NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OUTLINE TEMPLATE			
Course Title	AC MACHINES – 'B' SECTION		
Course Code	EE202	No. of Credits	4
Department	Electrical and Electronics Engineering	Faculty	Dr. M. Venkata Kirthiga
Pre-requisite Course	DC MACHINES AND TRANSFORMERS		
Course Coordinator	M. Venkata Kirthiga		
E-mail	eeacmachines@gmail.com	Telephone No.	0431 – 2503263
Course Type	Core course		

COURSE OVERVIEW

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.

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 fcus.

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 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 PMBLDC 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** *Chalk and talk using board*

3.	II week of January (9^{th} – 13^{th}) **3 hrs**	Development of three phase revolving flux in a three phase machine	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
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** *Chalk and talk using board*
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** *Chalk and talk using board*
9.	IV week of January (23^{rd} – 27^{th}) **2 hrs**	Load operation and load torque development	**Lecture** *Chalk and talk using board*
10.	IV week of January (23^{rd} – 27^{th}) **2 hrs**	Torque equations and formulae relating various parameters	**Lab schedule** **Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*

12.	V week of January (30^{th} Jan – 3^{rd} Feb) **2 hrs**	Torque – slip characteristics of a three phase induction motor	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
15.	II week of February (6^{th} – 10^{th}) **2 hrs**	Performance analysis and load characteristics of a three-phase induction motor	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
18.	III week of February (13^{th} – 17^{th}) **2 hrs**	Performance analysis of a three phase induction motor – circle diagram	**Lecture** *Chalk and talk using board*
19.	IV week of February (20^{th} – 24^{th}) **2 hrs**	Starting methods of a three-phase induction motor	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
23.	II week of March (6^{th} – 10^{th}) **2 hrs**	Induction generator – types and principle of operation	**Lecture** *Chalk and talk using board*
24.	II week of March (6^{th} – 10^{th}) **2 hrs**	Induction generator – equivalent circuit and phasor diagram	**Lecture** *Chalk and talk using board*
25.	III week of March (13^{th} – 17^{th}) **2 hrs**	Double field revolving theory	**Lecture** *Chalk and talk using board*
26.	III week of March (13^{th} – 17^{th}) **2 hrs**	Principle of operation of single phase induction motor and its types	**Lecture** *Chalk and talk using board*
27.	IV week of March (20^{th} – 24^{th}) **2 hrs**	Equivalent circuit analysis and formulae related to single phase induction motor	**Lecture** *Chalk and talk using board*
28.	IV week of March (20^{th} – 24^{th}) **2 hrs**	Load characteristics and torque-slip characteristics of a single phase induction motor	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
33.	II week of April (10^{th} – 14^{th}) **2 hrs**	Alternators – armature reaction	**Lecture** *Chalk and talk using board*
34.	II week of April (10^{th} – 14^{th}) **2 hrs**	Load characteristics and voltage regulation	**Lecture** *Chalk and talk using board*
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** *Chalk and talk using board*
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**

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 Distributers, 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 ~~30%~~ 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 of ~~35%~~ will be adopted for the course. peak/3 (or) avg/2

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 : eeacmachines@gmail.com for any academic related issues (including sharing of study materials) with respect to this course.

FOR SENATE'S CONSIDERATION

[Dr. M. Venkata Kirthiga, AP/EEE]	**[Dr. M. Jaya Bharata Reddy]**	**HoD/Dept. of EEE**
Course Faculty 2/1/17	**CC-Chairperson**	