Seat No.: _____   Enrolment No._____

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   **07**
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**
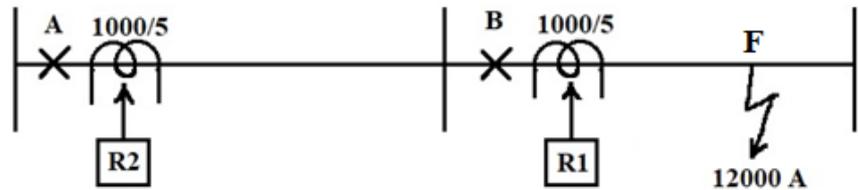electromagnetic potential transformer.

(c)

Figure 1

07
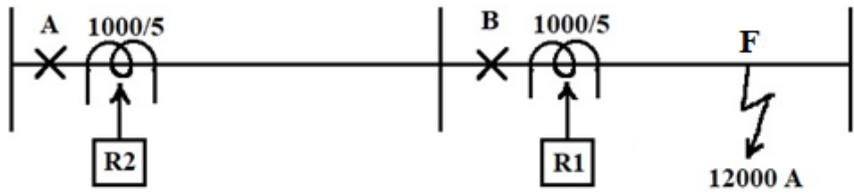
Two relays R_1 and R_2 are connected in two sections of a feeder, with CT ratios
of 1000/5 A as shown in Figure 1 above. The plug settings of relay R_1 and R_2
are 150% and 200% respectively. Operating time characteristic of both relays
at TMS=1 is given in Table 1 below.

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   **07**
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 **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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