**University of Management and Technology**

**Course Outline**

Course code: **EE317** Course title: **Power System Fundamentals**

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| Program | BSEE |
| Credit Hours | 3 |
| Duration | One Semester |
| Prerequisites | EE 212 Electrical Network Analysis |
| Resource Person | Mr. Ahmed Malik |
| Counseling Timing  (SEN-501 ) | See on window |
| Contact | Ahmed.malik@umt.edu.pk |

**Chairman/Director signature………………………………….**

**Dean’s signature…………………………… Date………………………………………….**

**Learning Objective:**

This introductory course will deal with the basic concepts involved in power systems, structure of modern power system, study of the conventional and nonconventional sources of electrical energy, calculation of transmission line parameters: inductance of single conductor, inductance of single and three phase lines, capacitance of single and three phase lines, mechanical design of transmission line, transmission line models, Underground cables, Effect of Lightning Phenomenon on Transmission Lines, and Limiting Factors at EHV and UHV.

The course strongly supports expected outcomes a, b, d and i of the HEC Electrical Engineering Curriculum. Upon completion of this course, students will become familiar with:

* Power generating stations
* Basic concepts of single phase and three phase system
* Power transmission system
* Electrical Design of Transmission Line
* Transmission Line Protection
* Underground cables
* Lighting effect on Overhead Transmission Lines
* Limiting Factors at EHV and UHV levels
* Mechanical Design of Transmission Line and Components

**Learning Methodology:**

Lectures, Interactive, Participative, and industrial Visits

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in percentage**

Sessionals (Quizzes Assignments) 25

Mid Term 25

Final exam 50

Total 100

**Recommended Text Books:**

* Electrical Power Transmission System Engineering (Analysis and Design) by TuranGonen[1]
* Principles of Power Systems by V.K. Mehta, Rohit Mehta [2]

**Reference Books:**

* Electrical Power Distribution & Transmission by L.M. Faulkenberry& W. Coffer [1]
* Power System Analysis byHadiSaadat, 4th Edition [2]
* Power System Analysis by John J. Gringer, William D. Stevenson, Jr. [3]

**Calendar of Course contents to be covered during semester**

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| **Lecture** | **Topics** | **Textbook (TB) /**  **Reference Readings(RB)** |
| **02** | **Introduction**  Importance of Electrical Energy, Generation, Sources of Energy, Comparison of Energy Sources, Units of Energy, Relationship among Energy units, Advantages of liquid Fuel over Solid Fuel and vice versa | Ch # 1 of TB[2] |
| **03** | **Generating Stations**  Steam Power Stations, Hydroelectric Power Stations, Diesel Power Stations, Nuclear Power Stations, Gas Turbine Power Plants, Comparison of different Power Plants | Ch # 2 of TB[2] |
| **02** | **Variable Load on Power Stations**  Structure of Electric Power System, Load Curves, important Terms and Factors, Units Generated per Annum, Load Duration curves, Typical Loads, Load Curves, Selection of Generating Units, Methods of meeting the Loads, Interconnected Grid System. | Ch # 3 of TB[2] |
| **01** | **Transmission System Plannig**  Introduction, Aging Transmission System, Benefits of Transmission System, Power Pools, Transmission Planning, Traditional Techniques | Chap # 01 of TB[1] |
| **04** | **Transmission Line Structures and Equipment**  Decision Process to build a Transmission Line, Design Trade-Offs, Traditional Line Design Practices, Transmission Line Structures, Substation Lines, Transmission Substations, SF6 Insulated Substations, Transmission Line Conductors, Insulators, Substation Grounding, Ground Conductor Sizing Factors, Mesh Voltage Design, Step Voltage Design, Types of Ground Faults, Ground Potential Rise, Transmission Line Grounds, Types of Grounding, Transformer Classifications, Environmental Impact of Transmission Lines, High Voltage Bushings with Draw Leads and Their Failures. | Chap # 02 of TB[1] |
| **02** | **FACTS and Other Concepts**  Factors affecting Transmission Growth, Stability Considerations, Power Transmission Capability, Surge Impedance and Surge Impedance Loading, Loadability Curves, Compensation, Shunt Compensation, Series Compensation, Flexible AC Transmission Systems. | Chap # 03 of TB[1] |
| **02** | **Over Head Transmission System**  Review of Basics, Three winding Transformers, Autotransformers, Delta-Wye and Wye-Delta Transformations, Transmission Line Constants, Resistance, Inductance and Inductive Reactance, Capacitance and Capacitive Reactance. | Chap # 04 of TB[1] |
| **Mid Term Exam** | | |
| **03** | **Over Head Transmission System**  Equivalent Circuits of Transmission Lines, Short Transmission Lines, Medium Length Transmission Lines, Long Length Lines, General Circuit Constants, Bundled Conductors, Effect of Ground on Capacitance of Three Phase Lines, Environmental Effects | Chap # 04 of TB[1] |
| **03** | **Underground Power Transmission and Gas Insulated Transmission Lines**  Underground Cables, Underground Cable Installation Techniques, Electrical Characteristics of Insulated Cables, EHV Underground Cable Transmission, Gas-Insulated Transmission Lines, Location of Faults in Underground Cables | Chap # 05 of TB[1] |
| **02** | **Transient Overvoltages and Insulation Coordination**  Travelling Waves, Effect of Line Terminations, Junction of Two Lines, Junction of Several Lines, Termination in Capacitance and Inductance, Bewley Lattice Diagram, Surge Attenuation and Distortion, Travelling waves on Three Phase Lines | Chap # 07 of TB[1] |
| **02** | **Transient Overvoltages and Insulation Coordination**  Lightning and Lightning Surges, Shielding Failures of Transmission Lines, Lightning Performance of UHV Lines, Stroke Current Magnitude, Switching and Switching Surges, Overvoltage Protection. | Chap # 07 of TB[1] |
| **02** | **Limited Factors for ExtraHigh and UltraHigh Voltage Transmission: Corona, Radio Noise, and Audible Noise**  Corona, Radio Noise, Audible Noise, Conductor Size Selection. | Chap # 08 of TB[1] |
| **02** | **Mechanical Design and Analysis:**  **Construction of Overhead Lines**  Factors affecting, Characteristics of Line Route, Right of Way, Mechanical Loading, Required Clearance, Types of Supporting Structures, Grade of Construction, Line Conductors, Insulator Types, Conductor Vibrations, Conductor Motion caused by Fault Currents | Chap # 12 of TB[1] |
| **02** | **Sag and Tension Analysis**  Effects of Change in Temperature, Line Sag and Tension Calculations, Spans of unequal length, Effects of Ice and Wind Loading, National Electric Safety Code. | Chap # 13 of TB[1] |
| **End Term Exam (Comprehensive)** | | |