GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: VI

Electrical & Electronics Engineering

Subject Name: **Switch Gear & Protection**
Subject Code: **160803**

Teaching Scheme				Evaluation Scheme		
Theory	**Tutorial**	**Practical**	**Total**	**University Exam (Theory) (E)**	**Mid Sem Exam (Theory) (M)**	**Practical (I)**
4	0	2	6	70	30	50

Sr. No	Course Content	Total Hrs.
1.	**Switch Gear:**	
	• Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages, Restriking Phenomenon. RRRV, Current Chopping and Resistance Switching, CB ratings and Specifications, Auto reclosures.	**5**
	• Fuses	**2**
	• Description and Operation of following types of circuit breakers: Air Break Circuit Breaker, Air Blast Circuit breakers, Interruption methods, Bulk oil circuit breaker, single and multi-break construction, Minimum oil circuit breaker, Voltage distribution in oil circuit breakers with arc control devices, SF6 circuit breaker, Vacuum circuit breaker	**6** **1**
	• Modifications of circuit breaker by shunt resistors.	**1**
	• Comparison of Circuit Breakers for Application	
2.	**Instrument Transformers:** Potential transformers, Current transformers	**2**
3.	**Protection:** • **Fundamental of Electromagnetic and Static Relays:** Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays, Relays Classification: Instantaneous, DMT and IDMT types.	**4**
	• **Application of relays:** Over current/ under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays.	**4** **4**

	• **Distance relays:** Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison.	**1**
	• **Static Relays:** Static Relays verses Electromagnetic Relays.	**4**
	• **Generator Protection:** Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection.	**3**
	• **Transformer Protection:** Protection of transformers, Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz relay Protection.	**1**
	• **Feeder and Bus-Bar Protection:** Differential Protection	**2**
	• **Protection of Lines:** Over Current, Carrier Current and Three-zone distance relay protection using Impedance relays, Translay Relay.	**2**
	• **Neutral Grounding:** Grounded and Ungrounded Neutral Systems, Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance, - Arcing Grounds and Grounding Practices.	**3**
	• **Protection against over voltages:** Generation of Over Voltages in Power Systems, Protection against Lightning Over Voltages, Valve type and Zinc-Oxide Lighting Arresters, Insulation Coordination, BIL, Impulse Ratio, Standard Impulse Test Wave, Volt-Time Characteristics.	

Text Books:

1. Oza, Bhuvanesh, Nair, N.C., Mehta, R.P., Makwana V.H., "Power System Protection and Switchgear," Tata McGraw-Hill, New Delhi, 2010
2. Rao, S.S., "Switchgear and Protection: theory, practice and solved problems," Khanna Publisher, New Delhi

Reference Books:

1. Paithankar, Y.G., Bhide, S.R., "Fundamentals of Power System Protection," PHI Learning Pvt. Ltd., New Delhi
2. Anderson, P.M., "Power System Protection," Wiley-IEEE Press, 1998
3. Mason C.R., "The Art & Science of Protective Relaying," Wiley Eastern Ltd.
4. Ravindranath, B., Chander, M., Power System Protection and Switchgear," New Age international (P) Ltd, New Delhi
5. Wadhwa, C.L., "Electrical Power Systems," New Age international (P) Ltd, New Delhi
6. Badri Ram, Vishwakarma, D.N., "Power System Protection and Switchgear," Tata McGraw-Hill, New Delhi

Reference for Laboratory and Assignments:

1. Bhuvanesh A. Oza and Sukumar M. Brahma, "Development of Power System Protection Laboratory through Senior Design Projects," *IEEE Transactions on Power Systems,* Vol. 20, No. 2, Pp. 532-537, May 2005