



# GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3730712

Semester – III

Subject Name: POWER SYSTEM TRANSIENTS

Type of course: Professional Elective Course

Prerequisite: Basic concepts and principles of Power Systems Analysis and Circuit and Networks

**Rationale:** Transient behavior of electrical power system is very important to understand the system stability and to design appropriate controllers. This course provides detailed concepts of switching and lightning transient voltages which power systems components may carry over and above the power frequency voltage. Modeling of transmission line for calculation of such voltages is described in this course. The design of insulation under such conditions will also be covered for transient stability study.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>INTRODUCTION</b> Source of transients, various types of power systems transients, effect of transients on power systems, importance of study of transients for insulation design.	04	10
2	<b>TRAVELLING WAVES ON TRANSMISSION LINE</b> Introduction, Circuit with Distributed constants, The wave equation, Reflection and Refraction of Travelling Waves, Behaviour of Travelling waves at Line Termination, Lattice Diagrams, Attenuation and Distortion of Travelling Waves, Switching operations involving Transmission Lines, Multi-conductor Systems and Multi-velocity Waves, Switching Surges on an integrated Systems and Problem on related Topics.	14	30
3	<b>LIGHTNING TRANSIENTS</b>	04	10



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	Introduction, Scope of Lightning Problem, The Physical phenomena of lightning phenomenon, charge formation in the clouds, rate of charging of thunder clouds, mechanisms of lightning strokes, Computation of a Specific lightning Events, Induced Lightning Surges, Protection afforded by ground wires, Tower footing resistance. Interaction between lightning and power system: Mathematical model for lightning		
4	<b>COMPUTATION OF TRANSIENTS</b> Introduction, The Digital Computer, The Electromagnetic Transients Program(EMTP), The Hybrid Program	05	13
5	<b>PROTECTION OF SYSTEMS AND EQUIPMENTS AGAINST TRANSIENT OVERVOLTAGES</b> Introduction, Protection of transmission line against lightning, Lightning Shielding of Substation, Surges Suppressors and Lightning arresters, Application of Surge Arresters, Surge Capacitors and Surge Reactors, Surge Protection of Rotating Machines, Transient Voltages and Grounding Practices, Protection of Control Circuits, Surge Protection Scheme for industrial Drive System, Problems	10	25
6	<b>INSULATION COORDINATION</b> Some Basic Idea About Insulation Coordination, The Strength of Insulation, The Hierarchy of Insulation Coordination, Test Voltage Wave forms and Transient Ratings, Determination and Statistical Approaches to Insulation Coordination.	05	12

### Reference Books:

1. "Electrical Transients in Power Systems" ALLAN GREENWOOD Willey Publication Second Edition (Indian Edition)
2. "Extra High Voltage AC Transmission Engineering", R.D.Begamudre, New Age Internation,
3. "High Voltage Engineering", M.S.Naidu and V.Kamaraju , Tata McGraw Hill, 2nd edition, 2000.
4. "Power systems Transients a statistical approach" C S Indulkar D P Kothari and K. Ramalingam. PHI Publication
5. P. Kundur, "Power System Stability & Control", Tata Mcgraw hill



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## Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	A quantitative foundation of the mechanism of lightning strokes and the production of lightning surges to understand how the various types of Transients in the system produced.	20
CO-2	Obtain the theoretic basis of the propagation, reflection and refraction of travelling waves for modeling of transmission line travelling waves	25
CO-3	Grasp the concepts of the impact of voltage transients caused by circuit breaker action, switching on integrated power system.	25
CO-4	Design of Insulations under the presence of transients and protection of power system against transient over voltages.	30

## Major Equipment:

**List of Open Source Software/learning website: EMTP software**

E-materials available at the website of NPTEL- <http://nptel.ac.in/>