

Program : Diploma in Electrical and Electronics Engineering	
Course Code : 5033C	Course Title: Switch Gear & Protection
Semester : 5	Credits: 4
Course Category: Program Elective	
Periods per week: 4 (L:3 T:1 P:0)	Periods per semester: 60

Course Objectives:

- To understand the knowledge about faults and failures in electrical power systems.
- To apply the remedial actions through switchgear for protection schemes

Course Prerequisites:

Topic	Course code	Course Name	Semester
Knowledge of DC machines		DC Machines & Traction Motors	3
Knowledge of AC machines		Induction Machines	4

Course Outcomes:

On completion of the course, the students will be able to:

CO n	Description	Duration (Hours)	Cognitive Level
CO1	Summarize the protection of electric power systems by circuit breakers.	16	Understanding
CO2	Illustrate the working of protective relays used in electrical systems.	14	Understanding
CO3	Explain various protection schemes used in electrical machines.	15	Understanding
CO4	Classify and explain the protection schemes used for busbar and transmission lines.	13	Understanding
	Series Test	2	

CO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7
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Outcomes							
CO1	2				3		
CO2	2						
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline

On completion of the course, the students will be able to:

Module Outcome	Description	Duration (Hours)	Cognitive Level
CO1	Summarize the protection of electric power systems by circuit breakers.		
M1.01	Outline the functions of switchgears in protection of electrical systems.	3	Understanding
M1.02	Classify the operation of various fuses	4	Understanding
M1.03	Explain the methods of arc extinction in circuit breakers	3	Understanding
M1.04	Illustrate the working of various types of isolators	6	Understanding
<p>Contents:</p> <p>Switch gears-Introduction-Necessity- essential features of switch gear- need of current limiting reactors and their arrangements.</p> <p>Fuses –desirable characteristics of a fuse element- factors affecting fuse current- important terms- current rating- fusing current- fusing factor- prospective current- cut off current- pre arcing time- arcing time- total operational time- breaking capacity-Types of fuses-high voltage fuses -low voltage fuses--HRC- construction-working- applications.</p> <p>Circuit breakers-Arc phenomenon-Arc formation process-methods of arc extinction -high resistance - low resistance-important terms-Arc voltage-recovery voltage-re-striking voltage-RRRV. Specifications of circuit breaker-Rated current- Rated voltage-braking capacity-making capacity- short time rating-circuit breaker classifications-construction-operation-advantages -Oil circuit breaker-air blast-Vacuum-SF6. Comparison between fuse and circuit breaker.</p> <p>Isolators- Types- construction-vertical break-horizontal break - pantograph type</p>			
CO2	Illustrate the working of protective relays used in electrical systems.		
M2.01	Classify relays and summarize their operations.	3	Understanding
M2.02	Explain the working of electromagnetic relays.	5	Understanding
M2.03	Summarize the scheme of protection using	3	Understanding

	distance and differential relays.		
M2.04	Compare static and electromagnetic relays.	3	Understanding
	Series Test-1	1	
Contents:			
Protective relays- typical relay circuit- fundamental requirements of protective relays- basic terminology- relay time- pick up current- reset current- current setting- plug setting multiplier- time setting multiplier-Classification of relays- based on applications- based on time of operation- time current characteristics.			
Electromagnetic relays- attraction types relays-construction - operation- attracted armature type-solenoid type-induction type relays-construction- working- over current (non directional and directional).			
Distance and differential protection- principle of operation- distance relay- differential relay.			
Static relay (block diagram only)- comparison between static and electromagnetic relays.- Types of protection- basic concepts with diagram -primary - backup			
CO3	Explain various protection schemes used in electrical machines.		
M3.01	Summarize the important faults in electrical machines	3	Understanding
M3.02	Illustrate various methods of alternator protection.	4	Understanding
M3.03	Summarize the protection of transformers	4	Understanding
M3.04	Explain the protection methods of electric motors.	4	Understanding
Contents:			
Faults in electrical machines- list important faults in alternators,transformers,electric motors			
Protection of Alternators - differential protection- merz price scheme- earth fault.			
Protection of Transformers- buchholz relay- construction- operation- earth fault (leakage) protection- combined leakage and overload protection-merz price circulating current scheme.			
Protection of motors - short circuit protection-overload protection-single phase preventer.			
CO 4	Classify and explain the protection schemes used for busbar and transmission lines.		
M4.01	Classify various schemes for busbar protection.	3	Understanding
M4.02	Explain various faults and protection of transmission lines.	4	Understanding
M4.03	Illustrate various methods for protection against overvoltage and lightning	4	Understanding
M4.04	Outline the microprocessor based over current protection.	2	Understanding
	Series Test – II	1	
Contents:			

Protection of Busbars - schemes of protection- differential protection- fault bus protection.

Protection of transmission lines- requirements of line protection system- methods of protection-schematic arrangement and principle of - time graded over current protection (for radial, parallel and ring main feeders)- differential pilot wire protection-merz price voltage balance system-distance protection.

Protection against over voltages- List causes of over voltage-voltage surge (definition only)

Lightning- definition-mechanism of lightning discharge- lightning stroke- types-harmful effects of lightning-Protection against lightning- devices used- overhead ground wires- Lightning arrestors-horn gap arresters(basic diagram and working only)

Microprocessor based over current relays- block diagram-working.

Text / Reference:

T/R	Book Title/Author
T1	Mehta V. K ;Rohit Mehta, Principles of Power System, S .Chand and Co., New Delhi.,2016, ISBN: 978-81-2192-496-2.
R1	Gupta. J. B. Switchgear and Protection, S. K. Kataria and Sons, New Delhi,2015, ISBN: 978-93-5014- 372-8.
R2	Rao Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi,2015, ISBN: 978-81-7409- 232-3.
R3	Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, 201, 5ISBN: 978-81-203-3660-5.

Online resources

Sl.No	Website Link
1	https://lecturenotes.in/subject/98/power-system-protection-ppsp
2	https://lecturenotes.in/course/all/all/electrical-and-electronics-engineering/6
3	http://www.nptelvideos.in/2012/11/power-system-analysis.html
4	https://cms-cdn.selinc.com/assets/Literature/Publications/Technical%20Papers/6014_MicroprocessorBasedTrans_Web.pdf?v=20150812-155659