



# **C.U.SHAH UNIVERSITY**

**FACULTY OF:** Technology & Engineering  
**DEPARTMENT OF:** Electrical Engineering  
**BRANCH:** Electrical Engineering  
**SEMESTER:** VI  
**COURSE:** B.Tech  
**CODE:** 4TE06SGP1  
**NAME –** Switchgear and Protection

## **Teaching & Evaluation Scheme**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE06SGP1	Switchgear and Protection	4	0	2	6	5	30	1.5	70	3	--	20	30	150

## **OBJECTIVES**

1. To study various Electrical switching and power protective devices namely circuit breaker, Two poll switch, isolator, earth switch, relays, and power transformer mathematical modelling of physical systems.
2. To study design and implementation of modelling circuits using Power switching components.
3. To study design and simulation of linear electromagnetics circuits using components

## **PREREQUISITES**

1. Basics and fundamental electro magnetics switchgear and protective circuits.

## **COURSE OUTLINES**

Sr. No.	Course Contents	Hours
1	<b>Theory of Circuit Interruption:</b> Introduction, Physics of arc phenomena, Maintenance of the arc, Losses from plasma, Essential properties of arc, Arc interruption theories. <b>Circuit Constants In Relation to Circuit Breaking:</b> Introduction, Circuit breaker rating, Circuit constants and circuit conditions Re-striking voltage transient Characteristics of re-striking voltage, Interaction between the breaker and circuit, Current chopping, The duties of switchgear. <b>Theory and Practice of Conventional Circuit Breakers:</b>	12

	<p>Automatic switch, Air-break circuit breakers, Oil circuit breakers, Single and multi-break construction, Air-blast circuit breaker, Performance of circuit breakers and system requirements, Modification of circuit breaker duty by shunt resistors, Power factor correction by series resistance, Comparative merits of different types of conventional circuit breakers.</p> <p><b>Recent Developments in Circuit Breakers:</b></p> <p>Modern trends, Vacuum circuit breakers, Sculpture hexafluoride (SF6) circuit breakers DC circuit breaker.</p>	
2	<p><b>Introduction And Philosophy of A Protective Relaying System:</b></p> <p>Types of Faults, Abnormalities, Functions of Protective Relay Schemes, major Components of Power system. Basic Tripping Circuit, Testing and Maintenance of Relays, Zones of Protection , Requirements of Protective Systems, Relay Operating Criteria, Main and Backup Protection, Historical Review of Protective Relay Technology.</p> <p><b>Protective Current and Potential Transformer:</b></p> <p>CT Equivalent Circuit, Vector diagram, Construction, magnetization Curve, Core, Errors, accuracy, Specifications, Factors affecting selection PT: Equivalent circuit, Construction, CVT, Specifications.</p> <p><b>Different Types Of Relays: Electromagnetic Relays:</b></p> <p>Classification, Thermal O/L Relays, Types Over Current Relays, Differential Relay, Directional Relay, Impedance Relays.</p> <p><b>Static Relays:</b></p> <p>Advantages and Limitations, basic Elements, Static Relays Architecture.</p>	12
3	<p><b>Generator Protection :</b></p> <p>Differential Protection, Inter-turn fault Protection, stator E/F, Rotor E/F, NPS, Field Failure, Over Load, Over Voltage, Reverse Power, Pole, Slipping, Backup Impedance, Under Frequency , Miscellaneous Protection.</p> <p><b>Transformer Protection:</b></p> <p>Faults in Transformer, Gas operated relays Over Current Protection – REF Protection – Differential Protection – Protection against over fluxing – Protection of Grounding transformers – Protection Against Overheating, Protection for small transformers.</p> <p><b>Induction Motor Protection:</b></p> <p>Starting of IM – Faults in IM – Abnormalities of IM – Protection of small IM – Protection of Large IM.</p>	12
4	<p><b>Protection Of Transmission Lines:</b></p> <p>Protection of Lines by Over Current Relays, Protection of Lines by Distance Relays, Carrier Current Protection for lines.</p> <p><b>Bus Zone Protection:</b></p> <p>Protection Requirements, Non unit protection, Unit protection schemes, Breaker Backup Protection.</p>	10
5	<p><b>Microprocessor Based Digital Protection:</b></p>	08

	Advantages of Numerical Relays, Numerical Relay Hardware , Digital Signal Processing, estimation of Phasors, Full Cycle Fourier Algorithm, Half Cycle Fourier Algorithm, Practical Consideration for Selection of Algorithm, DFT, FFT.  <b>Numerical Approach To Apparatus Protection (Overview):</b> Generator Protection – Transformer Protection – Induction Motor Protection.	
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### **Learning Outcomes**

After the completion of this course the students would be able to:

1. To design and implement various industrial and mathematical computational and simulation software in protective system.
2. To understand the various types of switching and protective devices.
3. To understand advance protective devices in power system.

### **Books Recommended**

- 1 Y. G. Parithankar and S. R. Bhide, "Fundamentals Of Power System Protection" 2nd edition, PHI.
- 2 S. S. Rao, "Switchgear And Protection" Khanna publication.
- 3 Oza, Nair, Mehta, Makwana, "Protection and switchgear",
- 4 C. Russell Masson, "Art And Science Of Protective Relaying"
- 5 B. Ravindranath and M. Chander, "Power System Protection And Switchgear"
- 6 B. Ram, "Power System Protection" TMH Publication.
- 7 Patra and Basu, "Power System Protection"
- 8 Divyesh Oza, "Modern Power System Protection" TMH Publication.
- 9 Bhavesh Bhalja, Nilesh Chothani, "Protection and switchgear", Oxford Publication 2011.