SCHEME OF COURSE WORK (2014-2015)

COURSE DETAILS:

Course Title	Switchgear and Protection
Course Code	13EE1119
Program	B.Tech
Branch	Electrical & Electronics Engineering
Semester	VI
Prerequisites	Electrical machines-I , II and power transmission engineering
Course to which it is prerequisite	All Advanced Courses In Electrical Engineering

COURSE OUTCOMES:

1	Describe and determine the rating of the different types of circuit breakers
2	Describe the construction and working principle of various types of electromagnetic relays.
3	Determine the characteristics of distance relay for transmission line protection.
4	Determine the characteristics of distance relay for transmission line protection.
5	Describe and determine different cause for over voltages in power system and can implement protective scheme overcome those problems.

PROGRAMME OUTCOMES:

The student of Electrical and Electronics engineering at the end of the program will be able to:

PO1 Apply the knowledge of basic sciences and electrical and electronics engineering fundamentals to solve the problems of power systems and drives.

PO2 Analyze power systems that efficiently generate, transmit and distribute electrical power in the context of present Information and Communications Technology.

PO3 Design and develop electrical machines and associated controls with due considerations to societal and environmental issues.

PO4 Design and conduct experiments, analyze and interpret experimental data for performance analysis.

PO5 Apply appropriate simulation tools for modeling and evaluation of electrical systems.

PO6 Apply the electrical engineering knowledge to assess the health and safety issues and their consequences.

PO7 Demonstrate electrical engineering principles for creating solutions for sustainable development.

PO8 Develop a techno ethical personality that help to serve the people in general and Electrical and Electronics Engineering in particular.

PO9 Develop leadership skills and work effectively in a team to achieve project objectives.

PO10 Communicate effectively in both verbal and written form.

PO11 Understand the principles of management and finance to manage project in multi disciplinary environments.

PO12 Pursue life-long learning as a means of enhancing the knowledge and skills.

COURSE OUTCOME/PROGRAM OUTCOMES:

CO/PO	1	2	3	4	5	6	7	8	9	10	11	12
CO-1	S	S	M	S	S	M		M				M
CO-2	S	S	M	S	S	M		M				M
CO-3	S	S	M	S	S	M		M				M
CO-4	S	S	M		S	M	M	M				M
CO-5	S	S	M		S	M	M	M				M

Assessment Methods	Assignments/Quiz/Mid Exam/Seminar/Viva-Voce/End Exam

TEACHING LEARNING AND EVALUATION

Week	Topic/content	Course outcomes	Sample questions	Teaching-learning stategy	Assesment method & schedule
1	**Unit-I** CIRCUIT BREAKERS**:** Principle of operation – RRRV – Current chopping- Circuit Breaker ratings and specifications,	CO-1	. What is meant by primary protection and back up protection? 2. Write is current chopping	Lecture/discussion	Assignment -1 & quiz-1

	Testing of Circuit Breakers				
Week -2	Constructional features and selection of LT breakers (Miniature circuit breakers/Metal clad circuit breakers/Earth leakage circuit breaker) and HT breakers (Air blast circuit breaker-Oil circuit breakers-SF_6 CB-Vacuum Circuit Breakers)	CO-1	1a. Derive an expression for the Restriking voltage and RRRV across the breaker contacts. b. A 11kv, 400 MVA circuit breaker suddenly closes on to fault. Determine (i) Symmetrical breaking current (ii) Asymmetrical breaking current assuming 50% DC component. (iii) Peak making current. (iv) Short time current rating. 2 a. Describe the construction and working of an SF6 circuit breaker. b. Explain the methods used for high resistance arc interruption.	Lecture/discussion/problem solving	Assignment -1 & quiz-1
Week -3	**unit-II** PROTECTIVE RELAYS-I: Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction	CO-2	1). Define following terms (a) protective relay (b) Flag. 2 What are the merits of induction cup type relay over induction disc relay?	Lecture/discussion/problem solving	Assignment -1 & quiz-1

	Cup relays. Relays Classification				
Week -4	Instantaneous, DMT and IDMT types - Application of relays - Over current, under voltage	CO-2	1. a. An IDMT relay operates in 5 seconds and 3 seconds for PSMs of 4 and 10 respectively. The relay is used to protect a feeder through a 1000/5A CT. Calculate the time of operation of the relay when the feeder current is 1500A. The relay has plug setting of 75% and time setting 0.4. The nominal current rating of the relay is 5A. b. Discuss with necessary circuit diagram, the principle of operation of an induction disc relay. (With help of torque derivation)	Lecture/discussion/problem solving	Assignment -1 & quiz-1
Week -5	, Directional, Differential and Percentage Differential. Numerical problems.	CO-2	1.a .Derive an expression for torque produced by an induction relay. b. Discuss the construction and working principle of shaded pole type induction and watt hour meter type induction relay with neat sketch.	Lecture/discussion/problem solving	Assignment -1 & quiz-1

Week -6	**Unit-III** Universal Torque Equation - Distance relays - Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison	CO-3	1. What is universal equation and obtain mho characteristics by using this equation 2. Explain about characteristics of reactance relay on r-x diagram.	Lecture/discussion/problem solving	Assignment -1 & quiz-1
Week -7	Static Relays - Static Relays versus Electromagnetic Relays	CO-3	1. What are advantages of static relay over electromagnetic relay	Lecture/discussion/problem solving	Assignment -1 & quiz-1
Week -8	Microprocessor Based relays - impedance, directional, reactance, Mho & offset Mho and mathematical expression for distance relay	CO-3	1. Draw the block diagram of microprocessor based impedance relay and explain each block.	Lecture/discussion/problem solving	Assignment -1 & quiz-1
Week -9	MID TEST-1	CO-1,CO-2,CO-3			
Week -10	NUMERICAL problems	Co-3		Lecture/discussion/problem solving	Assignment -2 & quiz-2
Week -11	BUCHHOLTZ Relay Protection Protection of transmission Lines - Over Current, Carrier Current and Three-zone	CO-4	1. . What is Buchholz relay? Which equipment is protected by it? For what types of faults is it employed? Discuss working	Lecture/discussion/problem solving	Assignment -2 & quiz-2

	Distance Relay Protection using Impedance Relays - Translay Relay		principle. 2. What are the components of carrier current protection scheme?		
Week -12	UNIT NO-IV PROTECTION OF GENERATOR, TRANSFORMER, FEEDERS AND BUSBARS: Per-Protection of Generators against Stator faults, Rotor faults, and Abnormal Conditions - Restricted	CO-4	1. Give some reasons for relay setting in case of transformer protection are kept higher than those for alternator. 2. Explain the principle of balanced voltage scheme for pilot wire?	Lecture/discussion/problem solving	Assignment -2 & quiz-2
Week -13	Earth Fault - Numerical Problems on % Winding Unprotected. Percentage Differential Protection of transformers - Numerical Problems on Design of CT's Ratio	CO-4	1. An 11Kv, 100MVA generator is grounded through a resistance of 6 ohm. The CTs have ratio of 1000/5. The relay is set to operate when there is an out of balance current of 1A. What Percentage generator winding will be protected by the percentage differential scheme of Protection	Lecture/discussion/problem solving	Assignment -2 & quiz-2

Week -14	**Unit-V** GROUNDING TECHNIQUES AND OVER VOLATGE PROTECTION, Grounded and Ungrounded Neutral Systems- Effects of Ungrounded Neutral on system performance	CO-5	1. What are advantages of neutral grounding?	Lecture/discussion/problem solving	Assignment -2 & quiz-2
Week -15	Methods of Neutral Grounding - Arcing Grounds and Grounding Practices	C0-5	1. What is resistance neutral grounding? What are the merits and demerits of it 2.A 50 Hz overhead line has the line to ground capacitance of 1.2uf. It is decided to use a ground fault neutralizer. Determine the reactance to neutralize the capacitance of 80% of the length of the line.	Lecture/discussion/problem solving	Assignment -2 & quiz-2
Week -16	Protection against Over Voltages- Volt-	CO-5	1. Describe the construction and	Lecture/discussion/problem solving	Assignment -2 & quiz-2

	Time Characteristics-Valve type and Zinc-Oxide Lighting Arresters		operation of valve type lightning arrester		
Week -17	Insulation Coordination-BIL, Impulse Ratio, Standard Impulse Test Wave		1. What is insulation coordination? 2. Explain about standard impulse test wave.		
Week -18	MID Exam-2	CO-3,CO-4,CO-5			
Week - 19,20	End Exam	All co's			External exam