**University of Management and Technology**

**Course Outline**

Course code: **EE406** Course title: **Power System Analysis**

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| Program | BSEE |
| Credit Hours | 3 |
| Duration | One Semester |
| Prerequisites | EE 212 Electrical Network Analysis |
| Resource Person | Muhammad Haris |
| Counseling Timing  (Office # S-3/41 ) | Tuesday, Thursday (12-3) |
| Contact | Ext: 3484  Muhammad.haris@umt.edu.pk |

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

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

**Learning Objective:**

This course has been designed to introduce the importance of analyzing various aspects of power system. It covers power flow studies and fault analysis of both symmetrical and unsymmetrical faults in power networks. This forms the basis for power system operation, control and protection. 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:

* Per Unit Systems
* One Line Diagram of the Network
* Impedance Diagram
* Admittance Diagram
* Admittance Matrix Ybus
* Impedance Matrix Zbus
* Network Calculations using Ybus and Zbus
* Power Flow Solutions
* Symmetrical Faults
* Symmetrical Components
* Sequence Components
* Unsymmetrical Faults
* Swing Equation

**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:**

* Power System Analysis by John J. Grainger & William D. Stevenson, Jr. [1]
* Power System Analysis by Hadi Saadat, Latest Edition [2]

**Reference Books:**

* Power System Analysis by Stevenson [1]

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

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| **Lecture** | **Topics** | **Textbook (TB) /**  **Reference Readings(RB)** |
| **02** | **Basic Concepts**  Single-Subscript Notation, Double-Subscript Notation, Power in Single Phase AC Circuits, Complex Power, Power Triangle, Direction of Power Flow, Voltage and Current in Balanced Three Phase Circuits | Ch # 1 of TB[1] |
| **02** | **Basic Concepts**  Per Unit Quantities, Changing the Base of Pwer Unit Quantities, Node Equations, The Single Line or One Line Diagram, Impedance and Reactance Diagrams | Ch # 1 of TB[1] |
| **02** | **Transformers**  Ideal Transformer, Equivalent Circuit of a Single Phase Transformer, Per Unit Impedances in Single Phae Transformer Circuits, Advantages of Per Unit Computations | Ch # 2 of TB[1] |
| **05** | **The Admittance Model and Network Calculations**  Branch and Node Admittances, Mutually Coupled Branches in Ybus, An Equivalent Admittance Network, Modification of Ybus, The Network Incidence Matrix and Ybus, Method of Successive Elimination, Node Elimination (Kron Reduction), Triangular Factorization, Sparsity and Near Optimal Ordering | Chap # 07 of TB[1] |
| **05** | **The Impedance Model and Network Calculations**  Bus Admittance and Impedance Matrices, Thevinin’s Theorem and Zbus, Modification of an Existing Zbus, Direct Determination of Zbus, Calculations of Zbus Elements from Ybus, Power Invariant Transformations, Mutually Coupled Branches in Zbus | Chap # 08 of TB[1] |
| **Mid Term Exam** | | |
| **05** | **Power Flow Solutions**  The Power Flow Problem, Gauss-Seidal Method, Newton-Raphson Method, Newton Raphson Power Flow Solution, Power Flow Studies in System Design and Operation, Decoupled Power Flow Method | Chap # 09 of TB[1] |
| **03** | **Symmetrical Faults**  Transients in RL Series Circuits, Internal Voltages of Loaded Machines under Fault Conditions, Fault Calculations Using Zbus, Fault Calculations Using Zbus Equivalent Circuits, Selection of Circuit Breakers | Chap # 10 of TB[1] |
| **04** | **Symmetrical Components and Sequence Networks**  Synthesis of Unsymmetrical Phasors from Their Symmetrical Components, Symmetrical Components of Unsymmetrical Phasors, Symmetrical WYE and DELTA Circuits, Power in Terms of Symmetrical Components, Sequence Circuits of WYE and DELTA Impedances, Transmission Line, Synchronous Machine and WYE-DELTA Transformers, Unsymmetrical Series Impedances, Sequence Networks | Chap # 11 of TB[1] |
| **02** | **Unsymmetrical Faults**  Unsymmetrical Faults on Power Systems, Sigle Line-Ground Faults, Line to Line Faults, Double Line to Ground Faults, Open Conductor Faults | Chap # 12 of TB[1] |
| **02** | **Power System Stability**  Stability Problem, Rotor Dynamics and Swing Equation | Chap # 16 of TB[1] |
| **End Term Exam (Comprehensive)** | | |