

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE301	POWER GENERATION, TRANSMISSION AND PROTECTION	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

- To set a foundation on the fundamental concepts of Power System Generation, Transmission, Distribution and Protection.

Syllabus

Power Generation-conventional-hydrothermal, nuclear - non conventional solar and wind-economics of power generation-Power factor Improvement-Power transmission -line parameters -resistance- inductance and capacitance- Transmission line modelling- classifications -short line, medium line, long line-transmission line as two port network-parameters- derivation -power flow through lines-Overhead lines-types of conductors-volume of conductors- Kelvin's law- Types of Towers-calculation of Sag and tension- Insulators- types -corona-underground cables-H V DC transmission-Flexible A C transmission-power Distribution system-need for protection-circuit breakers-protective relay types -Types of protection causes of over voltages -insulation coordination

Expected outcome .

The students will be able to

- Know the basic aspects in the area of power generation, transmission, distribution and protection.
- Design power factor correction equipment, transmission line parameters, and decide upon the various protection schemes to be adopted in various cases.

Text Books:

- B.R. Gupta: "Power system Analysis and Design", Wheeler publishers
- J.B. Gupta, "A course in Electrical Power", Kataria and sons, 2004.
- Wadhwa, "Electrical Power system", Wiley Eastern Ltd. 2005

References:

- A.Chakrabarti, ML.Soni, P.V.Gupta, V.S.Bhatnagar, "A text book of Power system Engineering" Dhanpat Rai, 2000
- Grainer J.J, Stevenson W.D, "Power system Analysis", McGraw Hill
- I.J.Nagarath & D.P. Kothari, "Power System Engineering", TMH Publication,
- K.R Padiyar," FACTS Controllers for Transmission and Distribution" New Age International, New Delhi
- Stevenson Jr. Elements of Power System Analysis, TMH
- Sunil S Rao ,"Switch gear and Protection",Khanna Publishers

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	<p>Introduction: Typical layout of Power system Network</p> <p>Generation of Electric Power: Overview of conventional (Hydro, Thermal and Nuclear) and Nonconventional Sources (Solar and Wind) (Block Diagram and Brief Description Only)</p> <p>Economics of Generation: Load factor, diversity factor, Load curve (Brief description only) Numerical Problems. Methods of power factor improvement using capacitors</p>	9	15%
II	<p>Power Transmission</p> <p>Transmission Line Parameters: Resistance, inductance and capacitance of 1-Φ, 2 wire lines-composite conductors</p>	10	15%

	<p>(Derivation Required). Inductance and capacitance of 3-Φ lines. Symmetrical and unsymmetrical spacing-transposition-double circuit lines-bundled conductors (Derivation Required) .Numerical Problems</p> <p>Modelling of Transmission Lines: Classification of lines-short lines-voltage regulation and efficiency-medium lines-nominal T and Π configurations-ABCD constants- long lines- rigorous solution- interpretation of long line equation-Ferranti effect. Tuned power lines-power flow through lines-Basics only</p>		
FIRST INTERNAL EXAMINATION			
III	<p>Introduction of Overhead transmission and underground transmission Conductors -types of conductors -copper, Aluminium and ACSR conductors -Volume of conductor required for various systems of transmission-Choice of transmission voltage, conductor size -Kelvin's law. Mechanical Characteristics of transmission lines – configuration-Types of Towers. Calculation of sag and tension-supports at equal and unequal heights -effect of wind and ice-sag template</p> <p>Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators. Corona -disruptive critical voltage -visual critical voltage -power loss due to corona -Factors affecting corona - interference on communication lines.</p> <p>Underground Cables -types of cables -insulation resistance - voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating.</p>	9	15%
IV	<p>HVDC Transmission: Comparison between AC &DC Transmission ,Power flow equations and control, Types of DC links Flexible AC Transmission systems: Need and Benefits, SCV, Configuration of FC + TCR, Series compensation, Configuration of TCSC Power distribution systems –Radial and Ring Main Systems - DC and AC distribution: Types of distributors- bus bar arrangement -Concentrated and Uniform loading -Methods of solving distribution problems.</p>	8	15%
SECOND INTERNAL EXAMINATION			
V	<p>Need for power system protection. Circuit breakers – principle of operation- formation of arc-Arc quenching theory- Restriking Voltage-Recovery voltage, RRRV (Derivation Required). Interruption of Capacitive currents and current chopping (Brief Description Only). Types of Circuit Breakers: Air blast CB – Oil CB – SF6 CB – Vacuum CB – CB ratings.</p>		20%

	Protective Relays- Zones of Protection, Essential Qualities- Classification of Relays -Electro mechanical, Static Relays, Microprocessor Based Relay. Electromechanical Relays-Attracted Armature, Balanced Beam, Induction disc, Thermal Relays (Brief Description only) Static Relays-Merits and Demerits, Basic components, Comparison and duality of Amplitude and Phase comparators. Static overcurrent, Differential, Distance Relays, Directional Relay-(principle and Block diagram only) Microprocessor Based Relay-Block diagram and flow chart of Over current Relay, Numerical Relay(Basics Only)	12	
VI	Protection of alternator: Stator inter turn, Earth fault Protection and Differential protection Protection of transformers- Percentage Differential Protection-Buchholz Relay Protection of transmission lines- Differential Protection-carrier current protection Causes of over voltages – surges and traveling waves – voltage waves on loss less transmission lines, Bewley Lattice diagram. Protection against over voltages - Surge diverters - Insulation co-ordination	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100

Exam Duration: 3Hours.

Part A: 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.