

GANPAT UNIVERSITY									
FACULTY OF ENGINEERING AND TECHNOLOGY (DIPLOMA PROGRAMMES)									
Programme	Diploma Engineering				Branch/Spec.	Electrical Engineering			
Semester	VI				Version	1.0.0.0			
Effective from Academic Year		2020-21			Effective for the batch Admitted in			July 2018	
Subject code	1EE2601		Subject Name		SWITCHGEAR & PROTECTION				
Teaching scheme					Examination scheme (Marks)				
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	4	0	1	0	5	Theory	40	60	100
Hours	4	0	2	0	6	Practical	30	20	50

Course Learning Outcomes:
<ul style="list-style-type: none"> Identify various types of faults in Power system Explain working of different types of circuit breakers in power system. Explain working of different types of relays in power system. Maintain the protection of transmission line and feeder from various faults Protect transformer, alternator, motor and bus bar

Theory syllabus				
UNIT	Unit Content	Unit Learning Outcomes	Marks	Hrs
Unit – I Elements of Protection	1a. Need of protective system 1b. Functions of basic elements of a protective system. 1c. Types, causes and effects of various Faults. 1d. Protection zones: Backup protection zones 1e. Protective Transformers: Specifications and Connection diagram of Current Transformer and Potential Transformer(single phase and 3 phase) 1f. Current limiting reactors. 1g. Neutral Earthing	1.1 Functions of basic elements of a protective system 1.2 Various types of faults and abnormalities occurring in a power system. 1.3 Concept of the Backup protection 1.4 Use of Current Transformer (CT) and Potential Transformer (PT) in protection system. 1.5 Working of current limiting reactors and their arrangements 1.6 Various methods of neutral Earthing.	10	10

<p style="text-align: center;">Unit – II Circuit Interrupting Devices</p>	<p>2a. Interrupting devices: Sequence of operation and interlocking</p> <p>2b. Fuse, types, characteristics, testing and applications</p> <p>2c. Isolators.</p> <p>2d. Circuit breaker: Arc phenomena and arc extinction, Construction, working principle of Oil circuit breakers, Airbreak, Air Blast, Sulphur Hexa Fluoride (SF6) and vacuum circuit breakers.</p> <p>2e. Auto-reclosure</p> <p>2f. Testing of circuit breaker</p> <p>2g. Resistance switching</p> <p>2h. Working principle of arc quenching in HVDC circuit breaker</p>	<p>2.1 Protective system showing different circuit interrupting devices using a line diagram</p> <p>2.2 Sequence of operation of and interlocking of interrupting devices.</p> <p>2.3 Terms associated with fuse and circuit breaker.</p> <p>2.4 Characteristics of fuse and circuit breakers.</p> <p>2.5 Arc formation and zero current interruption.</p> <p>2.6 Compare arc quenching in A.C. and D.C. Circuit Breaker.</p> <p>2.7 Resistance switching.</p>	14	14
<p style="text-align: center;">Unit – III Protective Relays</p>	<p>3a. Protective relay, classification and selection: Terms related to relay</p> <p>3b. Principle of working, construction and operation of electromagnetic induction (shaded pole, watt-hour meter and induction cup), Thermal relay</p> <p>3c. Settings of various types of relays</p> <p>3d. Directional relay</p> <p>3e. Distance relay (impedance, reactance and mho)</p> <p>3f. Negative phase sequence relay</p> <p>3g. Static relay, Construction and types</p> <p>3h. Principle and working of Microprocessor based relay</p>	<p>3.1 Need for different types of relays.</p> <p>3.2 State the terms related to relays.</p> <p>3.3 Concept of over current and directional relays.</p> <p>3.4 Setting of relays.</p> <p>3.5 Testing procedure of various relays.</p>	12	12
<p style="text-align: center;">Unit - IV Protection of Transmission Line and Feeder</p>	<p>4a. Transmission line protection scheme</p> <p>4b. protection scheme - Overload protection, Over-current and earth fault</p>	<p>4.1 Compare various protection scheme of transmission line.</p> <p>4.2 Criteria to selection the protection scheme</p>	10	10

	<p>protection, time graded and current graded protection, current balance differential protection</p> <p>4c. Carrier aided protection</p> <p>4d. Distance /Impedance protection</p> <p>4e. types of Auto reclosing</p> <p>4f. Protection of parallel feeders and Ring Mains</p>	<p>4.3 Impedance relay.</p> <p>4.4 Need of carrier aided protection.</p> <p>4.5 State the types of auto reclosing.</p> <p>4.6 Protection of feeders and ring mains and Bus bar.</p>		
<p>Unit – V Protection of Transformer, Alternator, Motor and Busbar</p>	<p>5a. Over current, Percentage differential and restricted earth fault protection of Transformers</p> <p>5b. Inrush phenomenon and over fluxing phenomenon in Transformer</p> <p>5c. Buchholz Relay, analysis of trapped gases</p> <p>5d. Various faults and abnormal operating conditions in Alternator and its protection schemes</p> <p>5e. Various faults and abnormal occurring in the Motor and its protection schemes</p> <p>5f. Differential Protection of Bus bars</p>	<p>5.1 Various protection scheme for transformer.</p> <p>5.2 Inrush current phenomenon in transformer.</p> <p>5.3 Protection offered by Buchholz Relay.</p> <p>5.4 Faults and abnormalities in alternator.</p> <p>5.5 Various faults occurring in motor and their protection schemes.</p> <p>5.6 Differential protection of Bus bars.</p>	10	10
<p>Unit – VI Over Voltage Protection</p>	<p>6a. Causes of over voltages</p> <p>6b. Methods of reducing over voltages</p> <p>6c. Operating principles, construction and applications of lightning arrester</p>	<p>6.1 State the causes of over voltage.</p> <p>6.2 Characteristics of Lightning Arrester.</p>	4	4

List of Practical	
1	Check the Polarity of Current Transformer and Potential Transformer and connect it with the relay.
2	Identify various switchgear equipment available in the lab and write its specification and symbols.
3	Identify parts of various circuit breakers and their specification.
4	Find the fusing factor of a given fusing material.
5	Demonstrate air break circuit breaker.
6	Dismantle a Vacuum circuit breaker.
7	Identify the various components of SF6 circuit breaker.

8	Test overload relay and plot Time-Current characteristic.
9	Use Buchholz relay for transformer protection.
10	Test thermal overload relay for protection of motor and set the relay properly.
11	Test static relay for the protection of motor
12	Apply balance current protection scheme using appropriate switch gear
13	Interpret various protective scheme used for transmission lines and feeders (from Blue print and visit).
14	Draw schematic diagram of protective schemes for 66 KV/ 132 KV/220 KV Substation nearby area. (after visit)
15	Interpret different protective scheme for transformer.

List of Instruments/Equipments/ Trainer Board	
1	Numerical relay panel with all protection.
2	Static earth fault relay
3	VCB with operation simulation panel
4	Panel for Biased Differential protection of Transformer
5	Current Transformer (Metering)
6	Potential Transformer
7	Buchholz Relay

List of Text Books			
1	Fundamentals of Power System Protection	Paithankar Y. G.and Bhide S. R	PHI, New Delhi (Latest Edition)
2	Power System Protection and Switchgear	Ram B and Vishwakarma D. N.	TMH, New Delhi (Latest Edition)
3	Switchgear and Protection	Rao S. S.	Khanna Publications, New Delhi (Latest Edition)

List of Reference Books			
1	Electrical Power System	Mehta V. K.	S. Chand Publications (Latest Edition)
2	Power system Protection and Switchgear	Ravindranath B. and M. Chander	Wiley Eastern Ltd, Delhi. (Latest Edition)

Link of Learning Resources	
1	www.nptel.iitm.ac.in
2	http://electrical-engineering-portal.com