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

i. Know the basic aspects in the area of power generation, transmission, distribution and protection.

ii. Design power factor correction equipment, transmission line parameters, and decide upon the various protection schemes to be adopted in various cases.

Text Books:

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

References:

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

Course Plan

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

	(Derivation Required). Inductance and capacitance of 3-Φ lines. Symmetrical and unsymmetrical spacing-transposition-double circuit lines-bundled conductors (Derivation Required) .Numerical Problems **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		
FIRST INTERNAL EXAMINATION			
III	**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 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. Underground Cables -types of cables -insulation resistance -voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating.	9	15%
IV	**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.	8	15%
SECOND INTERNAL EXAMINATION			
V	**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.		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: 3Hourrs.

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.