Reg. No.



VII SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING) ONLINE EXAMINATIONS, JANUARY – FEBRUARY 2021 SWITHGEAR AND PROTECTION [ELE 4101]

REVISED CREDIT SYSTEM

| Time: 3 | B Hours Date: 25 JANUARY 2021 Max. Marks: | 50 |
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| Instruc | tions to Candidates: | |
| | Answer ALL the questions. | |
| | Missing data may be suitably assumed. | |
| 1A. | Describe the Arc interruption theories with respect to arc extinction in circuit breaker | 03 |
| 1B. | What is current chopping? Describe the interruption of low magnetising current with the help of relevant sketch and waveforms. | 03 |
| 1C. | A 50 Hz, 3 Φ alternator with grounded neutral has inductance of 1.5 mH/phase and is connected to bus bar through a circuit breaker. The capacitance to earth between the alternator and circuit breaker is 0.002µF/phase. The circuit breaker opens when rms value of current is 7200 A. Determine the following: | |
| | i. Maximum rate of rise of restriking voltage | |
| | ii. Time for maximum rate of rise of restriking voltage | |
| | iii. Frequency of oscillations | |
| | Neglect the first pole to clear factor | 04 |
| 2A. | What are the important indirect testing methods in circuit breaker, explain them with a neat circuit diagram. | 03 |
| 2B. | An 66 kV, 1000 MVA Circuit breaker suddenly closes on to a fault. Determine: | |
| | i. The symmetrical breaking current | |
| | ii. The asymmetrical breaking current assuming 50% dc component. | |
| | iii. The peak making current as per IEC (Indian electrical commission) | |
| | iv. Short time rating | 04 |
| 2C. | With the help of relevant circuit diagram and phasor diagrams, explain the phenomena of arcing grounds in a power system. Which method of neutral grounding is best with respect to eliminating the problems due to arcing ground? Justify your answer. | 03 |
| 3A. | i. Discuss the points to be considered while selecting a fuse for protecting an electrical equipment. ii. Determine the diameter of a round fuse wire (in cm) to have a fusing current of 45 A, if a. Copper is used as the fuse element (K = 2530) b. Tin is used as the fuse element (K = 405.5) | 03 |
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- **3B.** A 500 HP, 3.3kV, 3-phase Induction motor having a full load power factor of 0.85 is protected against overload and stator winding faults using numerical over current relay connected to the secondary of 100 / 5 A CT.
 - i. Assuming that 15% over load is permissible, determine a suitable pick up current and thus select appropriate plug setting for the relay.
 - ii. For a fault current of 12 times the full load current, determine the actual time of operation of the relay, if the relay has extremely inverse characteristics and a time multiplier setting of 0.45, when
 - a. CT has no error
 - b. CT has a ratio error of 2%
 - c. CT has a ratio error of -1.5%.
- **3C.** Draw a detailed protection scheme for biased differential protection of a 33kV/ 220 kV, 250 MVA, delta-star power transformer. Suggest (determine) suitable CT ratios (select nearest standard CT ratios) for CTs on h.v. and l.v. side of power transformer.

For a fault current of 10,000A on l.v. side of transformer, determine and mark currents in the pilot wire and current through relay operating coil.

- **4A.** The neutral point of a 100 MVA, 11 kV alternator is earthed through a resistance of 2.5 Ω . Synchronous reactance per phase of alternator winding is 0.3 pu and resistance per phase is 0.025 pu. Differential protection is used to protect the alternator against stator winding faults and the relay is set to operate when there is out of balance current of 0.8 A. The C.T.s have ratio of 5000/5 A.
 - i. What percentage of the winding is protected against earth faults?
 - ii. What must be the minimum value of earthing resistance required to protect 92 % of each phase winding?
- **4B.** A transmission line has an impedance of $(2+j4) \Omega$ primary. It is protected by (a) Impedance relay (b) Mho relay. CT ratio 500/1 A and PT ratio is 132 kV/110 V. The relays are designed to protect 80 % length of the line. The fault takes place at 60 % of the line and the corresponding arc impedance $(3+j0.3) \Omega$ (primary). Determine the relay settings and comment on relay operation.
- **4C.** Describe the functions of coupling capacitor, Line trap unit and Transmitter and receiver unit used in carrier current protection of a transmission line. **03**
- **5A.** Explain the following types of protections provided for an induction motor. (i) Unbalanced protection and (ii) Protection against single phasing
- **5B.** What is the function of a phase comparator? How will you synthesize a mho relay using a phase comparator?
- **5C.** Discuss the comparative benefits and limitations of Electro mechanical, static and numerical relays. **03**

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