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| Course No | Course Name | L-T-P-Credits |
| **EE 204** | **Electrical Machines-II** | **3-1-0: 4** |
|  Prerequisite: Basic Electrical Engineering, Electrical Machines-I Co requisite: NIL |
| **Course Objectives**:

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| 1. Characteristics of AC windings
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| 1. Principle and characteristics of Induction Machines
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| 1. Performance analysis of Synchronous Machines
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| 1. Speed Control of AC machines
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| 1. Special type of machines
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|  **SYLLABUS** |
| **Module** | **Contents** | **Hours** |
| I | **Basics of Rotating Electrical Machines:** EMF polygon, Distribution factor, Pitch factor, Winding factor, MMF produced by a single coil & distributed winding, Determination of MMF waveform & magnitude for distributed windings; Openarmature winding for a.c machines; Development of single & double layer distributed windings; Clock diagram, Design of integral slot winding for ac machines with full-pitched & short-pitched coils, Production of Rotating Magnetic Field in ac machines  | 06 |
| II | **Poly-phase Induction Machines:**Construction, principle of operation, slip, phasor diagram, equivalent circuits, expression for torque, and output power, slip torque characteristics, effect of variation of supply voltage and rotor resistance on the characteristics, circle diagram, predetermination of characteristics from the circuit diagram, drawing circle diagram from design parameters and no load and blocked rotor test data, starting of induction motors, direct on line starter, star-delta starter and autotransformer starter for cage induction motor, rotor resistance starter for slip ring induction motor, speed control of induction motor by varying supply voltage, supply frequency and pole changing, speed control of slip ring induction motor by rotor resistance.  | 14 |
| IIIIVV | **Single Phase Induction Motors** Principle of operation, double revolving field theory, equivalent circuit, performance calculations and characteristics, starting methods, maximum starting torque conditions. **Synchronous Machines** Construction, Types of Exciters, EMF equation, phasor diagrams for cylindrical rotor synchronous machines, armature reaction, open and short circuit characteristics, leakage reactance, synchronous reactance, phasor diagram under loaded conditions, load characteristics, predetermination of regulation by EMF and Potier triangle methods for non-salient pole alternators, steady state power flow equations, power angle characteristics, constant excitation and constant power output, two reaction theory for salient pole alternators and pre-determination for regulation, maximum power, slip test, V curves, inverted V curves, compounding curves for synchronous motors, synchronizing power, synchronizing torque, hunting phenomenon, starting of synchronous motor, synchronous condenser, Parallel Operation of Alternators: Synchronizing, Synchroscope, parallel operation of alternators, alternator on infinite bus-bar, effect of change of excitation and prime mover inputs.**Special Machines** High torque induction motor, double cage and deep bar rotor construction, mains operated and self-excited induction generators, hysteresis motor, reluctance motor and stepper motor, brushless motors.  | 061404 |

**Essential Readings:**

* 1. A. Fitzgerald, C. Kingsley, S. Umans, Electric Machinery, TMH, New Delhi., 6th Edition,2013
	2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 4th Edition,2015

**Supplementary Readings:**

1. Say M. G., The performance and design of alternating current machines, CBS Publishers, Delh,

4th Edition,2004.

2) Bimbhra P. S., Electrical Machinery, Khanna Pub., Delhi., 7th Edition, 2018

3) Clayton A. E., The performance and design of direct current machines, Pitman and sons, London.

 4th Edition,1961

4) Bhag S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford, 4th Edition,2014