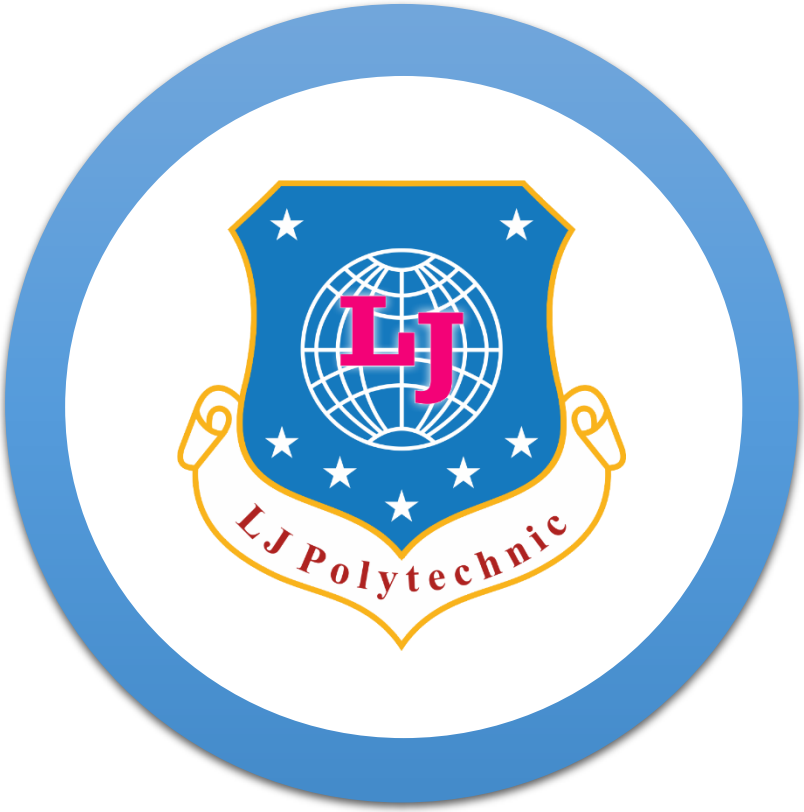
Lok Jagruti Kendra University
University with a Difference

Diploma
in
Electrical Engineering



Course Code: 025070601
Switchgear and Protection

Programme / Branch Name			Diploma in Electrical Engineering			
Course Name	Switchgear and Protection				**Course Code**	025070601
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

- ✓ Fundamental knowledge of power system
- ✓ Basic concepts of power system and its related equipment
- ✓ Knowledge of Some topics of various schemes of protection system

3. Rationale

This subject is offered to emphasize the role of power system which needs to protect all equipment and their schemes. The course aims to introduce the basic concepts of circuit brakers and relay and its information. Various components involved in the protection schemes of the transmission line and different machines such as transformer, generator and motors are also included. In addition to the various applications of protection systems, the course also covers the issues related to the integration of these systems in the existing network. Thus, the course is intended to provide the foundation for the protection schemes for overhead line, transformer and other machines.

4. Objectives

- ✓ Analyze various protection schemes for overhead line, transformer and other machines.
- ✓ Analyze various circuit brakers and relays and its types.
- ✓ It will develop potential to analysis of such schemes of protection and calculation of setting of relay.

5. Contents

Unit No.	Topics	Sub-Topics	Learning Outcome	% Weightage	Hours
1	**Elements of Protection**	1.1. Need of protective system 1.2. Functions of basic elements of a protective system. 1.3. Types, causes and effects of various Faults. 1.4. Protective Transformers: Specifications and Connection diagram of Current Transformer and Potential Transformer 1.5. Neutral Earthing	• Describe the functions of basic elements of a protective system • Describe the various types of faults and abnormalities occurring in a power system. • Explain the use of Current Transformer (CT) and Potential Transformer (PT) in protection system. • Describe various methods of neutral Earthing.	20	10
2	**Circuit Interrupting Devices**	2.1 Interrupting devices: Sequence of operation and interlocking 2.2 Isolators 2.3 Circuit breaker: Arc phenomena and arc extinction, Construction, working principle of Oil circuit breakers, Air break, Air Blast, Sulphur Hexa Fluoride (SF6) and vacuum circuit breakers. 2.4 Resistance switching	• Describe protective system showing different circuit interrupting devices using a line diagram • Explain the sequence of operation of and interlocking of interrupting devices • Explain characteristics of circuit breakers. • Explain arc formation and zero current interruption. • Explain the resistance switching.	20	12

3	**Protective Relays**	3.1 Protective relay, classification and selection: Terms related to relay 3.2 Principle of working, construction and operation of electromagnetic induction (shaded pole, watt-hour meter and induction cup), Thermal relay 3.3 Settings of various types of relays 3.4 Directional relay 3.5 Distance relay (impedance, reactance and mho) 3.6 Negative phase sequence relay 3.7 Static relay, (Construction and type) 3.8 Principle and working of Microprocessor based relay	• Describe need for different types of relays • State the terms related to relays. • Explain concept of over current and directional relays. • Explain setting of relays	20	12
4	**Protection of Transmission Line, transformer, Feeder and busbar**	4.1 Transmission line protection scheme 4.2 protection scheme - Overload protection, Over-current and earth fault protection, Time graded and current graded protection, Current balance differential protection 4.3 Carrier aided protection, Carrier inter-tripping, acceleration and blocking scheme 4.4 Distance/Impedance protection 4.5 Protection of parallel feeders and Ring Mains 4.6 Over current, Percentage differential and restricted earth fault	• Compare various protection scheme of transmission line • Describe the criteria to selection the protection scheme • Explain need of carrier aided protection. • Explain protection of feeders and ring mains and Bus bar • Explain various protection scheme for transformer. • Describe the inrush current phenomenon in transformer. • Explain the protection offered by Buchholz Relay • Explain Differential protection of Bus bars.	25	12

		protection of Transformers 4.7 Buchholz Relay, analysis of trapped gases 4.8 Differential Protection of Bus bars			
5	**Over Voltage Protection**	5.1 Causes of over voltages 5.2 Methods of reducing over voltages 5.3 Operating principles, construction and applications of lightning arrester	• State the causes of over voltage. • Explain the characteristics of Lightning Arrestor. • Describe the Insulation coordination and basic impulse insulation Level	15	10
				Total Hours	**42**

6. List of Practical's / Exercises

The practical/exercises should be properly designed and implemented 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	Identify various switchgear equipment available in the lab and write its specification and symbols	Switchgear equipment	2
2	Identify parts of various circuit breakers and their specification	Circuit breaker	2
3	Find the fusing factor of a given fusing material.	Fusing factor	2
4	Dismantle a Vacuum circuit breaker.	Vacuum circuit braker	2
5	Identify the various components of SF6 circuit breaker.	SF6 circuit breaker	2
6	Test overload relay and plot Time-Current characteristic	Time-Current characteristic	2
7	Use Buchholz relay for transformer protection.	Buchholz relay	2
8	Draw schematic diagram of protective schemes for 66 KV/ 132 KV/220 KV Substation nearby area. (after visit)	schematic diagram of protective schemes	2
9	Interpret different protective scheme for transformer	transformer	2
10	Set up a Horn gap lightning arrester	Horn gap lightning arrester	2
		Total Hours	20

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Chapter Name	Teaching Hours	Distribution of Topics According to Bloom's Taxonomy					
			R %	U %	App %	C %	E %	An %
1	Elements of Protection	10	40	20	20	20	10	10
2	Circuit Interrupting Devices	12	40	20	20	20	10	10
3	Protective Relays	12	20	20	20	15	10	15
4	Protection of Transmission Line, transformer, Feeder and busbar	12	40	20	20	20	10	10
5	Over Voltage Protection	10	30	20	20	10	10	10

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

8. Textbooks

1) Switchgear and Protection, Rao S. S., Khanna Publications, New Delhi (Latest Edition)
2) Switchgear and Protection, Gupta J.B., Katariya Pub. New Delhi (Latest Edition)

9. Reference Books

1) Fundamentals of Power System Protection, Paithankar Y. G. and Bhide S. R, PHI, New Delhi (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/