

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 students will try to learn:</p> <p>I. The working of different types of protection equipment's like circuit breakers and relays. II. Protection schemes of various power system components like alternators, motors, feeders, transformers and bus-bars. III. various methods to protect power system against over voltages like lightening arrestors and surge absorbers.</p> <p>COURSE OUTCOMES: After successful completion of the course, students will be able to:</p> <p>CO 1 Identify various abnormal conditions like short circuits and overcurrent's in power system are protected by fuse and circuit breakers for avoiding outages. CO 2 Understand Arc phenomenon and Arc extinction methods of circuit breaker under fault condition for extinguishing Arc current like high resistance and low resistance. CO 3 Describe types of circuit breakers and constructional details used for the protection of power system under fault condition. CO 4 Explain construction and working of various types relays for detection of fault and disconnection of a faulty section like electromagnetic, induction, static and numerical relays. CO5 Classify substations and its components like transformer and switchgear to provide reliable supply for the consumers CO6 Summarize protection schemes of feeder and bus-bars for protection of transmission lines like translay and Merz-price protection. CO7 Identify rotor, stator, inter turn faults and protection schemes of generator for avoiding interruption of supply. CO8 Outline protection schemes of transformer against open and short circuit faults for maintaining continuous supply CO9 Demonstrate the causes of over voltages in the power system network in order to study its behavior for avoiding voltage surges in the system CO10 Classify types of lightening arrestors for the protection of power system network from high voltage surges in order to provide uninterruptable power supply.</p>								
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:		
<ol style="list-style-type: none"> 1. Paithankar, S R Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2003. 2. C LWadhwa, "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>