GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) EXAMINATION - WINTER 2021

Subject Code:3170908 Date:10/12/2021

Subject Name:Switchgear And Protection

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- 4. Simple and non-programmable scientific calculators are allowed.
- **Q.1** (a) What do you understand by 30° and 60° connections with reference to 03 directional overcurrent relays?
 - (b) The percentage differential protection of transformer will not operate during **04** an external fault. Explain and justify with suitable figure.
 - (c) What do you understand by a zone of protection? Discuss various zones of protection for a modern power system. Why do adjacent protective zones overlap?
- Q.2 (a) Explain the effect of arc resistance on Mho relay reach and the directional 03 property of Mho relay with the help of characteristics on R-X plane.
 - **(b)** Explain capacitor voltage transformer. Give its comparison with **04** electromagnetic potential transformer.

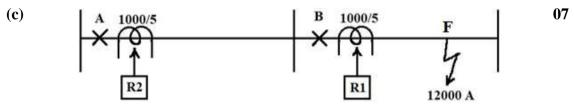


Figure 1

Two relays R_1 and R_2 are connected in two sections of a feeder, with CT ratios of 1000/5 A as shown in Figure 1 above. The plug settings of relay R_1 and R_2 are 150% and 200% respectively. Operating time characteristic of both relays at TMS=1 is given in Table 1 below.

Table 1									
PSM	2	4	5	6	8	10	12	15	20
Operating Time (s)	10	5	4	3.6	3	2.8	2.6	2.2	1.6

The time multiplier setting of relay R_1 is 0.3. The time grading scheme has a discriminative time margin of 0.5 seconds between the relays. A three-phase short circuit at F results in a fault current as shown in figure.

Find the actual operating times of R_1 and R_2 .

What is the time multiplier setting of R_2 ?

OR

(c) With suitable waveforms, explain the problem of magnetizing inrush in case of transformer protection. Explain how percentage differential relay with harmonic restraint can overcome this problem.

Q.3	(a)	Briefly explain how the CT ratio should be selected for differential protection of bus-bars.				
	(b)	Explain in brief selectivity, sensitivity, discrimination and speed with reference to protective relaying.	04			
	(c)	In relation to circuit breaker arc interruption, explain the recovery rate theory and energy balance theory. Also with suitable figure, define restriking voltage and recovery voltage.	07			
		OR				
Q.3	(a)	What is back up protection and why is it needed?	03			
	(b)	Explain the necessity of directional overcurrent relay in case of single end fed parallel feeders and radial feeders.				
	(c)	Compare Air Blast Circuit Breaker, SF ₆ Circuit Breaker and Vacuum Circuit Breaker with reference to their arc quenching mechanisms.	07			
Q.4	(a)	Briefly explain various types of faults and abnormal conditions in transformers.	03			
	(b)	Explain unbalanced loading and loss of excitation as abnormal operating condition of alternator.	04			
	(c)	With the help of characteristics on R-X plane, compare between performance of impedance and reactance relays in terms of: i) Directional property exhibited by the relay; ii) Performance of relay during power swing.	07			
		OR				
Q.4	(a)	Explain the difference between CT cores used for measurement and those used for protective relays.	03			
	(b)	Explain three stepped distance protection of transmission line.	04			
	(c)	Explain the basic schematic of differential protection of bus-bars. Explain its behavior with reference to internal and external faults, clearly explaining the reason of maloperation during external faults.	07			
Q.5	(a)	Explain the concept of adaptive relaying.	03			
	(b)	Explain how to select short-time current rating of CT and accuracy class of CT while selecting a CT.	04			
	(c)	With schematic, explain protection from phase fault and ground fault inside the three phase induction motor.	07			
		OR				
Q.5	(a)	Explain the problem associated with unbalanced supply voltage and the method of protection from the same for a three phase induction motor.	03			
	(b)	Draw and explain the general block diagram of numerical relay.	04			
	(c)	List out various stator and rotor faults of generator. Explain transverse differential protection of generator winding.	07			

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•	•	Code:3170908 Date:01/06	/2022
Sub	ject	Name:Switchgear And Protection	
Tim	e:02	:30 PM TO 05:00 PM Total Mark	s: 70
Instr	uction	ıs:	
	1.	Attempt all questions.	
	2.	Make suitable assumptions wherever necessary.	
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0.1	()		
Q.1	(a)	Define following qualities of a protective relay: (i) Sonsitivity (ii) Solostivity (iii) Discrimination	03
	(b)	(i) Sensitivity (ii) Selectivity (iii) Discrimination Explain following terms with reference to Circuit Breaker:	04
	(D)	(i) Breaking Current (ii) Making Current	04
	(c)	Draw and explain basic tripping mechanism of relay.	07
	(C)	Draw and explain busic arpping mechanism of relay.	07
Q.2	(a)	Define the terms 'Plug Setting Multiplier'. An IDMT type overcurrent relay is	03
~·-	(44)	used to protect a feeder through a 600/1A CT. The relay has a plug setting of	00
		125%. Find the Plug Setting Multiplier, if a fault current of 6000A flows through	
		the feeder.	
	(b)	Explain the operating characteristic of percentage biased differential relay.	04
	(c)	Draw a schematic diagram of primary protection zone of various equipments.	07
		Also explain the difference between primary and back-up protection.	
	()	OR	0=
	(c)	With a neat sketch, explain working of induction disc type relay.	07
Q.3	(a)	Enumerate the superiority of distance relay for the protection of transmission line.	03
V.	(b)	Explain restricted earth fault protection of three phase transformer.	04
	(c)	Give comparison of Simple Impedance relay, Reactance relay and MHO relay.	07
		OR	
Q.3	(a)	Describe different abnormalities in the transformer.	03
	(b)	Define under reach and over reach of distance relay.	04
	(c)	With a neat diagram, explain working of Buchholz relay.	07
0.4	(a)	Explain protection of generator against unbelenced leading	03
Q.4	(a) (b)	Explain protection of generator against unbalanced loading. Compare measuring CT & protective CT.	03
	(c)	Classify various types of faults and abnormal condition in Induction motors and	07
	(C)	· · · · · · · · · · · · · · · · · · ·	07
		OR	
Q.4	(a)	Explain the effect of CT saturation on busbar protection.	03
	(b)	Describe protection against loss of excitation in generator.	04
	(c)	A 200 MW, 13.8 kV, 0.9 PF, 50 Hz, 3-φ, Y-connected generator is protected by	07
		•	
		· · · · · · · · · · · · · · · · · · ·	
		percentage of stator winding protected.	
0.5	(e)	Define the following: (i) CT ratio error (ii) CT phase angle error (iii) CT Rurden	U3
~			
	(1)		V- T
Q.4 Q.5	(a) (b)	Protections used for them. OR Explain the effect of CT saturation on busbar protection. Describe protection against loss of excitation in generator.	

With the help of schematic diagram, discuss various components of numerical

(c)

relay.

07

OR

(a)	Define: (i) Re-striking voltage (ii) Recovery voltage (iii) RRRV	03
(b)	Compare Electromagnetic type PT & Capacitive type PT	04
(c)	With a neat sketch, Describe SF6 Circuit Breaker.	07
		 (a) Define: (i) Re-striking voltage (ii) Recovery voltage (iii) RRRV (b) Compare Electromagnetic type PT & Capacitive type PT (c) With a neat sketch, Describe SF6 Circuit Breaker.
