FACULTY OF ENGINEERING AND TECHNOLOGY

First Year Master of Technology (Electrical Engineering)

In Effect from Academic Year 2021-22

Subject Code: 1ET2130203	**Subject Name:** Modern Power System Protection
Pre-requisite Subject	Fundamentals of Power System Protection

Course Objective: To understand new algorithm and advance technology for protection of system.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
3	-	2	5	60	40	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction to Digital Relays** Comparison of digital relays with previous generation relays, Basic Components of Digital Relays with block diagram, Signal Conditioning Subsystems, Surge Protection Circuits, Anti-aliasing filter, Conversion Subsystem, The Sampling Theorem, Sample and Hold Circuit, Concept of analog to digital and digital to analog conversion, Idea of sliding window concept, introduction to intelligent electronic device (IED), Different relay algorithms such as algorithms for pure sinusoidal relaying signal, algorithm based on solution of system differential equations, Fourier analysis based half cycle and full cycle algorithm.	08	20%
2	**Over current Relay Coordination for Radial and Parallel Feeder** Protection of an interconnected system, Link net structure, Flowchart of Primary/Backup relay pairs, Flowchart of Time Multiplier Setting. Examples based on existing power system network.	10	30%
3	**Wide Area Protection and Measurement** Definition of wide-area protection, Architectures of wide-area protection, concept of synchronized sampling, wide area phasor measurement technology, concept of Adaptive relaying, advantageous of adaptive relaying and its application.	06	15%
4	**System Response during Severe Upsets** Introduction, Nature of system response to severe upsets such as system response to Islanding conditions, Under generated islands, Over generated islands, Reactive Power Balance, Power Plant Auxiliaries, Power System Restoration, Load Shedding, Factors to be considered for load shedding scheme such as maximum anticipated overload, number of load shedding steps, size of load shed at each step, frequency setting, time delay, rate of frequency decline, frequency relays, Issues with islanding and methods of islanding.	07	20%
5	**Auto-reclosing and Synchronizing** Introduction, history of auto-reclosing, advantageous of auto-reclosing, classification of auto-reclosing, auto-reclosing based on number of phases, auto- reclosing based on number of attempts, auto-reclosing based on speed, Sequence of events in single-shot auto-reclosing scheme, factors to be considered during reclosing such as choice of zone in case of distance relay, dead time, reclaim time, instantaneous trip lockout, intermediate lockout, breaker supervision function, Synchronism check, phasing voltage method, angular method, automatic synchronization	05	15%

Course Outcome:

After learning the course the students should be able to:

1. Analyze the tripping characteristics of various relays and its applications. Design inductors and transformers for power electronic converters.
2. To operate various static relays, set their parameters and also to confirm its operations.
3. To operate various Numeric relays, set their parameters and also to confirm its operations.

List of Text Books:

1. A.T. Jhons and S.K. Salman, Digital Protection of Power System, IEE Series, 1995.
2. Walter A. Elmore, Protective Relaying Theory and Applications, Marcel Dekker, Inc; New York.
3. S.H. Horowitz and A. G. Phadke, Power System Relaying, John Wiley & Sons, New York, 1996.
4. B. A. Oza, N.C. Nair, R.P. Mehta and Vijay Makwana, Power System Protection, McGraw Hill, 2009.

List of Reference Books:

1. Bhavesh Bhalja, R. P. Maheshwari and N. G. Chothani, Protection and Switchgear, Oxford University Press, 1st Edition, 2011
2. P. M. Anderson, Power System Protection, IEEE Press, New York, 1999.
3. J. L. Blackburn, “Applied Protective Relaying,” Westinghouse Electric Corporation, New York, 1982.
4. Van C. Warrington A. R. “Protective Relays: Their Theory and Practice,”, Vol 1, Chapman & Hall Ltd, London, 1962.
5. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems,” Research study press Ltd, John Wiley & Sons, Taunton, UK, 1988.

List of Experiments:

1. Study of digital relays with detailed description of each component of the schematic diagram of digital relay.
2. Setting up IDMT relays for a radial feeder.
3. Setting up IDMT relays for a power system using link net structure.
4. Study of auto-reclosing with related details.
5. Study of system response during severe upset and power system restoration.
6. Study of load shedding schemes with all related details.
7. Study of protection of transmission line which is compensated by fixed series capacitors.