Lok Jagruti Kendra University
University with a Difference

Diploma in Electrical Engineering

LJ Polytechnic

Course Code: 025070302
Electrical Machines

Programme / Branch Name			Diploma in Electrical Engineering			
Course Name	Electrical Machines				**Course Code**	025070302
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week / Credits				Evaluation Scheme			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**Total**
4	0	2	5	50	50	50	150

Legends: L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisite

- ✓ Physics with basic concepts of magnetism and Mathematics with simplification (Pre-university level)
- ✓ Electrical machine based on DC supply and single-phase transformer
- ✓ Some basic characteristics with diagram of electrical machines and transformer
- ✓ Use major electrical equipment such as DC motor and Generator, single and three-phase transformer, induction and synchronous motor and alternator.

3. Rationale

In the study of this course, the students will understand and learn the construction, working, characteristics and applications of various types of Electrical machines such as DC motor and Generator, Single-phase Transformer which are the common machines which are used in our day-to-day life. Electrical machines is a core subject for the knowledge of which is essential for electrical engineering diploma holders and they need to assimilate it to succeed in the industry. In this regard, the basic knowledge of various types of AC and DC machines is essential. The knowledge of this core subject is essential for comprehending the courses that will be introduced later in the diploma program as well as developing requisite skills for effective functioning in the industry.

4. Objectives

- ✓ Analyze various machines such as DC machines (generator, motor) and single and three-phase transformer, induction and synchronous motor and alternator.
- ✓ Analyze electrical machines for various characteristics related functions and speed control related knowledge
- ✓ It will develop potential to measure & analysis of such machines for the application in industrial areas.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1	**DC Generator**	1.1. Important parts of DC generators and its material 1.2. Functions of whole parts used in DC generators 1.3. EMF equation of DC generator 1.4. Working principle of DC generator 1.5. Types of windings 1.6. Types of Generators and its characteristics 1.7. Armature rection and its effects and commutation 1.8. Efficiency and losses of DC generator	• Functions of various parts of DC generator • EMF equation of DC generator • Working principle of DC machine • Different types of winding and types of DC generator • Performances and various characteristics of DC generator • Calculation based on losses and numerical of DC generator • Armature reaction and commutation effects	20	8
2	**DC Motor**	2.1 Working principle of DC motor 2.2 Back emf of DC motor and its importance 2.3 Power relationship of motor 2.4 Types of DC motor 2.5 Direction of rotation of DC motor 2.6 Speed equation and regulation 2.7 Torque equation for armature and shaft 2.8 Operating characteristics of DC motor 2.9 Various types of tests in DC motor such as brake test, Swinburne test and field test 2.10 Applications of DC motors	• Back emf • Characteristics for operation of motor • Explain working principle of DC motor • Power equation • Speed equation and regulation • Torque equation • Various types of DC motor • Different types of tests of DC motor • Applications of various DC motors	20	8

3	**Transformer**	3.1 Construction and working principle of single-phase transformer 3.2 EMF equation and transformation ratio 3.3 Core and shell type transformer 3.4 Losses and efficiency of single-phase transformer 3.5 Construction with sketches of parts of three-phase transformer 3.6 Star delta connections 3.7 Parallel operation with conditions 3.8 Auto transformer	• Construction and working principle of single-phase transformer • EMF equation and transformation ratio • Difference between core and shell type transformer • Losses and efficiency • Maximum efficiency expression • Construction of various parts and different types of connections • Need of parallel operation • Steps for conducting OC and SC test • Construction of auto transformer	20	9
4	**Induction motor**	4.1 Construction, types - Squirrel cage - Single and double cage, Wound rotor 4.2 Working principle with Torque-slip curve, equivalent circuit and phasor diagram 4.3 Torque equation, Starting, running and condition for the maximum torque 4.4 No load test and Blocked rotor test, Losses and efficiency	• Explain how a rotational field is produced in a 3phase induction motor • Differentiate between squirrel cage and wound rotor induction motor with their salient features. • Explain the torque slip characteristics of squirrel cage and wound rotor induction motor including the generation operation.	20	9

5	**Alternator and Synchronous motor**	5.1 Principle of working and construction. - Salient and Cylindrical rotor 5.2 Equivalent circuit and phasor diagram 5.3 Voltage regulation methods 5.4 Synchronization of alternator with bus bar/alternator 5.5 Principle of working, starting methods of synchronous motor 5.6 Equivalent circuit and phasor diagram 5.7 Synchronous condenser and hunting and its prevention 5.8 Effect of change in excitation 'V'-curves	• Explain the working principle of an alternator • Differentiate between turbo generator and hydro generators and derive an emf equation • Voltage regulation and Synchronization • Connections and operations synchronous motor using proper starting method • Improve the power factor of the system using synchronous condenser • Differentiate the features between the synchronous and induction motor	20	8
				Total Hours	**42**

6. List of Practical's / Exercises

The practical/exercises should be properly designed and implemented in an attempt to develop different types of skills that students can acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Sr. No	Practical / Exercises	Key Competency	Hours
1	To Study different parts of D.C. Machine	Various parts of DC machine	2
2	To perform external and internal characteristics of D.C. series generator.	Characteristics of Series generator	2
3	To perform internal and external characteristics of D.C. series motor	Characteristics of Series motor	2
4	To study speed control of dc shunt motor	Speed control methods	2
5	To study Swinburne's test on a dc machine	Swinburne's test	2
6	To find out the efficiency of 1-φ transformer using direct loading method	Direct loading method	2
7	To find the efficiency of transformer, by performing O.C. and S.C. test on transformer	O.C. and S.C. test	2

8	Identify various accessories of three phase transformer by visiting to nearby substation and draw its sketch	Accessories sketches	2
9	Perform no load and blocked rotor test on a three-phase induction motor to obtain various parameters	Loading test	2
10	Measure the slip of 3-phase Induction motor by using Tachometer and by Stroboscopic method.	Slip Measurements	2
11	Perform no load and blocked rotor test on a three-phase induction motor to obtain various parameters	V curve's	2

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	App %	C %	E %	An %
1	DC Generator	40	20	20	20	10	10
2	DC Motor	40	20	20	20	10	10
3	Transformer	20	20	20	15	10	15
4	Induction motor	40	20	20	20	10	10
5	Alternator and Synchronous motor	30	20	20	10	10	10

Legends: R-Remembering C- Creating
U- Understanding E- Evaluating
App- Applying An- Analyzing

8. Textbooks

1) Electrical Technology Volume-II AC & DC Machines by B. L. Theraja, S. Chand and Company Ltd., Latest Edition
2) Electrical Machines by S. K. Sahdev, Cambridge University Press, Latest Edition

9. Reference Books

1) Principles of Electrical Machines by V. K. Mehta and Rohit Mehta, S. Chand and Company Ltd., Latest Edition
2) Theory and Performance of Electrical machines by J.B. Gupta, S.K. Kataria & Sons Publication, Latest Edition
3) Electrical Machines by R.K. Rajput, Laxmi Publications (P) Ltd., Latest Edition

10. Open Sources (Website, Video, Movie)

1) https://onlinecourses.nptel.ac.in/
2) https://circuitglobe.com/
3) https://electrical-engineering-portal.com/
4) https://www.electrical4u.com/
5) https://tryengineering.org/profile/electrical-engineering/