

**B.E. ELECTRICAL ENGINEERING
FOURTH YEAR
FIRST SEMESTER EXAM 2025**

POWER SYSTEM PROTECTION AND SWITCHGEAR

Time: Three Hours

Full Marks: 100

(50 marks for each part)
Use a separate Answer-Script for each Part

PART-I

Group A

Answer *any two* questions from Group A.

1.	a) Explain why for a fault at alternator terminals a single line to ground fault is generally more severe than a three phase fault.	4
	b) Explain with suitable diagram how the zero sequence network depends on the type of transformer connection.	6
2.	a) A 50MVA, 30kV generator has zero, positive and negative sequence reactances of 5%, 25% and 15% respectively. i) Find the ratio of the fault current for a solid single line to ground fault to that when all the three phases are dead short circuited. ii) Determine the value of the reactance to be placed in the generator neutral to limit the fault current for a solid single line to ground fault to that for a solid symmetrical fault. iii) If instead of reactance, a resistance is connected in the generator neutral, determine the value of the resistance.	10
3.	a) Derive the necessary equation to determine the fault current for double line to ground fault. Draw the necessary sequence network.	6+2
	b) How pre-fault load current is considered in fault analysis?	2
<u>Group B</u>		
Answer <i>any three</i> questions from Group B.		
4.	a) Explain with suitable diagram the phenomena of current chopping in circuit breaker.	7

	b) Discuss the role of main and arcing contacts in air circuit breaker.	3
5.	a) Explain the phenomenon of arc formation in vacuum circuit breaker.	6
	b) Mention the factors which influence arc extinction process in a circuit breaker.	4
6.	a) Explain with necessary derivations how restriking transients can be damped by connecting a resistance across the contacts of a circuit breaker.	8
	b) What do you understand by RRRV in circuit breaker?	2
7.	a) Discuss the effect of i) power factor and ii) the type of fault and the condition of neutral point upon the active recovery voltage with suitable diagrams.	3+3
	b) What are the disadvantages of SF ₆ circuit breaker?	4

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PART II

Figures in the margin indicate full marks

	Group –A Answer any three questions from Group-A															
1.	(a) Discuss the main features of protective relay.	(6)														
	(b) Distinguish between ‘plug setting’ and ‘plug setting multiplier’. Write the use of these parameters in an overcurrent protection system.	(4)														
2.	(a) Draw characteristics of attraction type overcurrent relay and IDMTL type overcurrent relay and explain them. Which one would perform better for feeder protection? Justify your answer.	(4+3=7)														
	(b) Why is an ordinary over-current relay insufficient to protect a ring-main distribution system? How does directional overcurrent relay overcome this limitation?	(3)														
3.	(a) An IDMTL relay with PSM =18 carries a fault current of 135A in CT secondary. The rated current CT secondary current is 5A. Calculate plug setting of the relay. This relay acts as a backup relay with DTM of 0.2 sec where the primary relay's actual operation time is 0.52 sec. Also calculate TMS of the relay. The relay characteristic for time setting of 1.0 is given below: <table border="1"><tr><td>PSM</td><td>2</td><td>6</td><td>10</td><td>12</td><td>18</td><td>20</td></tr><tr><td>Time</td><td>10</td><td>3.8</td><td>3</td><td>2.8</td><td>2.4</td><td>2.2</td></tr></table>	PSM	2	6	10	12	18	20	Time	10	3.8	3	2.8	2.4	2.2	(5)
PSM	2	6	10	12	18	20										
Time	10	3.8	3	2.8	2.4	2.2										
	(b) Discuss how the reach of the distance relay may change due to arcing faults. Which distance relay is immune to this change in reach? Justify your answer.	(3+2=5)														
4.	(a) Explain the power swing with a suitable example. What difficulty is faced by a distance relay during a power swing? How it can be addressed?	(2+1+2=5)														
	(b) Draw and explain trip control circuit for 3-step 3-zone distance protection assuming all the relays are impedance relay. Also mention how directional feature is incorporated in it.	(5)														
5.	Discuss why a biased differential relay is used instead of an ordinary differential relay in power system protection. Explain the operating principle of such a relay. Also, draw the characteristics curve.	(6+4)=10														
	Group –B Answer any two questions from Group-B															
6.	Explain with the help of suitable diagrams and necessary derivations how the apparent impedance seen by the distance relay varies for a single line to ground fault and a double line fault in a three-phase transmission line.	(5+5=10)														

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7.	With the necessary trip circuit explain the Blocking scheme in Carrier Aided Distance Protection.	(10)
8.	Describe how the c.t.s on a star-delta transformer's two sides should be connected to prevent spurious tripping using the required connection diagram and derivation. Also, describe the need for transformer differential relays' harmonic restraint feature.	(8+2= 10)
9.	Discuss how loss of excitation protection is carried out for an alternator. Also, explain how loss of synchronism protection is provided for an alternator.	(6+4= 10)