II Year-II Semester		L	T	P	C
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ELECTRICAL MACHINES – II (R1622022)

Preamble:
This course covers the topics on 3-phase induction motor, 1-phase induction motor and synchronous machines which have wide application in power systems. The main aim of the course is to provide a detailed analysis of operation and performance of 3-phase induction motor, 1-phase induction motor and synchronous machines. In addition, it also covers voltage regulation and parallel operation of synchronous generators.

Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes.

Cos	Course Outcomes	POs
1	Able to explain the operation and performance of three phase induction motor.	2
2	Able to analyze the torque-speed relation, performance of induction motor and induction generator.	2
3	Able to explain design procedure for transformers and three phase induction motors.	2
4	Implement the starting of single phase induction motors.	2
5	To perform winding design and predetermine the regulation of synchronous generators.	2
6	Avoid hunting phenomenon, implement methods of staring and correction of power factor with synchronous motor.	3

Syllabus:

UNIT I:

Objective: Understand the principle of operation and performance of 3-phase induction motor.

3-phase Induction Motors
Construction details of cage and wound rotor machines - production of rotating magnetic field - principle of operation - rotor emf and rotor frequency - rotor current and pf at standstill and during running conditions - rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram

UNIT II:

Objective: Quantify the performance of induction motor and induction generator in terms of torque and slip.

Characteristics, starting and testing methods of Induction Motors
Torque equation - expressions for maximum torque and starting torque - torque slip characteristic - double cage and deep bar rotors - crawling and cogging – speed control of induction motor with V/f method – no load and blocked rotor tests - circle diagram for predetermination of performance– methods of starting – starting current and torque calculations – induction generator operation (Qualitative treatment only)

UNIT III:

Objective: To understand the torque producing mechanism of a single phase induction motor.

Single Phase Motors
Single phase induction motors – Constructional features and equivalent circuit Problem of starting– Double revolving field theory–Starting methods, shaded pole motors, AC Series motor.

UNIT IV:

Objective: To understand the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.

Construction, Operation and Voltage Regulation of Synchronous generator
Constructional features of non–salient and salient pole type – Armature windings – Distributed and concentrated windings – Distribution– Pitch and winding factors –E.M.F equation–Improvements of waveform and armature reaction–Voltage regulation by synchronous impedance method– MMF method and Potier triangle method–Phasor diagrams– Two reaction analysis of salient pole machines and phasor diagram.

UNIT V:

Objective: To study parallel operation and control of real and reactive powers for synchronous generators

Parallel operation of synchronous generators
Parallel operation with infinite bus and other alternators – Synchronizing power – Load sharing – Control of real and reactive power– Numerical problems**.**

UNIT VI:

Objective: To understand the operation, performance and starting methods of synchronous motors.

Synchronous motor – operation, starting and performance
Synchronous Motor principle and theory of operation– Phasor diagram – Starting torque– Variation of current and power factor with excitation –Synchronous condenser – Mathematical analysis for power developed– Hunting and its suppression – Methods of starting – Applications.

Text Books:

1. Electrical Machines – P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald,Charleskingsley,StephenD.Umans, TMH

REFERENCE BOOKS:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth,McGrawHill Publications, 4th edition
2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition
3. Electrical Machinery by AbijithChakrabarthi and SudhiptaDebnath,McGraw Hill education 2015

4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010

5. Electric Machines by MulukutlaS.Sarma&Mukeshk.Pathak, CENGAGE Learning.

6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons