	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2019-20**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EE 204	**Electrical Machines-II**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes: Students will be able to		
	Introduction of basic features of AC machines		CO1	Understand characteristics of AC windings
	Explanation of operation, equivalent circuit of AC machines		CO2	Analyse the principle and characteristics of Three Phase Induction Machines
	Study of speed control & testing of AC machines		CO3	Evaluate operation & equivalent circuit of single-phase induction machines
	Presentation of working of special machines		CO4	Analyse Performance & operation of Synchronous Machines
	Difference in construction & working in single and three phase ac machines		CO5	Understand basic working of special type of machines

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**3**
2	CO2	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**2**
3	CO3	**2**	**3**	**3**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**
4	CO4	**2**	**2**	**3**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**2**	**3**	**2**
5	CO5	**2**	**2**	**3**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**3**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
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; Open type armature 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**	**CO1**
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**	**CO2**
III	**Single Phase Induction Motors** Principle of operation, double revolving field theory, equivalent circuit, performance calculations and characteristics, starting methods, maximum starting torque conditions.	**06**	**CO3**
IV	**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.	**14**	**CO4**
V	**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.	**04**	**CO5**
	Total Hours	**44**	

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