

Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Master of Technology (M. Tech)
Course Code	:	1MPS01
Course Title	:	Modern Power System Protection
Type of Course	:	Professional Core (PC)
Year of Introduction	:	2023-24

Prerequisite	:	Switchgear & Protection
Course Objective	:	Students must develop skills for operating various controls and switchgear in the power system. They are also required to carry out remedial measures for faults/abnormalities in machines/equipment in the power system using appropriate diagnostic instruments/devices. This course attempts to develop these skills in students and hence it is a core course for all electrical engineers.
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	To Analyze the purposes of protection, in relation to major types of apparatus, protection principle, dangers and criteria.
	CO2	To Apply justify suitable protection system.
	CO3	To Analyse and compare specified protection systems.
	CO4	To Understand & Remember merits of various principles, relay hardware and interrupting devices.

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	SEE	CIA	SEE	CIA	
3	0	2	4	70	30	30	20	150

Legends: **L**-Lecture; **T**-Tutorial/Teacher Guided Theory Practice; **P** - Practical, **C** - Credit, **SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.))

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with CO
1	Introduction to Protective Relaying and Electromagnetic Relays: Faults, Causes and Effects, Protective Zones, Primary and Backup Protection, Desirable Qualities and Terms of Protective Relaying, Basic Connection of Trip Circuit, Types of Relay Units, Relay Pick up, Reset or Drop out, Pick-up/ Drop off Ratio, Construction and Working of Different Electromagnetic Relays.	03	5 %	CO1
2	Over Current Protection of Transmission Line: Introduction, Fuse, Thermal Relays, Over Current Relays, Application of Definite Time & IDMT O.C. Relays for Protection of Feeder, Directional Over Current Relay, Limitations of O.C. Relays.	03	7 %	CO4
3	Transformer Protection: Types of Faults, Over Current Protection, Percentage Differential Protection, Inrush Phenomenon, High Resistance Ground Faults in Transformers, Inter-turn Faults, Incipient Faults, Over-fluxing Phenomenon.	03	7 %	CO3
4	Distance Protection of Transmission Line: Drawbacks of O.C. Protection, Introduction to Distance Protection, Types of Distance Relay, Impedance, Reactance, MHO Relay, Performance of Distance Relay During Normal Load and Power Swing, Effect of Arc Resistance on Reach of Distance Relays, Comparison of Distance Relays, Distance Protection of Transmission line, Reasons for Inaccuracy of Distance Relay Reach, Three Step Protection, Trip contact configuration, 3-step protection of double and fed lines.	06	15 %	CO4
5	Generator Protection: Various faults & abnormal operation conditions, stator & rotor faults, transverse differential protection, unbalanced loading, over speeding, loss of excitation, loss of prime mover.	06	15 %	CO3
6	Induction Motor Protection: Various faults & abnormal operation conditions, starting of induction motor, protection of small & large induction motor.	07	15 %	CO2

7	Numerical Protection: Introduction, block diagram of numerical relay, numerical over current protection, numerical transformer protection, numerical distance protection of transmission line.	07	15 %	CO3
8	Circuit Constant in Relation to Circuit Breaking: Introduction, Circuit breaker rating, Circuit constants & circuit conditions Re-striking voltage transient Characteristics of re-striking voltage, Interaction between the breaker & circuit, Current chopping, duties of switchgear.	03	6 %	CO4
9	Theory & Practice of Conventional Circuit Breaker and Modern Circuit Breakers: Automatic switch, Air-break circuit breakers, Oil circuit breakers, Single and multi-break Construction, Air-blast circuit breaker, Performance of circuit breakers and system requirements, Modification of circuit breaker duty by shunt resistors, Power factor correction by series resistance, Comparative merits of different types of conventional circuit breakers, Modern trends, Vacuum circuit breakers, Sulphur hexafluoride (SF ₆) circuit breakers D.C. circuit breaker, auto-reclosing - definitions & features, 3-Phase versus 1-Phase auto-reclosing.	07	15 %	CO4

Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	20	25	25	20	05	05

NOTE: This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	To study the Numerical Protection of induction motor.	02
2	To obtain the operating characteristics of an IDMT relay.	02
3	To study the operating characteristics of directional over current relay.	02
4	To study the operating characteristics of the transformer percentage differential relay.	02
5	To study the magnetic inrush current in a transformer and its protection.	02

6	To obtain and study the magnetization characteristic of CT.	02
7	To study transformer differential protection.	02
8	To study the protection schemes for different abnormal conditions in an alternator.	02
9	To study Buchholz relay for transformer protection.	02
10	To study Generalized block diagram of Numerical Relay.	02

Major Equipment/ Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
1	MATLAB / Simulink
2	ETAP
3	NEPLAN

Suggested Learning Websites

Sr. No.	Name of Website
1	www.nptel.ac.in
2	www.vlabs.co.in
3	www.circuitlab.com

Reference Books

Sr. No.	Name of Reference Books
1	Fundamentals Of Power System Protection – Y. G. Paithankar & S. R. Bhide, 2nd edition, PHI.
2	Switchgear And Protection – S. S. Rao, Khanna publication.
3	Power System Protection and Switchgear – B. Ravindranath and M. Chander.
4	Protection and switchgear, By Bhavesh Bhalja, R. P. Maheshwari, Nilesh hotani, 1st edition, 2011, Oxford Publication.
5	Modern Power System Protection – Divyesh Oza, TMH Publication.