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| Course No | Course Name | L-T-P-Credits |
| **EE 202** | **Power Systems I** | **3-1-0: 4** |
|  Prerequisite: Nil;  |
| **Course Objectives**:1. To make the students familiar with generation, transmission & distribution of the electrical energy.
2. To understand the technical and economic aspects of the electrical systems.

**Course Outcomes**:1. Ability to understand the general structure of generation, transmission and distribution.
2. Ability to examine the mechanical aspects as well as electrical design of overhead transmission lines.
3. Ability to analyse the performance of different transmission line models.
4. Ability to understand the detailed constructions of underground cable and transients in power systems.
5. Ability to understand the concept of tariff and the necessity of power factor improvement.
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|  **SYLLABUS** |
| **Module** | **Contents** | **Hours** |
| I | **Generating Power Stations**:Introduction of different types of power generation, Power scenario in India, Plant layout and operation of Thermal, Gas turbine based, Hydro-electric & Nuclear power plants, Renewable generations, Economics of Power generation, Tariff, Power factor and its effect on system economy, Power factor improvement, Deregulation. | 06 |
| II | **Representation of Power System Network:**Introduction and basic structure of power system, Single line diagram, different types of supply system and their comparison, High voltage transmission, Economic choice of voltage and conductor size, Introduction to Per Unit Quantities. | 05 |
| III | **Distribution of Electric Power:** Introduction, Structure, Types of D.C distributors, D.C distribution calculations, A.C distributor, fed at one and fed at both the ends with concentrated loads and uniformly distributed loads, ring distributors with interconnector, current distribution in three wire and four wire ac systems, overview of distribution automation. | 07 |
| IV | **Mechanical Design of Overhead Lines:**Introduction, Different components of overhead transmission lines, string efficiency, methods of improving string efficiency, Phenomenon of Corona, Corona loss, Introduction to sag and tension, Calculation of sag and tension, consideration of ice & wind loading, spacing and clearances. | 07 |
| V | **Parameters of Transmission Lines**Introduction and basic theory, calculation of line resistance, inductance and capacitance for simple arrangements and multi-circuit lines, concept of self GMD and mutual GMD, bundled conductor, spacing of conductors, equivalent spacing, symmetrical and unsymmetrical spacing, transposition for single and double circuit, skin and proximity effects, Effect of earth on capacitance calculation. | 07 |
| VI | **Characteristics and Performance of Transmission Lines**Introduction, Short and medium transmission lines, Charging currents, Calculation by nominal-T, nominal-π and end-condenser method, Regulation and efficiency, Concept of ABCD parameters, Ferranti effect, Modeling of long transmission line, Rigorous solution to long transmission line, evaluation of ABCD constants, interpretation of long line equation, Surge impedance and surge impedance loading, Equivalent circuit of a long transmission line, Power flow through a transmission line, Circle diagrams. | 06 |
| VI | **Underground Cables**Introduction, cable construction, classification of cables, insulation resistance of a single core cable, capacitance and dielectric stresses in a single core cable, most economical conductor size in a cable, grading of cables, capacitance grading/Dielectric grading, inter-sheath grading, limitations of grading, Cable capacitance, charging or capacitive current, capacitance of three core cable and measurements of capacitances. | 05 |
| VII | **Transients in Power Systems**Introduction, Circuit closing transient, Sudden symmetrical short circuit of alternator, Recovery transient due to removal of short circuit, Travelling waves on transmission lines, Wave equations, Arcing grounds, Line design based on direct strokes, Surge arrestors Insulation coordination. | 05 |

**Essential Readings:**

1. I.J Nagrath & D.P. Kothari, “Modern Power System Analysis”, Tata McGraw Hill, 4th Edition, 2011.
2. C.L. Wadhwa, “Electric Power System”, New Age International Publishers, 6th Edition, 2010
3. W. D. Stevenson, “Element of Power System Analysis”, McGraw Hill, 4th Edition, 1982

**Supplementary Readings:**

1. Ashfaq Hussain, “Electric Power Systems”, CBS Publisher & Distributors, 5th Edition, 2017.
2. Arun Ingole, “Power Transmission and Distribution”, Pearson, 1st Edition, 2018.
3. Luces m. Faulkenberry & Walter Coffer, “Electric Power Distribution and Transmission”, Pearson, 2nd Edition, 2007.
4. A. Chakrabarti, M.L. Soni, P.V. Gupta, & U.S. Bhatnagar, “A Text Book on Power System Engineering”, Dhanpat Rai & Co, 2008.
5. S.N. Singh, Electric Power Generation, Transmission and Distribution, Prentice Hall India Pvt., Limited, 2nd Edition 2008.