Subject Description Form

Subject Code	EE4003 / EE4003A				
Subject Title	Electrical Machines				
Credit Value	3				
Level	4				
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite for EE4003: EE3002 Pre-requisite for EE4003A: EE3002A				
Objectives	 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. This course is designed to ensure the students developing an in-depth understanding of various drive systems in industry. To give the knowledge of various electrical machines such as power electronic driven AC motors. 				
Subject 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, and condition monitoring for 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	 Appreciation of machine design: Appreciation of basic technological factors. Main dimensions. Electric loading and magnetic loading. Magnetic circuit. Magnetomotive force produced in windings. Reactances of AC machines and transformation: Inductance parameters. Winding Transformation. Circuit equations, conversion process. Electromagnetic torque, equation of motion. Synchronous machines: Load characteristics of isolated generator. Linearized equations of small oscillations. Natural frequency. Induction machines: Basic circuit model of induction motor. Performance analysis of single- and three-phase induction machines. Unbalanced operation. Dynamic Operation. Temperature-rise tests. Drives for induction machines: Induction motor drives fed from PWM inverters. 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 MethodologyUutomesabcdeLectures \checkmark \checkmark \checkmark \checkmark \checkmark Tutorials \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark Assessment Methods in Alignment with Intended Learning OutcomesSpecific assessment methods/tasks $\%_{inighthethody/insks}$ Intended subject learning assessedIntended subject learning assessed \checkmark	Teaching/Learning Methodology	Lectures and tutorials are theories. Experiences on ar through mini-projects, in w problems with real-life con analytical thinking. The min so that the students are er information.	ctures and tutorials are the primary means of conveying the basic concepts and ories. Experiences on analysis, control, design and practical applications are given ough mini-projects, in which the students are expected to solve design and control blems with real-life constraints and to attain pragmatic solutions with critical and alytical thinking. The mini-projects are designed to supplement the lecturing materials that the students are encouraged to take extra readings and to look for relevant cormation.							
abcdeLectures \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark Tutorials \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark Mini-projects \checkmark \checkmark \checkmark \checkmark \checkmark \checkmark Assessment Methods in Alignment with Intended Learning OutcomesSpecific assessment methods/tasksIntended subject learning outcomes to be assessed0utcomes \circ \checkmark \checkmark \checkmark \checkmark \checkmark \circ \circ \circ \bullet \bullet \bullet \bullet \circ \circ 24% \checkmark \checkmark \checkmark \checkmark \circ 1.5 24% \checkmark \checkmark \checkmark \checkmark \circ 1.5 24% \checkmark \checkmark \checkmark \checkmark \circ 1.5 1.5 1.5 1.5 1.5 1.5 \circ 1.5 1.5 1.5 1.5 1.5 1.5 \bullet $1.$		Teaching/Learning Methodology		Outcomes						
Lectures \checkmark				a	b	c	d	e		
Interval Mini-projectsImage: Constant of the student study effortImage: Constant of the student stude effortImage: Constant of		Lectures		✓	~	✓	\checkmark	✓		
Mini-projects \checkmark		Tutorials		✓	✓	✓	\checkmark	 ✓ 		
Assessment Methods in Alignment with Intended Learning Outcomes Specific assessment methods/tasks % weighting 1 Intended subject learning outcomes to be assessed 0 Learning Outcomes 60% ✓ ✓ ✓ ✓ 1. Examination 60% ✓ ✓ ✓ ✓ ✓ 2. Class test 24% ✓ ✓ ✓ ✓ ✓ ✓ 3. Mini-project & report 16% ✓		Mini-projects	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark			
Intended Learning Outcomes Image: Content of the standard study effort: Image: Content of the stud	Assessment Methods in Alignment with	Specific assessment methods/tasks	Intended subject learning outcomes to be assessed				to be			
1. Examination 00% V V V V 2. Class test 24% ✓ ✓ ✓ ✓ ✓ 3. Mini-project & report 16% ✓<	Intended Learning Outcomes	1 Examination	60%	a	0	c v	d	e		
2. Class test 2470 1 1 1 1 3. Mini-project & report 16% ✓ ✓ ✓ ✓ ✓ Total 100% ✓	Outcomes	2. Class test	24%	• •	• •	v	v	•		
Student Study Class contact: 100% Student Study Class contact: 36 Hr • Lecture/Tutorial 36 Hr • Laboratory/Mini-project 3 Hr Other student study effort: 15 Hr • Self-study 51 Hr Total student study effort 10 Hr • Self-study 51 Hr • Other student study effort 105 Hr • Other 51 Hr		3 Mini-project & report	16%	· ·	· •	✓	✓	✓		
Student Study Class contact: • Lecture/Tutorial 36 Hr • Lecture/Tutorial 36 Hr • Lecture/Tutorial 31 Hr Other student study effort: 15 Hr • Self-study 51 Hr		Total	100%					<u> </u>		
Student Study Class contact: 36 Hr • Lecture/Tutorial 36 Hr • Laboratory/Mini-project 3 Hr Other student study effort: 31 Hr • Mini-project/report 15 Hr • Self-study 51 Hr Total student study effort 105 Hr B.K. Bose, Power Electronics and AC Drives, Prentice-Hall, 2002 P. Vas, Vector control of AC machines, Clarendon Press: Oxford Unversity Press		This subject discusses the specific topics of electrical machines. The outcomes on concepts, design and applications are assessed by usual means of examination and test whilst those on analytical skills, problem-solving techniques and practical considerations of electrical machine design, analysis and control, as well as technical reporting and teamwork, are evaluated by mini-project and the reports.								
Enorr Expected • Lecture/Tutorial 36 Hr • Laboratory/Mini-project 3 Hr • Coher student study effort: 3 Hr • Other student study effort: 15 Hr • Mini-project/report 15 Hr • Self-study 51 Hr Total student study effort 105 Hr Reading List and References Reference books: 1. B.K. Bose, Power Electronics and AC Drives, Prentice-Hall, 2002 2. P. Vas, Vector control of AC machines, Clarendon Press: Oxford University Press	Student Study Effort Expected	Class contact:								
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