INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ELECTRICAL TRANSIENTS IN POWER SYSTEMS								
III Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BPSE29	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Power systems								

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 focuses 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:

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

IV. COURSE CONTENT:

MODULE –I: REVIEW OF TRAVELLING WAVE PHENOMENA (10)

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 (10)

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 (10)

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/1853/14488https://www.weibull.com/basics/reliability.htm

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Definition and terminology
5. Assignments
6. Model question paper-I
7. Model question paper-II
8. Lecture notes
9. Power point presentations