Course Syllabi: UEE401: Alternating Current Machines (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE401: Alternating Current Machines

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
- *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, DhanpatRai and Co. (P) Ltd. (2004).*
- *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*
- *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
- *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004).*
- *Fitzgerald, A.E., Kingsley, C. Jr., and Umans, Stephen, Electric Machinery, McGraw–Hill (2002).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Three–Phase Induction Motors: Construction, working principle, Slip and its effect on rotor parameters: rotor frequency, Torque–slip characteristics, Power flow diagram, Efficiency, Synchronous watt, Measurement of slip, Equivalent circuit, No–load test, Blocked rotor test, Circle diagram, Starting methods, Speed control methods, Crawling, Cogging, Deep cage and Double cage rotors, Applications, self excited and grid connected Induction generator.

Fractional kW Motors and Special Machines: Classification, Production of rotating field, Double revolving field theory, Equivalent circuit, Determination of equivalent circuit parameters, Split phase induction motor, Capacitor motor, Permanent split capacitor motor; Shaded pole motor, Universal motor, Stepper motor.

Synchronous Generators/Alternators: Introduction, Comparison with DC generator, Advantages of rotating field over rotating armature, Constructional features, Excitation systems, Armature windings, EMF equation, Winding factor, Harmonics, Armature resistance, Armature reaction: Unity power factor, Zero lagging and Zero leading power factor, Armature reaction reactance, Equivalent circuit of an alternator, Voltage equation, Phasor diagram of a loaded alternator for various types of loads, Voltage regulation and methods of estimation of voltage regulation, Load characteristic of alternators, power equation, Two reaction theory and Torque–angle characteristic of a salient–pole alternator, Maximum reactive power for a salient–pole alternator, Losses and efficiency, Determination of X_d and X_q, Parallel operation of alternators, Synchronising procedures, Synchronising power and Torque co–efficient, Damper Windings, Hunting.

Synchronous Motors: Voltage equation, Phasor diagram, Operation at constant load with variable excitation, Power equations, salient pole Synchronous motor, Starting of synchronous motors, Applications, Synchronous condensers.

Laboratory work: Voltage regulation, Direct and quadrature axis reactances, Operating characteristics, Synchronizing, Parallel operation and load division, Sudden short circuit

analysis and determination of sub transient, Transient and steady state reactances and various time constants, Determination of positive, negative and zero sequence reactances, Synchronous motor starting, Efficiency. Three phase induction motors: starting methods, Equivalent circuit parameters, Load test, Polarity test, Single phasing, Efficiency, Schrage motor, Single-phase induction motors: Equivalent circuit parameters and performance indices.

5. Specific goals for the course

After the completion of the course, the students will be able to:

- Simulate the steady-state and transient state performance of induction and synchronous machines.
- Validate and identify the machine parameters.
- Select the appropriate AC motor for different large power application.
- Analyse the stability of single machine – infinite bus system and form the grid to supply large load.
- Choose the appropriate fractional horse power motor as per the usage in daily life.

6. Brief list of topics to be covered

- Three–Phase Induction Motors
- Fractional kW Motors and Special Machines
- Synchronous Generators/Alternators
- Synchronous Motors