



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000741

Subject Name: Advanced Power System protection

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	PCC

Prerequisite:	Power System Protection and Switch-gear
Rationale:	Advanced Power System Protection study is crucial to address the evolving challenges in modern power systems. As grids become more and more complex with the integration of renewables, smart technologies, and interconnected networks, advanced protection ensures the continued stability, reliability, safety, and efficiency of electric supply. Advanced power system protection ensures prevention of catastrophic failures, thus reducing costs and ensuring long-term system sustainability.

Course Outcome:

After learning the course the students should be able to

Sr. No.	CO Statement	% Marks Weightage
CO1	Analyse the architecture, attributes, and advantages of digital relays in power system protection	10
CO2	Configure protective relay settings to ensure effective coordination in interconnected power systems.	20
CO3	Apply mathematical algorithms, including interpolation and numerical methods, for advanced protection systems.	25
CO4	Design digital protection schemes for generators, transformers, and transmission lines.	35
CO5	Evaluate adaptive relaying strategies and address protection challenges arising from renewable energy integration.	10

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		C	Theory Marks		Practical Marks	
					ESE(E)	PA (M)	PA (V)	PA (I)
3	0	2	4	70	30	30	20	150



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Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to digital relaying Digital relaying architecture, Signal Conditioning: Transducers, surge protection, analog filtering, Conversion subsystem: Sampling theorem, Anti-aliasing filter, and anti-aliasing error, Sample and hold circuits, A to D conversion, D to A conversion, Multiplexers, Benefits and limitations of digital relaying	4	10
2	Coordination of Inverse Definite Minimum Time (IDMT)/Directional Over Current (DOC) Relays in an Interconnected Power System Network Protection of an interconnected system, Link net structure, Flowchart of Primary/Backup relay pairs, Flowchart of Time Multiplier Setting. Examples based on the same	8	20
3	Mathematical background to protection algorithms: Interpolation formulae Numerical Differentiation and Integration Least squares method Sinusoidal wave-based algorithms Differential equation-based algorithms	12	25
4	Recent Trends in Protection : Digital Differential Protection of Generators & Transformers, Digital Transmission Line Protection. Digital protection of Induction motor. Problems and Solution for Protection of Series Compensated Transmission Line Fault Characteristics of renewable sources Protection challenges of transmission and distribution system with renewables.	15	35
5	WAM & Adaptive Relaying: Definition of wide-area protection, Architectures of wide-area protection, concept of synchronized sampling, the concept of Adaptive relaying, advantages of adaptive relaying and its application.	6	10
TOTAL		45	100



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List of experiments

1. Study of detailed description of each component & schematic diagram of digital relay
2. Study of sampling theorem.
3. Setting up IDMT relays for a radial feeder
4. Setting up IDMT/DOC relays for a power system using link net structure
5. Study of Curve fitting and smoothing techniques.
6. Study of differential equation-based algorithms.
7. Study of Sinusoidal wave base algorithm
8. Study of digital differential protection of transformers.
9. Study of digital protection of transmission line
10. Problems and Solution for protection of Series Compensated Transmission Line
11. Study of fault characteristics of renewable sources.
12. Study of concept of Wide Area Protection and Adaptive Relaying

Reference Books:

1. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems," Research study press Ltd, John Wiley & Sons, Taunton, UK, 1988.
2. A. T. Johns and S. K. Salman, "Digital Protection for Power Systems," Peter Peregrinus Ltd, UK, 1995.
3. Bhavesh Bhalja, R. P. Maheshwari and N. G. Chothani, "Protection and Switchgear," Oxford University Press, New Delhi, India, 2011.
4. P. M. Anderson, Power System Protection, IEEE Press, New York, 1999.
5. S. H. Horowitz and A. G. Phadke, "Power System Relaying," John Wiley & Sons, New York, 1996.
6. W. A. Almore, "Protective Relaying Theory and Applications," Marcel Dekker Inc; New York, 1994.
7. <https://nptel.ac.in/courses/108105167>
