

POWER SYSTEM PROTECTION

VII Semester: EEE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE014	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45		Tutorial Classes: 15		Practical Classes: Nil			Total Classes: 60	
<p>COURSE OBJECTIVES: The course should enable the students to:</p> <ol style="list-style-type: none"> I. Understand types of various circuit breakers. II. Classify relays into various types such as of electromagnetic, static and numerical relays. III. Evaluate the performance of protection schemes of generator and transformer. IV. Analyze the performance of feeder and bus-bar protection. V. Discuss the protection schemes against over voltages. <p>COURSE OUTCOMES (COs):</p> <ol style="list-style-type: none"> CO 1: Understand the working of various types of circuit breakers and protective equipments of power systems. CO 2: Understand the working of various protective relays. CO 3: Discuss about various components of substation and understand protection of feeders and bus bars. CO 4: Understand the various faults and protection methods for the Generators and Transformers. CO 5: Understand the various protection schemes of power system against over voltages. <p>COURSE LEARNING OUTCOMES (CLOs):</p> <ol style="list-style-type: none"> 1. Understand various types of faults in Power system. 2. Apply the knowledge on different Protective Equipments of Power Systems.. 3. Understand concept of recovery and restriking voltages. 4. Understand working of various protective systems. 5. Compare the different type of circuit breakers performance based on which selection of circuit breaker can be made for a given application. 6. Discuss the construction and working of Fuse and circuit breakers. 7. Explain working of protective relays. 8. Understand the concept of DMT, IDMT type relays. Understand the significance of reactive power control in power systems to maintain quality of power. 9. Understand layout of Substations. 10. Understand layout of Substations, neutral earthling, testing of CB, CT and PT. 11. Remember the faults and protection for the Feeders and Bus-Bars. 12. Understand and justify a suitable protection system for a specified application. 13. Understand the faults and protection for the Generators and Transformers. 14. Understand Rotor, Stator Faults, inter turn faults and their protection. 15. Understand the protection of power system against over voltages. 								

UNIT-I	CIRCUIT BREAKERS	Classes: 12
<p>Circuit Breakers: Elementary principles of arc interruption, restriking and recovery voltages, restriking phenomenon, average, maximum and rate of rise of restriking voltage, current chopping and resistance switching, circuit breaker ratings and specifications, auto reclosures, description and operation of various types of circuit breakers, minimum oil circuit breakers, air blast circuit breakers, vacuum and SF6 circuit breakers, numerical problems.</p>		
UNIT -II	ELECTROMAGNETIC, STATIC AND NUMERICAL RELAYS	Classes: 14
<p>Electromagnetic relays: Principle of operation and construction of attracted armature, balanced beam, induction disc and induction cup relays; Relays classification: instantaneous, definite minimum time and inverse definite minimum time relays over current / under voltage relays, direction relays, differential relays and percentage differential relays, universal torque equation; Distance relays: Impedance, reactance, mho and offset mho relays, characteristics of distance relays; Static relays: Overview of static relay, block diagram, operating principle and comparison, static relays versus electromagnetic relays; Numerical relays: Introduction, block diagram of numerical relay, sampling theorem, anti aliasing filter, block diagram of phasor measurement unit and intelligent electronic device, data acquisition systems and numerical relaying algorithms, applications and numerical problems.</p>		
UNIT-III	SUBSTATIONS AND PROTECTION OF FEEDER / BUS BAR	Classes: 12
<p>Indoor and outdoor substations: Substations layout, bus bar arrangements like single, sectionalized, main and transfer bus bar system with relevant diagrams; Gas insulated substation (GIS): Types, single line diagram, constructional aspects of GIS, Installation, maintenance, advantages, comparison of GIS with air insulated substations.</p> <p>Protection of lines: Over current, carrier current and three zone distance relay protection using impedance relays, translay relay; Protection of bus bars: Differential protection, grounded and ungrounded neutral systems, effect of ungrounded neutral on system performance, methods of neutral grounding, solid, resistance, reactance arcing grounds and grounding practices, application of numerical relays.</p>		
UNIT-IV	GENERATOR AND TRANSFORMER PROTECTION	Classes: 09
<p>Generator protection: Protection of generators against stator faults, rotor faults, and abnormal conditions, restricted earth fault and inter turn fault protection, numerical problems on percentage winding unprotected; Transformer protection: Percentage differential protections, numerical problem on design of current transformers ratio, buchholz protection.</p>		
UNIT-V	PROTECTION AGAINST OVER VOLTAGES	Classes: 06
<p>Over voltages in power systems: Generation of over voltages in power systems, protection against lightning over voltages, valve type and zinc oxide lightning arresters, insulation coordination, basic insulation level, impulse ratio, standard impulse test wave, volt time characteristics.</p>		
Text Books:		
<ol style="list-style-type: none"> 1. Sunil S Rao, "Switchgear and Protection", Khanna Publishers, 1st Edition, 2013. 2. Badari Ram, D N Viswakarma, "Power System Protection and Switchgear", TMH Publications, 1st Edition, 2001. 3. A R van C Warrington, "Protective Relays: Their Theory and Practice", Springer Science & Business Media, Volume 2, 2nd Edition, 1977. 		

4. B L Soni, Gupta, Bhatnagar, Chakrabarthy, "Power System Engineering", Dhanpat Rai & Co, 3rd Edition, 2007. T S Madhava Rao, "Power system protection: static relays", McGraw-Hill Companies, 2nd Edition, 1989.

Reference Books:

1. Paithankar, S R Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2003.
2. C L Wadhwa, "Electrical Power Systems", New Age international (P) Limited, 6th Edition, 2010.
- VK Mehta, "Principles of power systems", S Chand Publications, 4th Edition, 2009.

Web References:

1. <https://www.electrical4u.com/working-or-operating-principle-of-dc-motor>
2. <https://www.freevideolectures.com>
3. <https://www.ustudy.in> > Electrical Machines
4. <https://www.freeengineeringbooks.com>

E-Text Books:

1. <https://www.textbooksonline.tn.nic.in>
2. <https://www.freeengineeringbooks.com>
3. <https://www.eleccompengineering.files.wordpress.com>
4. <https://www.books.google.co.in>