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 directional overcurrent relays?   **03**

(b) The percentage differential protection of transformer will not operate during an external fault. Explain and justify with suitable figure.   **04**

(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?   **07**

Q.2 **(a)** Explain the effect of arc resistance on Mho relay reach and the directional property of Mho relay with the help of characteristics on R-X plane.   **03**

(b) Explain capacitor voltage transformer. Give its comparison with electromagnetic potential transformer.   **04**
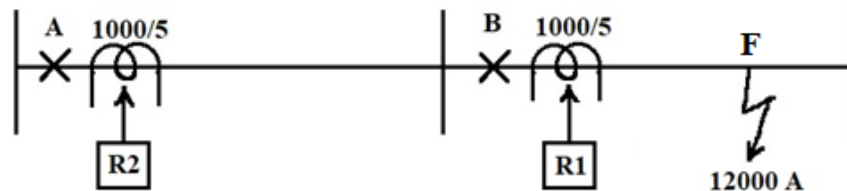
(c)   **07**

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.   **07**

Q.3 (a) Briefly explain how the CT ratio should be selected for differential protection **03** of bus-bars.

(b) Explain in brief selectivity, sensitivity, discrimination and speed with **04** reference to protective relaying.

(c) In relation to circuit breaker arc interruption, explain the recovery rate theory **07** and energy balance theory. Also with suitable figure, define restriking voltage and recovery voltage.

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 **04** parallel feeders and radial feeders.

(c) Compare Air Blast Circuit Breaker, SF$_6$ Circuit Breaker and Vacuum Circuit **07** Breaker with reference to their arc quenching mechanisms.

Q.4 (a) Briefly explain various types of faults and abnormal conditions in **03** transformers.

(b) Explain unbalanced loading and loss of excitation as abnormal operating **04** condition of alternator.

(c) With the help of characteristics on R-X plane, compare between performance **07** of impedance and reactance relays in terms of: i) Directional property exhibited by the relay; ii) Performance of relay during power swing.

OR

Q.4 (a) Explain the difference between CT cores used for measurement and those used **03** for protective relays.

(b) Explain three stepped distance protection of transmission line. **04**

(c) Explain the basic schematic of differential protection of bus-bars. Explain its **07** behavior with reference to internal and external faults, clearly explaining the reason of maloperation during external faults.

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 **04** CT while selecting a CT.

(c) With schematic, explain protection from phase fault and ground fault inside **07** the three phase induction motor.

OR

Q.5 (a) Explain the problem associated with unbalanced supply voltage and the **03** method of protection from the same for a three phase induction motor.

(b) Draw and explain the general block diagram of numerical relay. **04**

(c) List out various stator and rotor faults of generator. Explain transverse **07** differential protection of generator winding.

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022

Subject Code:3170908   **Date:01/06/2022**

Subject Name:Switchgear And Protection

Time:02:30 PM TO 05:00 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.**

			MARKS
Q.1	**(a)**	Define following qualities of a protective relay: (i) Sensitivity (ii) Selectivity (iii) Discrimination	**03**
	(b)	Explain following terms with reference to Circuit Breaker: (i) Breaking Current (ii) Making Current	**04**
	(c)	Draw and explain basic tripping mechanism of relay.	**07**
Q.2	**(a)**	Define the terms 'Plug Setting Multiplier'. An IDMT type overcurrent relay is used to protect a feeder through a 600/1A CT. The relay has a plug setting of 125%. Find the Plug Setting Multiplier, if a fault current of 6000A flows through the feeder.	**03**
	(b)	Explain the operating characteristic of percentage biased differential relay.	**04**
	(c)	Draw a schematic diagram of primary protection zone of various equipments. Also explain the difference between primary and back-up protection.	**07**
		OR	
	(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**
	(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**
Q.4	**(a)**	Explain protection of generator against unbalanced loading.	**03**
	(b)	Compare measuring CT & protective CT.	**04**
	(c)	Classify various types of faults and abnormal condition in Induction motors and protections used for them.	**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 earth-fault relay. The relay is set to operate at 10%. The CT ratio is 10,000/1 A. A resistor is used in the neutral circuit of the generator to limit the earth-fault current to 50% of the normal load current. Determine the value of the resistor and percentage of stator winding protected.	**07**
Q.5	**(a)**	Define the following: (i) CT ratio error, (ii) CT phase angle error, (iii) CT Burden	**03**
	(b)	Discuss Recovery Rate Theory (Slepian's Theory) and Energy Balance Theory (Cassie's Theory) for arc extinction in Circuit breaker.	**04**
	(c)	With the help of schematic diagram, discuss various components of numerical relay.	**07**

Q.5 **(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**

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