 1503 1397">ES, CS</td> </tr> <tr> <td data-bbox="469 1397 564 1424">2</td> <td data-bbox="564 1397 1326 1424">Reluctance Drives</td> <td data-bbox="1326 1397 1503 1424">ES, CS</td> </tr> </tbody> </table>	Week no.	Topics	Program Criteria	2	Introduction to Electric Drive Systems	ES ,CS	2	Review and Understanding of Switch-Mode Power Electronics	DIC, ES	2	DC Motors and Feedback Controller Design	DIC, ES, CS,	2	AC Motors and Space Vectors	ES, CS, CV	2	PM AC Drives and Synchronous Machines	ES, CS, CV	2	Induction Motor Drives	ES, CS	2	Reluctance Drives	ES, CS
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Contribution of Course to meet the professional component:	<p>This course prepares students to work professionally in the area of power electronics, electric drives and motor control related fields. Students should be able to apply knowledge of mathematics and engineering, and identify formulas to solve engineering problems.</p>																								
Course Instructor(s):	Dr. Wong Man-Chung																								
Prepared by:	Dr. Man-Chung Wong																								



### **Program Criteria Policy:**

#### Course VS Program Criteria

Scale: 1 (Highest) to 4 (Lowest)

Course	PS	DIC	BS	CS	ES	DE	LA	CV	DM
Electric Drive		3		4	1			4	

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
Electric Drive	T	P	TP		P						P	P

**\*T – TEACH; P – PRACTICE; M – MEASURED**

The electrical and computer engineering program outcomes are:

- Ability to apply knowledge of mathematics, science and engineering.
- Ability to design and conduct experiments.
- Ability to design a system, component or process to meet desired needs.
- Ability to function on multidisciplinary teams.
- Ability to identify, formulate and solve engineering problems.
- Understanding of professional and ethical responsibility.
- Ability to communicate effectively.
- Broad education necessary to understand the impact of engineering solutions in global and societal context.
- Recognition of the need for and an ability to engage in life-long learning.
- Knowledge of contemporary issues.
- Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
- Ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations

## Curriculum Detail

### ECEB 358 Electric Drive

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	0.5	1.5	14	56	2/5 hours	50	50

**Term:** 6<sup>th</sup> and 8<sup>th</sup>

Hours			Percentage content of					
Lecturer	Lab/tut	Other	Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
28	20/8	0	20	0	50	20	0	10

## **Design Elements**

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

### Course Assessment Policy:

- No late homework is accepted. Zero mark will be given when homework is copied.
- 2 students form one group and group report should be handed up.
- Quizzes will be held during the semester.
- 1 mid-term exam and 1 final exam will be performed with 2 hours and 3 hours respectively.