

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)

POWER SYSTEM TRANSIENTS

SUBJECT CODE: 2720720

SEMESTER: II

Type of course: Engineering

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

Rationale: This course provides detailed concepts of switching and lightning transient voltages which power systems components may carry over and above the power frequency voltage. Modelling of transmission line for calculation of such voltages is described in this course. The design of insulation under such conditions will also be covered.

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)			
		ESE			OEP	PA	RP			
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	INTRODUCTION 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	TRAVELLING WAVES ON TRANSMISSION LINE 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.	15	30
3	LIGHTNING TRANSIENTS 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	05	10
4	COMPUTATION OF TRANSIENTS Introduction, The Digital Computer, The Electromagnetic Transients Program(EMTP), The Hybrid Program	06	15

5	PROTECTION OF SYSTEMS AND EQUIPMENTS AGAINST TRANSIENT OVERVOLTAGES 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	12	25
6	INSULATION COORDINATION 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.	04	10

Reference Books:

1. ELECTRICAL TRANSIENTS IN POWERSYSTEMS By ALLAN GREENWOOD Willey Publication Second Edition (Indian Edition)
2. R.D.Begamudre, 'Extra High Voltage AC Transmission Engineering', New Age International,
3. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 2nd edition, 2000.

Course Outcome:

After learning the course the students should be able to:

1. Understand how the various types of Transients in the system produced and provide an internal description of the system including possible Transients in the systems.
2. Understand Lightning and effect on power systems.
3. Understand Modelling of transmission line for travelling waves.
4. Understand the protection of power system against transient over voltages.
5. Design ideas of Insulations under the presence of transients.

List of Experiments / Tutorials:

1. Introduction to MATLAB for various matrix operations.
2. Simulation of EMTP for parameter.
3. Transition line frequency dependent parameter identification.
4. Tutorial on ground wire calculation.
5. Tutorial on calculation of specifications of protection equipment under the influence of various transients.
6. MATLAB program for transmission line modelling using distributed parameter.
7. MATLAB Simulation for generation of abnormal and normal switching transients
8. MATLAB Simulation of RL, RLC circuit
9. MATLAB simulation/programming various types of fault in power systems.

Major Equipment:

Computers.

List of Open Source Software/learning website:

PSCAD EMTDC software, MATLAB Software.

NPTEL courses related to power system analysis, dynamics and stability

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.