Subject Code	SEHS4649
Subject Title	Electrical Machines
Credit Value	3
Level	4
Medium of Instruction	English
Pre-requisite/ Co-requisite/ Exclusion	Nil
Prior Knowledge	Basic principle of electromechanical conversion, such as emf equations in motors, machine ratings, types of windings in motors, torque-speed curves, power/ load angle relationship, etc. *(This is not a pre-requisite subject requirement and is only for students' reference of the scope of basic knowledge required for this subject.)*
Objectives	1. After completing an elementary subject on electromechanical energy conversion, the students are exposed to more challenging topics such as electrical machine design methods, transient and unbalanced operations of electrical machines in this course. 2. This course is designed to ensure the students developing an in-depth understanding of various drive systems in local industry. 3. To give the knowledge of various electrical machines such as AC, DC and power electronic driven motors.
Intended Learning Outcomes	Upon completion of the subject, students will: a. Have acquired a good understanding of the basic design methods of electric machines. b. Have had experience in synchronous machines including load characteristics, oscillations equations, and displacement stability. c. Be able to analyse the unbalanced and dynamic operation, condition monitoring and temperature-rise for the single and 3-phase induction machines. d. Be able to understand the drives for induction machines and their harmonics analysis for drives. Be aware of various switched-mode

	driven machines. e. Be capable to understand the control method for induction machines including closed loop and vector control.
Subject Synopsis/ Indicative Syllabus	1. ***Appreciation of machine design*:** Appreciation of basic technological factors. Main dimensions. Electric loading and magnetic loading. Magnetic circuit. Magnetomotive force produced by windings. 2. ***Reactances of AC machines and transformation*:** Inductance parameters. Winding Transformation. Circuit equations, conversion process, torque, equation of motion. 3. ***Synchronous machines*:** Load characteristics of isolated generator. Linearised equations of small oscillations. Natural frequency. 4. ***Induction machines*:** Basic circuit model of induction motor. Performance analysis of single- and three-phase induction machines. Unbalanced operation. Dynamic Operation. Temperature-rise tests. 5. ***Drives for induction machines*:** Induction motor drives fed from stepped wave/PWM inverters. Harmonics analysis for drives. 6. ***Control of machines*:** Open loop and closed loop control. Concept of vector control, torque control. **Laboratory/Mini-project Experiments:** The students are required to team up to work on laboratory session or mini-project. The mini-project is problem-based learning type and they are required to research for information, and do the design and analysis on the topics selected.

Teaching/ Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on analysis, control, design and practical applications are given through mini-projects, in which the students are expected to solve design and control problems with real-life constraints and to attain pragmatic solutions with critical and analytical thinking. The mini-projects are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and to look for relevant information.

Teaching/ Learning Methodology	**Intended Subject Learning Outcomes**				
	a	**b**	**c**	**d**	**e**
Lectures	✓	✓	✓	✓	✓
Tutorials	✓	✓	✓	✓	✓
Mini-projects	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/ tasks	**% weighting**	**Intended subject learning outcomes to be assessed**				
		a	**b**	**c**	**d**	**e**
Continuous Assessment	**40%**					
1. Mini-project & report	16%	✓	✓	✓	✓	✓
2. Class test	24%	✓	✓			
Examination	**60%**	✓	✓	✓	✓	✓
Total	100%					

It is a subject of the specific topics of electrical machines. The outcomes on concepts, design and applications are assessed by the usual means of examination and test whilst those on analytical skills, problem-solving techniques and practical considerations of electrical machine control and design, as well as technical reporting and teamwork, are evaluated by mini-project and the reports.

Student Study Effort Expected	**Class contact:**	
	• Lecture/ Tutorial	36 Hrs.
	• Laboratory/Mini-project	3 Hrs.
	Other student study effort:	
	• Mini-project/report	12 Hrs.
	• Self-study	49 Hrs.
	Total student study effort	**100 Hrs.**
Reading List and References	**Reference books** B.K. Bose, *Power Electronics and AC Drives*, Prentice-Hall, 2002. P. Vas, *Vector control of AC machines*, Clarendon Press: Oxford University Press, 1990. D.W. Novotny and T.A. Lipo, *Vector control and dynamics of AC drives*, Oxford University Press, 1996. D. Hanselman, *Brushless Permanent Magnet Motor Design*, The Writers' Collective, 2003. Haitham Abu-Rub, Atif Iqbal, Jaroslaw Guzinski, *High performance control of AC drives with MATLAB/ Simulink models*, Wiley, 2012. *The Reading List and References are indicative. Relevant reading materials will be suggested and assigned from time-to-time when they are deemed appropriate.*	

Sep 2018