

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/SP20**)

CLASS: B.Tech.
BRANCH: EEE

SEMESTER : VII
SESSION : MO/22

SUBJECT: EE401 SWITCHGEAR AND PROTECTION

TIME: 03 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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- Q.1(a) Determine the symmetrical breaking and asymmetrical breaking of circuit breaker? [2]
Q.1(b) The rating of a three-phase circuit is as follows: 2000 MVA, 1250 A, 33 kV, 4 Sec. Judge the rated making current, rated symmetrical breaking current and short time rating. [3]
Q.1(c) Derive the conditions for the arc across the contacts of the circuit breaker can be made critically damped, oscillatory and non-oscillatory with supporting waveform and circuit diagram. [5]
- Q.2(a) Analyze the torque equation for operation of numeric impedance relay from the generalized relay torque equation. [2]
Q.2(b) Analyze the operation of electromechanical reactance relay with proper diagram and mathematical justification? [3]
Q.2(c) As per the given Fig. 1, if both the relays are set to 100% plug setting. Appraise the time of operation of both relays with time grading margin of 0.6 sec and time multiplier setting of R_1 relay as 0.15. [5]

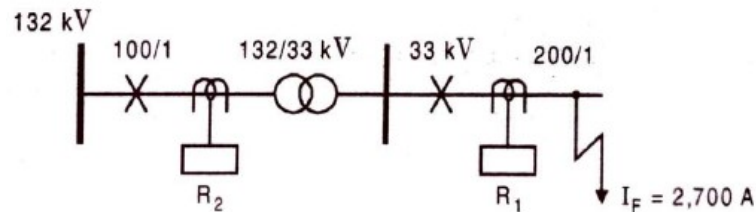


Fig. 1

- Q.3(a) Identify the protection mechanism for stator inter-turn fault. [2]
Q.3(b) Analyze and justify the design for negative sequence protection of alternator. [3]
Q.3(c) A generator winding is protected by using a percentage differential relay whose characteristic is having a slope of 10%. A ground fault occurred near the terminal end of the generator winding while generator is carrying load. Assuming CT ratio of 500/5 A, $I_1 = 400 + j0$, $I_2 = 150 + j0$. Judge if the relay will operate to trip the circuit breaker? [5]
- Q.4(a) Analyze the protection of induction motor against thermal overloading conditions. [2]
Q.4(b) A 3-phase 33,000/6,600 V transformer is connected in star/delta and the protecting CT on the low-voltage side have a ratio of 300/5. Evaluate the CT ratio on the H.V. side? Also present the design schematic for the same. [3]
Q.4(c) Analyze the problems associated with usage of differential protection for transformer and provide the solution to overcome atleast two such problems. [5]
- Q.5(a) Identify the significance of time graded protection. [2]
Q.5(b) Analyze the effect of arc resistance on the operation of impedance, reactance and Mho relays and compare which relay is most and least affected and why? [3]
Q.5(c) Analyze the design modification for synchronous operation of three zone protection of transmission lines using wireless signals. [5]