

203145: Power System I

Teaching Scheme
Th : 04 Hrs/ Week

Credits
Th/Tut: 04

Examination Scheme [Marks]
In Sem (Online) : 50 Marks
End Sem : 50 Marks

Prerequisite:

- Power Generation.
- Various insulating materials and properties.
- Knowledge of fundamental of electrical circuit components.

Course Objective:

- To learn basic structure of electrical power systems, various electrical terms related with power system and understand various types of tariffs.
- To understand specifications and applications of major electrical equipment present in power plant.
- To get knowledge of mechanical & electrical design of overhead and underground transmission system.
- To learn representation of transmission lines for performance evaluation.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Recognize different patterns of load curve, calculate different factors associated with it and tariff structure for LT and HT consumers.
- Aware of features, ratings, application of different electrical equipment in power station and selection of overhead line insulators.
- Analyze and apply the knowledge of electrical and mechanical design of transmission lines.
- Identify and analyze the performance of transmission lines.

Unit 01 : Structure of Electrical Power Systems and tariff: (8 Hrs)

- A) Structure of Electrical Power Systems:** Structure of Electrical Power System, Different factors associated with generating stations such as Connected load, Maximum Demand, Demand Factor, average load, load factor, diversity factor, plant capacity factor, reserve capacity, plant use factor, Load curve, load duration curve, concept of base load and peak load stations, Interconnected grid system. Fitting of available generating stations into the area load duration curve.
- B) Tariff :** Introduction of Tariff, Tariff setting principles, desirable characteristics of Tariff, various consumer categories and implemented tariffs such as two part, three part, Time of Day tariff for H.T. & L.T. industrial and commercial consumers along with current electricity charges, Introduction to Availability Based Tariff (ABT), Interruptible tariff, Incentives and penalties applied to various consumers.

Unit 02 : Major Electrical Equipment's in Power Stations and Overhead line insulators : (8 Hrs)

- A) Major Electrical Equipment's in Power Stations :** Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays, current transformers, Potential transformers, Lightning arresters, Earthingswitches, isolators, carrier current equipment (P.L.C.C.), Control panels, battery rooms, metering and other control room equipment in generating stations.

- B) Overhead Line Insulators:** Types of insulators & their applications such as pin type, suspension type, strain type, Silicon Rubber insulators, post insulators, Shackle insulators, bushings, voltage distribution along string of suspension insulators, string efficiency, equalization of potential across each unit, method of improving string efficiency, insulator failure.

Unit 03 : Mechanical Design of Overhead Lines and Underground

Cables:

(8 Hrs)

- A) Mechanical Design of Overhead Lines:** Main components of overhead lines, Line supports, conductor spacing, length of span, calculation of sag for equal and unequal supports and effect of ice and wind loadings.
- B) Underground Cables:** Classification, Construction of cable, XLPE cables, insulation resistance, dielectric stress in single core cable, capacitance of single core and three core cable, cables used for HVDC transmission. Grading of cables, inter sheath grading, capacitance grading.

Unit 04 : Resistance and Inductance of Transmission Line:

(9 Hrs)

Resistance of transmission line, skin effect and its effects, proximity effect, internal & external flux linkages of single conductor, inductance of single phase two wire line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of G.M.R. and G.M.D, necessity of transposition, inductance of three phase double circuit line with symmetrical and unsymmetrical spacing, inductance of bundled conductors.

Unit 05 : Capacitance of Transmission Line:

(7 Hrs)

Electric potential at single charged conductor, potential at conductor in a group of charged conductors, capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R. and G.M.D for capacitance calculations, capacitance of three phase line with symmetrical and unsymmetrical spacing, capacitance of double circuit three phase line with symmetrical and unsymmetrical spacing.

Unit 06 : Performance of Transmission Lines:

(8 Hrs)

Classification of lines based on length and voltage levels such as short, medium and long lines. Performance of short transmission line with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Pi' and 'Nominal Tee' circuits using R, L and C parameters. Ferranti effect, Representation of 'Tee' and 'Pi' models of lines as two port networks, evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of Efficiency & regulation of short & medium lines.

Industrial visit: Minimum one visit to HV substations is recommended.

Text Books:

- [T1] J. B. Gupta, "Transmission and Distribution", S. K. Kataria & Sons, New Delhi.
- [T2] V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication
- [T3] J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria & Sons, New Delhi.
- [T4] Dr. B. R. Gupta, "Generation of Electrical Energy", S. Chand Publication
- [T5] A Chakraborty, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai & Co., Delhi.
- [T6] S. N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

- [R1] Nagrath& Kothari, “Power System Engineering”, Tata McGraw Hill Publications.
- [R2] D. Das, “Electrical Power System”, New Age Publication.
- [R3] W.D. Stevenson, “Power System Analysis”, Tata McGraw Hill Publications.
- [R4] “Know your Power – citizen’s primer” – Prayas energy group

References:

www.mahadiscom.in
www.mercindia.org.in