ELECTRICAL TRANSIENTS IN POWER SYSTEMS

IIISemester: EPS								
Course Code	Category	Hours / Week		Credits	Maximum Marks			
BPSC29	Core	L	T	P	С	CIA	SEE	Total
		3	0	0	3	30	70	100
Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil			Total Classes: 45			

I. COURSE OVERVIEW:

The purpose of this course to enable the students about different types of power system transients, their phenomena and protective equipment used. The course mainly focus on the behavior of travelling waves for lines terminated by different conditions, lightning, switching and temporary over voltages, modelling of overhead lines, parameters of underground cables and the computation of power system transients using the Electro Magnetic Transient Program (EMTP).

II. COURSE OBJECTIVES:

The students will try to learn:

- I. The reasons for occurrence of transients in a power system.
- II. The change in parameters like voltage & frequency during transients.
- III. Lightning phenomenon and its effect on power system.
- IV. About the various protective devices against transients.

III. COURSE OUTCOMES:

After s	After successful completion of the course, students will be able to:						
CO 1	Discuss the behavior of travelling waves for a line terminated by open circuit, short circuit and lumped reactive elements to find the reflection and refraction coefficients.	Analyze					
CO 2	Use the Bewley's lattice diagram in travelling wave analysis under different loading conditions to design the protective equipment's for lines.	Apply					
CO 3	Discuss the energizing transients and methods to control the over voltages, line dropping and rejection.	Analyze					
CO 4	Compute the resistance, inductance and capacitance of a transmission lineusing the concepts of Geometric Mean Radius (GMR) and Geometric Mean Distance (GMD).	Analyze					
CO 5	Compute the cable series impedance and shunt admittance of self-contained single core and three core cables.	Analyze					
CO 6	Examine the power system transients using Electro Magnetic Transient Program (EMTP)	Analyze					

IV. SYLLABUS

MODULE -I: REVIEW OF TRAVELLING WAVE PHENOMENA (09)

Lumped and Distributed Parameter: Wave equation, reflection, refraction, behavior of travelling waves at the line terminations, lattice diagrams, attenuation and distortion.

MODULE -II: LIGHTNING, SWITCHING AND TEMPORARY OVERVOLTAGES (09)

Lightning over voltages: interaction between lightning and power system ground wire voltage and voltage across insulator; switching overvoltage: short line or kilometric fault, energizing transients - closing and re-closing of lines, methods of control; temporary over voltages: line dropping, load rejection; voltage induced by fault; very fast transient overvoltage (VFTO).

MODULE -III:PARAMETERS AND MODELLING OF OVERHEAD LINES (09)

Review of line parameters for simple configurations: series resistance, inductance and shunt capacitance; bundle conductors: Equivalent GMR and equivalent radius.

Modal propagation in transmission lines: modes on multiphase transposed transmission lines, α - β -0 transformation and symmetrical components transformation, modal impedances; analysis of modes on transposed lines; effect of ground return and skin effect; transposition schemes.

MODULE -IV: PARAMETERS OF UNDERGROUND CABLES (09)

Distinguishing features of underground cables: technical features, electrical parameters, overhead lines versus underground cables; cable types: Series impedance and shunt admittance of single core self-contained cables, impedance and admittance matrices for three phase system formed by three single coreself contained cables, approximate formulas for cable parameters.

MODULE -V: COMPUTATION OF POWER SYSTEM TRANSIENTS - EMTP (09)

Digital computation of line parameters: Why line parameter evaluation programs; Salient features of mt line: Constructional features of that affect transmission line parameters, elimination of ground wires bundling of conductors; Principle of digital computation of transients: features and capabilities of EMTP; steady state and time step solution modules: basic solution methods.

V. Text Books

- 1. Allan Greenwood, "Electrical Transients in Power System", Wiley& Sons Inc. New York, 1st Edition, 1991.
- 2. Harold A Peterson, "Transient in Power Systems", McGraw Hill, 1st Edition, 1966.

VI. Reference Books:

- 1. Kuffel and Abdullah, "High Voltage Engineering", PHI,1st Edition, 2000.
- 2. Rakesh D Begamudre, "EHV AC Transmission Engineering", PHI, 1st Edition, 2006.
- 3. Naidu M S and Kamaraju V, "High Voltage Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2004.
- 4. Hermann W. Dommel, EMTP Theory Book, second Edition, Microtran Power System Analysis Corporation, Vancouver, British Columbia, Canada, May 1992, Last Update: April 1999.

VII. Web References:

- 1. https://www.EMTP Literature from www.microtran.com
- 2. https://www.smartech.gatech.edu/bitstream/handle/1853/14488
- 3. https://www.weibull.com/basics/reliability.htm

VIII. E-Text Books:

- 1. https://www.download.springer.com/static/pd
- 2. https://www.web.mit.edu/energylab/www/pubs/el99-005wp.pdf