

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OUTLINE TEMPLATE			
Course Title	AC MACHINES		
Course Code	EE202	No. of Credits	4
Department	Electrical and Electronics Engineering	Faculty	Dr. S. Senthil Kumar
Pre-requisite Course	DC MACHINES AND TRANSFORMERS		
Course Coordinator	Dr. S. Senthil Kumar		
E-mail	senthilanitha@gmail.com	Telephone No.	0431 – 2503261
Course Type	Core course		
COURSE OVERVIEW			
<p>Most industries today are being equipped with electrical drives and locomotives thanks to the easy controllability and modular structure. This creates an urge among the electrical engineers to know about the basics of electrical machines in particular ac machines since they are used in most industrial drives. These electric drives are well known for the flexible and effective controllability. Hence it also becomes important to know about the methods of implementing various speed control techniques and braking mechanisms for these machines.</p> <p>Such requirements have motivated to frame this course as core course for electrical engineering students. This course syllabus has been framed such that the initial topics deal with the constructional details and working principle of the rotating ac machines and upon completion would help the students to choose appropriate machine for various industrial applications. After designing any machine, it becomes inevitable to validate the design and hence an appropriate model for any machine becomes necessary. Hence equivalent circuit model is also being given focus in this course and further analysis of the performance of the machine is also given focus.</p> <p>Hence on completion of this course a B.Tech. Student upon graduating as Electrical Engineer would have a basic knowledge on choice of appropriate ac machine drive for various industrial</p>			

applications with appropriate control strategy.			
COURSE OBJECTIVES			
This course provides a basic understanding of AC machinery fundamentals, machine parts and helps to gain the skills for operating AC machines. The course also equips students with ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.			
COURSE OUTCOMES (CO)			
Course Outcomes			Aligned Programme Outcomes (PO)
On completion of the course the students will be able to			
1. Understand the constructional details and principle of operation of AC Induction and Synchronous Machines.			PO ₁ , PO ₂ , PO ₈ – PO ₁₄
2. Understand and appraise the principle of operation and performance of PMSBLDC machines.			PO ₁ , PO ₂ , PO ₈ – PO ₁₄
3. Analyze the performance of the AC Induction and Synchronous Machines using the phasor diagrams and equivalent circuits.			PO ₁ , PO ₂ , PO ₈ – PO ₁₄
4. Select appropriate AC machine for any application and appraise its significance.			PO ₁ , PO ₂ , PO ₈ – PO ₁₄
COURSE TEACHING AND LEARNING ACTIVITIES			
S. No.	Week	Topic	Mode of Delivery
1.	I week of January (4 th – 6 th) 1 hr	Introduction to the course and flexible mode of course delivery	Lecture
2.	I week of January (4 th – 6 th) 1 hr	Introduction to Polyphase induction motors	Lecture <i>Chalk and talk using board</i>

3.	II week of January (9 th – 13 th) 3 hrs	Development of three phase revolving flux in a three phase machine	Lecture <i>Chalk and talk using board</i>
4.	II week of January (9 th – 13 th) 1 hr	Principle of operation of a three-phase induction motor, Construction and types of three phase induction motor	Lecture <i>Chalk and talk using board</i>
5.	III week of January (16 th – 20 th) 2 hrs		
6.	III week of January (16 th – 20 th) 2 hrs	No-load operation and torque development	Lecture <i>Chalk and talk using board</i>
7.	III week of January (16 th – 20 th) 2 hrs	Starting of three phase induction motor and constructional details on rotor types and windings	Laboratory class - demo
8.	IV week of January (23 rd – 27 th) 2 hrs	Torque equations and factors influencing torque development – no-load operation	Lecture <i>Chalk and talk using board</i>
9.	IV week of January (23 rd – 27 th) 2 hrs	Load operation and load torque development	Lecture <i>Chalk and talk using board</i>
10.	IV week of January (23 rd – 27 th) 2 hrs	Torque equations and formulae relating various parameters	Lab schedule Lecture <i>Chalk and talk using board</i>
11.	V week of January (30 th Jan – 3 rd Feb) 2 hrs	Factors influencing torque development – power stages in three phase induction motor	Lecture <i>Chalk and talk using board</i>

12.	V week of January (30 th Jan – 3 rd Feb) 2 hrs	Torque – slip characteristics of a three phase induction motor	Lecture <i>Chalk and talk using board</i>
13.	V week of January (30 th Jan – 3 rd Feb) 2 hrs	Numericals related to three phase induction motor	Tutorials
14.	II week of February (6 th – 10 th) 2 hrs	Equivalent circuit representation of a three phase induction motor	Lecture <i>Chalk and talk using board</i>
15.	II week of February (6 th – 10 th) 2 hrs	Performance analysis and load characteristics of a three-phase induction motor	Lecture <i>Chalk and talk using board</i>
16.	II week of February (6 th – 10 th) 1 hr	Assessment 1	Technical quiz
17.	III week of February (13 th – 17 th) 2 hrs	No-load and Blocked rotor operation of a three phase induction motor – determination of machine parameters	Lecture <i>Chalk and talk using board</i>
18.	III week of February (13 th – 17 th) 2 hrs	Performance analysis of a three phase induction motor – circle diagram	Lecture <i>Chalk and talk using board</i>
19.	IV week of February (20 th – 24 th) 2 hrs	Starting methods of a three-phase induction motor	Lecture <i>Chalk and talk using board</i>
20.	IV week of February (20 th – 24 th) 1 hr	Speed control of a three-phase induction motor	Flip Class Discussion on 90 mins lecture video

21.	IV week of February (20 th – 24 th) 2 hrs	Assessment 2	Problem solving
22.	V week of February (27 th Feb – 3 rd March) 2 hrs	Braking methods for a three-phase induction motor	Lecture <i>Chalk and talk using board</i>
23.	II week of March (6 th – 10 th) 2 hrs	Induction generator – types and principle of operation	Lecture <i>Chalk and talk using board</i>
24.	II week of March (6 th – 10 th) 2 hrs	Induction generator – equivalent circuit and phasor diagram	Lecture <i>Chalk and talk using board</i>
25.	III week of March (13 th – 17 th) 2 hrs	Double field revolving theory	Lecture <i>Chalk and talk using board</i>
26.	III week of March (13 th – 17 th) 2 hrs	Principle of operation of single phase induction motor and its types	Lecture <i>Chalk and talk using board</i>
27.	IV week of March (20 th – 24 th) 2 hrs	Equivalent circuit analysis and formulae related to single phase induction motor	Lecture <i>Chalk and talk using board</i>
28.	IV week of March (20 th – 24 th) 2 hrs	Load characteristics and torque-slip characteristics of a single phase induction motor	Lecture <i>Chalk and talk using board</i>
29.	V week of March (27 th – 31 st) 2 hrs	Numericals related to three phase induction motor	Tutorials
30.	V week of March (27 th – 31 st) 1 hr	Assessment 3	Technical quiz

31.	I week of April (3 rd – 7 th) 2 hrs	Assessment 4	Problem solving
32.	I week of April (3 rd – 7 th) 2 hrs	Alternators – construction, principle and types	Lecture <i>Chalk and talk using board</i>
33.	II week of April (10 th – 14 th) 2 hrs	Alternators – armature reaction	Lecture <i>Chalk and talk using board</i>
34.	II week of April (10 th – 14 th) 2 hrs	Load characteristics and voltage regulation	Lecture <i>Chalk and talk using board</i>
35.	III week of April (17 th – 21 st) 2 hrs	Synchronization of alternators with grid, Synchronous motors – principle of operation and starting methods	Flip Class Discussion on lecture video
36.	III week of April (17 th – 21 st) 2 hrs	Phasor diagram - V and inverted V curves - Hunting and its suppression	Lecture <i>Chalk and talk using board</i>
37.	IV week of April (24 th – 29 th) 3 hrs	Permanent magnet brushless motors – construction, principle and types – principle of operation – phasor diagram - torque equation	Industrial Lecture
38.	IV week of April (24 th – 29 th) 1 hr	Assessment 4	Technical quiz
39.	IV week of April (24 th – 29 th) 4 hrs	Assessment 5	Group Activity

40.	I week of May (1 st – 5 th) 2 hrs	Assessment 6	End semester exam - Descriptive type
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COURSE ASSESSMENT METHODS

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Technical quiz	II week of February (6 th – 10 th)	1 hr	10%
		V week of March (27 th – 31 st)	1 hr	10%
		IV week of April (24 th – 29 th)	1 hr	10%
				Total = 30%
2.	Problem solving	IV week of February (20 th – 24 th)	2 hrs	5%
		I week of April (3 rd – 7 th)	2 hrs	5%
				Total = 10%
3.	Group Activity	IV week of April (24 th – 29 th)	4 hrs	20%
4.	End Semester Exam	I week of May (1 st – 5 th)	2 hrs	40%

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.
2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.
3. M. G. Say, 'Performance and design of Alternating Current Machines', John Wiley and Sons Publications, 3rd Edition, 1983.
4. Arthur Eugene Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw Hill Education Publications, 6th Edition, 2002.

5. Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press-Oxford, 1989.
6. Parkar Smith, N.N., 'Problems in Electrical Engineering', CBS Publishers and Distributors, 9th Edition, 1984.

COURSE EXIT SURVEY

1. Students' feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on Course Outcomes at the end of the semester

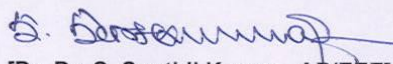
COURSE POLICY

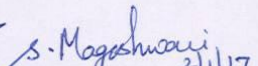
1. All the students are expected to attend all the contact hours. Anyhow attendance is not expected for discussion classes on video lectures.
2. Students who fall short of 50% attendance to the contact hours are not eligible to appear for the final written examination of 40% weightage.
3. No retest will be conducted for those students who are being physically absent for any of the evaluation / assessment methods. Anyhow flexibility is given to the students to fix the date for each mode of evaluation convenient to all the students. In case of emergency, the student may submit compensatory assignments on submission of appropriate documents as proof. Compensatory assignments would be framed according to the time frame available and the assessment task missed by the students.
4. Relative grading with a passing minimum is as per our institute norms.
5. In case of any student found guilty indulging in any mal practice, he/she will be awarded no marks in that particular assessment. If found using mobile phones or any other gadgets for any mal-practice during the final written examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks in the final written examination.


ADDITIONAL COURSE INFORMATION

1. The Course Coordinator is available for consultation during the time intimated to the students then and there.
2. All correspondence will be sent to the webmail id of the students alone. Hence all students are advised to check their webmail ids regularly.
3. The students will communicated through the email id: senthilanitha@gmail.com for any academic related issues (including sharing of study materials) with respect to this course.

FOR SENATE'S CONSIDERATION


[Dr. Dr. S. Senthil Kumar, AP/EEE]
Course Faculty


S. Magashwari
CC-Chairperson 2/1/17


HoD/Dept. of EEE