Course Title: Advanced Electrical Machinery
Course Code: EPEG 302
Credit Hours: 3

Course Description:
This course provides a thorough understanding of the design, performance and applications of important ac electrical machines.

Course Contents:

Unit 1: Power Transformers
Types, Construction and applications, Transformers tapping, Per unit systems, Three phase connections and harmonic suppression, Vector groups, Three-phase transformation using two transformers, Parallel operation and load division, Cooling systems of transformers, Specific loading and output equations of power transformers

Unit 2: Three-Phase Induction Motors
Principle of operation, Rotating magnetic field, Production of torque, Reversal of rotation, Squirrel cage and wound rotor construction, Equivalent circuit, Synchronous speed, Slip and its effect on rotor frequency and voltage, Equivalent circuit, Losses and efficiency, No load and blocked rotor tests, Transformation ratio, Power and torque, Power factor, Torque-speed characteristics, Starting and speed control, stator control, rotor control, v-f control, Induction generator and its application, Doubly Fed Induction Generator and its application

Unit 3: Synchronous Generators
Introduction, Construction, winding diagram, Power and torque, Speed and frequency, EMF equation, Alternators on load, vector diagram, Voltage regulation, Equivalent circuit, Measurement of parameters, Generator operating alone, Capability chart, Synchronization, Parallel operation with infinite bus and power sharing, Parallel operation of same size generators, Loss of field excitation, Cooling systems, Shut down procedures, Permanent Magnet Synchronous Generator and its application

Unit 4: Synchronous Motors
Principle of operation, Torque-angle characteristics, Method of starting, Counter voltage (CEMF) and armature reaction voltage, Excitation method, V curves, Losses and efficiency, Power factor improvement, Speed control, v-f control, Ratings, Hunting and damping

Unit 5: Electrical Machine Design
Transformer design: Output equation of transformer, expression for volts/turn, determination of main dimensions of the core, window and yoke, estimation of number of turns, calculation of the size of the conductor of primary and secondary winding, calculation of resistance of windings, calculation of leakage reactance of windings, estimation of voltage regulation, determination of no load current and magnetizing volt-ampere; Induction motor design: Output equations, relative sizing of single phase and three phase motors, design of main dimensions, stator winding design, design of squirrel cage rotor, design of wound rotor, design on end rings, calculation of no load current, leakage reactance, cooling system design

References:

1. S. J. Chapman, *Electric machinery fundamentals*, McGraw- Hill
2. C I. Hubert, *Electric Machines*, Prentice Hall Inc
3. A.E. Fitzgerald, C. Kingsley, S. D. Umans, *Electrical Machinery*, McGraw Hill
4. D. P. Kothari, I. J. Nagrath, *Electrical Machines*, McGraw- Hill
5. I. L. Kosow, *Electrical Machinery & Transformer*, PHI
6. M. N. Bandyopadhyay, *Electrical Machines*, PHI
7. P.C. Sen, *Principles of Electrical Machines and Power Electronics*, John Wiley & Sons
8. A.K. Sawhney, A. Chakrabarti, *A course in Electrical Machine Design*, Dhanpat Rai & Co.
9. M.V. Despande, *Design & Testing of Electrical Machines*, Prentice Hall India
10. A. Gray, P.M. Lincoln, *Electrical Machine Design: The Design and Specification of Direct and Alternating Current Machinery*, McGraw-Hill
11. J. Pyrhonen, T. Jokinen, V. Hrabovcova, *Design of Rotating Electrical Machines*, John Wiley and Sons
12. T. A. Lipo, *Introduction to AC Machine Design*, John Wiley and Sons

Evaluation:

In-Semester Evaluation: 50%
End-Semester Evaluation: 50%