



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year II Semester		L	T	P	C
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INDUCTION AND SYNCHRONOUS MACHINES					

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 Objectives:

- Understand the principle of operation and performance of 3-phase induction motor.
- Quantify the performance of induction motor and induction generator in terms of torque and slip.
- To understand the torque producing mechanism of a single phase induction motor.
- To understand the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.
- To study parallel operation and control of real and reactive powers for synchronous generators.
- To understand the operation, performance and starting methods of synchronous motors.

UNIT - I

3-phase induction motors

Construction details of squirrel cage and slip ring induction motors – production of rotating magnetic field – principle of operation – Equivalent circuit – phasor diagram- slip speed-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.

UNIT - II

Characteristics 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 control method – no load and blocked rotor tests – circle diagram for predetermination of performance – induction generator operation (Qualitative treatment only)

UNIT - III

Starting methods of 3-phase induction motors

Methods of starting of three phase Induction motors: DOL, Auto transformer, Star-Delta and rotor resistance methods.

Single phase induction motors:

Constructional features- equivalent circuit- problem of starting-double revolving field theory- Methods of starting. AC series motors.



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UNIT - IV

Construction, operation, voltage regulation and parallel operation of synchronous generator:

Constructional features of non-salient and salient pole machines –types of armature windings – distribution, pitch and winding factors – E.M.F equation –improvements of waveform and armature reaction –phasor diagrams- voltage regulation by synchronous impedance method – MMF method and Potier triangle method– two reaction analysis of salient pole machines and phasor diagram.

Parallel operation with infinite bus and other alternators – synchronizing power – load sharing – control of real and reactive power – numerical problems.

UNIT - V

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 – capability curves - synchronous condenser – mathematical analysis for power developed – hunting and its suppression – methods of starting – applications.

Course Outcomes: At the end of the course, student will be able to

- Explain the operation and performance of three phase induction motor.
- Analyze the torque-speed relation, performance of induction motor and induction generator.
- Implement the starting of single phase induction motors.
- Develop winding design and predetermine the regulation of synchronous generators.
- Explain hunting phenomenon, implement methods of starting and correction of power factor with synchronous motor.

Text Books:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald, Charles Kingsley, Stephen D.Umans, TMH

Reference Books:

1. 1.Performance and design of AC machines – M.G. Say
2. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House
3. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 2010.
4. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition