**University of Management and Technology**

**Course Outline**

Course code: **EE423** Course title: **Power System Protection**

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| Program | BSEE |
| Credit Hours | 3 |
| Duration | One Semester |
| Prerequisites | EE317 Power System Fundamentals |
| Resource Person | Muhammad Haris |
| Counseling Timing  (Office # 7, Hall # 510, SEN Building ) | Tuesday (11:00-1:00) |
| Contact | Ext: 3663  muhammad.haris@umt.edu.pk |

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

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

**Introduction:**

Power System Protection is the branch of power system concerned with the principles of design and operation of equipment called Relays, which detects abnormal power system conditions, and initiates corrective action as quickly as possible in order to return the power system to its normal state.

**Learning Objective:**

Students who complete this course will have gained a theoretical and applied understanding of power system protection. The performance of instrument transformers, transducers, protective relays, and circuit breakers is first addressed. These devices are then integrated into coordinated   
protective systems for generators, transformers, transmission lines, reactors, capacitor banks, system buses, etc. Although basic protection concepts are hardware-independent, the application of electromagnetic, solid state, and microprocessor-based relays will also be discussed. Trade-offs   
between reliability, selectivity, speed, simplicity, and economy are emphasized.

**Learning Outcomes:**

* **Knowledge and understanding**

Having successfully completed the course, the student will be able to demonstrate knowledge and understanding of:

* The various types of protection systems.
* The types of protective relays.
* Performance and design calculations for transformers and generator protection schemes.
* Instrument transformer selection.
* Types of protective devices and their choices.
* Unit and non-unit protection systems.
* **Cognitive skills (thinking and analysis).**

Students are allowed and encourage to make seminars on various topics in power system protection schemes with comprehensive discussions.

* **Communication skills (personal and academic).**

Having successfully completed the module, student will be able to:

* Appreciate the importance of protective relays in power systems.
* Compare and contrast the operation of different types of protective schemes.
* Derive equations related to the different protection methods.
* Formulate relevant equivalent circuits of the protection schemes to analyze their actual behavior.
* Identify different types of protective relays and their applications.
* Analyze simple problems related to protection schemes.
* **Practical and subject specific skills (Transferable Skills).**

Having successfully completed the module, the student will be able to:

* Choose among the different types of protection schemes to suit a given application task.
* Explain the operation and performance of different types of protective relays.
* Apply engineering studies for different types of power system protection.
* Interpret results and correlate them with theoretical predictions
* Write a technical repots.

**Teaching Methodology:**

Lectures will be used to describe and develop the concepts stated above.

Group tasks will be given to enhance interactive learning.

Industrial visits will be arranged to further strengthen the basic concepts and to increase practical exposure.

**Grade Evaluation Criteria**

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

**Marks Evaluation Marks in percentage**

Sessional (Quizzes + Assignments) 25%

Mid Term 25%

Final exam 50%

Total 100%

**Recommended Text Books:**

* Power System Relaying, 3rd edn. By Stanley H. Horowitz and Arun G. Phadke

**Reference Books:**

* Protective Relaying principles and application, 3rd edn. By J. Lewis Blackburn and Thomas J. Domin
* Fundamentals of power System Protection by Y.G. Paithankar and S. R. Bhide

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

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| **Lectures** | **Topics** | **Textbook (TB) /**  **Reference Readings(RB)** |
| **03** | **Introduction to protective relaying**  What is relaying? Power system structural considerations, power system bus configurations, the nature of relaying, elements of a protection system | Ch # 01 of TB |
| **04** | **Relay operating principles**  Detection of faults, relay designs, electromechanical relays, solid-state relays, computer relays, other relay design considerations | Ch # 02 of TB |
| **05** | **Current and Voltage Transformers**  Steady state performance of current transformers, transient performance of CT, special connections, linear coupler and electronic CTs, VTs, CCVTs, transient performance, electronic voltage transformers | Ch # 03 of TB |
| **04** | **Non pilot overcurrent protection of transmission lines**  Fuses, Sectionalizers, reclosers, inverse time delay overcurrent relays, instantaneous overcurrent relays, directional overcurrent relays, polarizing | Chap # 04 of TB |
|  | **Mid Term Exam** |  |
| **04** | **Non pilot distance protection of transmission lines**  Stepped distance protection, R-X diagram, three phase distance relays, distance relay types, relay operation with zero voltages, polyphase relays, relays for multi terminal lines, protection of parallel lines, effect of transmission line compensation devices, loadability of relays | Chap # 05 of TB |
| **03** | **Pilot protection of transmission lines**  Communication channels, tripping versus blocking, directional comparision blocking, directional comparison unblocking, underreaching transfer trip, permissive overreaching transfer trip, permissive underreaching transfer trip, phase comparison relaying, current differential, pilot wire relaying, multi terminal lines | Chap # 06 of TB |
| **04** | **Transformer protection**  Overcurrent protection, percentage differential protection, causes of false differential currents, supervised differential relays, three phase transformer protection, voltz per hertz protection, nonelectrical protection, protection system for transformers | Chap # 08 of TB |
| **03** | **Rotating machinery protection**  Stator faults, rotor faults, unbalanced currents, overload, overspeed, abnormal voltage and frequencies, loss of excitation, loss of synchronism, power plant auxiliary system, winding connections, startup and motoring, inadvertent energization, torsional vibration, sequential tripping | Chap # 07 of TB |
| **End Term Exam (Comprehensive)** | | |