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

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. / Electrical and Electronics Engineering		
Course Title	AC MACHINES		
Course Code	EEPC15	No. of Credits	4
Course Code of Pre-requisite subject(s)	EEPC12 - DC MACHINES AND TRANSFORMERS		
Session	January 2023	Section (if, applicable)	A
Name of Faculty	P. RAJA	Department	EEE
Email	machines.raja@gmail.com	Telephone No.	0431-250 3264
Name of Course Coordinator(s) (if, applicable)	NA		
E-mail		Telephone No.	
Course Type	[√] Core course [ ] Elective course		

Syllabus (approved in BoS)

Alternators – construction, principle and types - armature reaction - load characteristics – voltage regulation – two-reaction theory – parallel operation.

Synchronous motors - Synchronous machines on infinite bus bars - phasor diagram - V and inverted-V curves - Hunting and its suppression - starting methods.

Poly-phase induction motors - construction, principle and types – no-load and load characteristics – noload and blocked rotor test - equivalent circuit – circle diagram.

Poly-phase induction motors - Starting and speed control methods – Braking methods. Induction generators – types, principle of operation, equivalent circuit and applications.

Single-phase induction motors - construction, principle and types - double revolving field theory – equivalent circuit. Permanent magnet brushless motors – construction, principle and types – torque equation.

Text Books & Reference Books:

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', CBS Publishers & Distributors Pvt. Ltd., New Delhi, 3rd Edition, 2002.
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 PressOxford, 1989.
6. Parker Smith, N.N., 'Problems in Electrical Engineering', CBS Publishers and Distributers, 9th Edition, 1984.

COURSE OBJECTIVES

This course provides a basic understanding of AC machinery fundamentals, and machine parts and helps to gain the skills for operating AC machines. The course also equips students with the ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.

COURSE OUTCOMES (CO)

Course Outcomes

Upon completion of the course the students would be able to

CO1. Understand the constructional details and principle of operation of AC Induction and Synchronous Machines.

CO2. Understand and appraise the principle of operation and performance of single-phase induction motors and other special motors.

CO3. Analyze the performance of the AC Induction and Synchronous Machines using the phasor diagrams and equivalent circuits.

CO4. Select appropriate AC machine for any application and appraise its significance.

Course articulation matrix (CO-PO mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	NA	2	2	1	2	1	1	3
CO2	2	1	1	2	NA	2	2	1	2	1	1	3
CO3	3	3	3	3	2	2	2	2	2	2	2	3
CO4	3	2	2	3	1	2	2	2	2	1	2	3

COURSE PLAN – PART II

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 their 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 us to frame this course as a 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.

Hence on completion of this course a B.Tech. student upon graduating as an Electrical Engineer would have a basic knowledge of the choice of appropriate ac machine drive for various industrial applications with appropriate control strategy.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1.	3rd Week of January (18th Jan to 20th Jan) **(2 Contact Hours)**	Introduction to the course, mode of course delivery Refreshing of the basics	**Lecture** *Chalk and talk*
2.	4th Week of January (23rd Jan to 27th Jan) **(3 Contact Hours)**	Polyphase Induction machines – Basics and introduction. Development of three phase revolving flux in a three-phase machine	**Lecture** *Chalk and talk*
3.	5th Week of Jan & 1st Week of February (30th Jan to 3rd Feb) **(4 Contact Hours)**	Stator design of a three phase induction machines – three phase winding	**Lecture** *Chalk and talk*
4.	2nd Week of February (6th Feb to 10th Feb) **(4 Contact Hours)**	Construction of a three-phase induction motor – Rotor details and classification	**Lecture** *Chalk and talk*
5.	3rd Week of February (13th Feb to 17th Feb) **(4 Contact Hours)**	Starting of three phase induction motors – Starters and Torques equations related to starting condition	**Lecture** *Chalk and talk*
6.	4th Week of February (20th Feb to 24th Feb) **(4 Contact Hours)**	Torque equations and formulae relating to various parameters. Factors influencing torque development – power stages in three phase induction motor. No-load and Load operation Load torque development	**Lecture** *Chalk and talk using board*
7.	5th Week of February & 1st Week of March (27th Feb to 3rd Mar) **(4 Contact Hours)**	**Assessment I**	**Objective type questions & Numericals**
8.	2nd Week of March (6th Mar to 10th Mar) **(4 Contact Hours)**	Torque – slip characteristics. Equivalent circuit representation of a three-phase induction motor Performance analysis and load characteristics of a three-phase induction motor	**Lecture** *Chalk and talk*
9.	3rd Week of March (13th Mar to 17th Mar) **(4 Contact Hours)**	No-load and Blocked rotor operation of a three-phase induction motor – determination of machine parameters Speed Control methods and Starting methods	**Lecture** *Chalk and talk* **Tutorial**
10.	4th Week of March (20th Mar to 24th Mar) **(4 Contact Hours)**	Braking methods for a three-phase induction motor Induction generator – types and principle of operation Equivalent circuit and phasor diagram for Induction Generators	**Lecture** *Chalk and talk*

11.	5th Week of March (27th Mar to 31st Mar) **(4 Contact Hours)**	Principle of operation of single-phase induction motor and its types. Equivalent circuit analysis and formulae related to single phase induction motor. Load characteristics and torque-slip characteristics of a single phase induction motor	**Lecture** *Chalk and talk*
12.	1st Week of April (3rd Apr to 7th Apr) **(1 Hour)**	**Assessment II**	**Objective type questions & Numerical**
13.	1st Week of April (3rd Apr to 7th Apr) **(3 Contact Hours)**	Numerical related to three phase induction motor and single-phase induction motors AC Series Motor	**Tutorials** **Lecture** *Chalk and talk*
14.	2nd Week of April (10th Apr to 14th Apr) **(4 Contact Hours)**	Alternators – construction, principle and types, armature reaction	**Lecture** *Chalk and talk*
15.	3rd Week of April (17th Apr to 21st Apr) **(4 Contact Hours)**	Load characteristics and voltage regulation Synchronization of alternators with grid Permanent Magnet Brushless DC Motors **Assessment IV**	**Lecture** *Chalk and talk using board* **Flipped Class and Demo in lab** Discussion on lecture video
16.	4th Week of April (24th Apr to 28th Apr) **(4 Contact Hours)**	Synchronous motors – principle of operation and starting methods Phasor diagram - V and inverted V curves - Hunting and its suppression	**Lecture** *Chalk and talk using board*
17.	2nd Week of May 8th May (3 Hours)	**Final Assessment**	**End semester exam - Descriptive type**

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	**Assessment I** Objective type questions	5th Week of February	60 minutes	15
2	**Assessment II** Objective type questions	1st Week of April	60 minutes	15
3	**Assessment III** Surprise Test	---	---	10
4.	**Assessment IV** Numerical Solutions	3rd Week of April	60 minutes	10
5.	**Assessment V** Group Activity	3rd – 4th Week of April	---	10
CPA	*Compensation Assessment* (Written Test)	4th week of April	60 minutes	20
6.	**Final Assessment**	8th May 2023	180 minutes	40

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

MODE OF CORRESPONDENCE

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail only.
2. Queries (if required) to the course teacher shall only be emailed to machines.raja@gmail.com

COMPENSATION ASSESSMENT POLICY

- CPA will be offered only for the students who could not appear for Assessments 1, 2 and 4.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under the On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded a 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, and copying from others during an assessment will be treated as punishable dishonesty.
- Zero marks to be awarded to the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, members, shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

  The above policy against academic dishonesty shall be applicable to all programmes.

ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty. Queries may also be emailed to the Course Coordinator directly at machines.raja@gmail.com

FOR APPROVAL

19/01/2023		25/01/23
Course Faculty	CC-Chairperson 19/1/2023	HoD / EEE
[Dr. P. RAJA]	[Dr. C. NAGAMANI]	