

## IV B.Tech I Semester Regular Examinations, October/November - 2019

## SWITCHGEAR AND PROTECTION

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

*Question paper consists of Part-A and Part-B**Answer ALL sub questions from Part-A**Answer any FOUR questions from Part-B*

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**PART-A (14 Marks)**

1. a) What are basic functions of a circuit breaker? [3]
- b) Write the differences between differential relay and biased differential relay. [3]
- c) Write short notes on inter turn faults in an alternator. [2]
- d) What is meant by dead zone? [2]
- e) Write short notes on over load capacity and reliability of static relay. [2]
- f) What are the uses of counter poise wires? [2]

**PART-B (4x14 = 56 Marks)**

2. a) Draw and explain the voltage distribution diagram in the occurrence of the arc. [7]
- b) In a system having 220kV, the line to ground capacitance 0.018 microfarad, inductance 4.5 H. Find the voltage appearing across the pole of the circuit breaker if a magnetizing current of 8.5A instantaneous, is interrupted. Calculate also the value of resistance to be used across the contacts to eliminate the re-striking voltage? [7]
3. a) Explain the principle of operation of non directional disc relay with neat diagram. [7]
- b) The current rating of a relay is 5A and set at 150%, TMS=0.4, CT ratio is 400/5, the fault current is 6000A. Find the operating time of the relay. At TMS=1 the operating time at various PSMs are tabulated as:

PSM	2	4	5	8	10	20
Operating time(Sec)	10	5	4	3	2.6	2.2

4. a) The neutral point of a 10kV alternator is earthed through a resistance of 8.5 ohms, the relay is set to operate when there is an out of balance current of 1A. the CTs are having a ratio of 1000/5. What percentage of the winding is protected against fault to earth and what must be the minimum value of earthing resistance to give 85% protection to each phase winding? [7]
- b) A three phase, 200kVA, 11kV/400V transformer is connected in delta-star. The CTs on low voltage side have turns ratio of 500/5. Find the CT ratio on high voltage side. Also find the circulating current when the fault of 800A of following type occur on the low voltage side: Earth fault with in the protective zone and outside the protective zone? [7]

Code No: **R1641024**

**R16**

**Set No. 1**

5. a) Explain the frame leakage protection of bus bars with circuit diagram. [7]  
b) Discuss in detail about the non directional time graded protection with time distance characteristics. [7]
6. a) Discuss how the static directional relay works to get the directional characteristics? [7]  
b) Draw and explain the static instantaneous relay by using the transistors. [7]
7. a) Discuss in detail about the specifications of surge arresters. [7]  
b) Explain about the various grounding methods with circuit diagrams and necessary equations. [7]



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1. a) Write short notes on the break down voltage of a circuit breaker. [3]
- b) What is meant by over travel of a relay? [3]
- c) List out the faults that occur in the auxiliary equipment of the transformer. [2]
- d) Write briefly about the directional earth fault relays. [2]
- e) How the voltage transients are effecting the operation of the static relays? [2]
- f) What is the difference between solid grounding and resistance grounding? [2]

**PART-B (4x14 = 56 Marks)**

2. a) Explain about the static and dynamic characteristics of an arc in a circuit breaker. [7]
- b) In short circuit test on a three pole, 132kV circuit breaker, the following observations are made: power factor of the fault is 0.3, the recovery voltage 0.9 times full line value, the breaking current is symmetrical, the frequency of oscillations of re-striking voltage is 16KHz. Assuming the neutral is grounded and the fault is not grounded. Find the average value of RRRV? [7]
3. a) Discuss the concepts of current setting and time settings of the relay with examples. [7]
- b) Draw and explain the directional and voltage current characteristics of a directional relay. [7]
4. a) The percentage differential relay is applied for protecting the alternator. The relay has a slope characteristic of 10%. A high resistance ground fault occurred near the grounded neutral end of the generator while carrying the load. As a consequence the currents in amperes flowing at each end of the winding are  $310+j0$  and  $325+j0$ . Assuming the CT ratio as 400/5 amperes, will the relay operate and trip the breaker? [7]
- b) A 11kV, 3 phase alternator has full load rated current of 200A. The reactance of the armature winding is 14%. The differential protection system is set to operate on earth fault currents of more than 200A. Find the neutral earthing resistance which gives earth fault protection to 90% of the stator winding? [7]
5. a) Explain in detail about the non directional current graded system with current distance characteristics. [7]
- b) Explain about the longitudinal differential protection of feeders. [7]

- 6. a) Explain the operation of UJT and rectifier type comparators with circuit diagrams. [7]
- b) Derive the R-X characteristics of static ohm and reactance relays. [7]
  
- 7. a) Draw and explain the voltage –current characteristics of surge diverter. [7]
- b) List out the effects of ungrounded neutral on the overall system performance. [7]



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**PART-A (14 Marks)**

1. a) List the various specifications that are considered for a circuit breaker. [3]
- b) Write short notes on over shoot of a relay. [3]
- c) List out various internal faults that occur in a transformer. [2]
- d) Write short notes on ground relays in the line protection. [2]
- e) How the burden on CTs is reduced by using the static relays? [2]
- f) What are the parameters that cover the insulation coordination for a substation? [2]

**PART-B (4x14 = 56 Marks)**

2. a) Discuss about the low resistance interruption theory with relevant characteristics. [7]
- b) Calculate the RRRV of 132kV circuit breaker with neutral earthed. The broken current is symmetrical, the re-striking voltage has frequency of 18KHz, power factor of 0.17. Assume the fault is also earthed. [7]
3. a) Explain the theory of induction relay with neat diagram and derive the torque equation. [7]
- b) Explain the constructional details of reverse power relay. [7]
4. a) Emphasize how a directional relay is used in the generator protection? [7]
- b) Describe with the help of a neat diagram the connections of differential protection of transformer. A 3 phase 33/6.6kV star-delta connected transformer is protected by differential protection. The CTs on LV side have a ratio of 500/5A. Find the ratio of CTs on the HV side. [7]
5. a) Explain about the protection of parallel feeders with non directional relays with a neat circuit diagram. [7]
- b) Draw and explain the stepped time distance characteristics of impedance relays. [7]
6. a) Derive the R-X characteristics of static impedance and reactance relays. [7]
- b) Draw and explain the block diagram of direct amplitude comparator. [7]
7. a) Explain the differences between direct and indirect lightning strokes with diagrams. [7]
- b) Discuss the principle of operation of zinc oxide gapless arrester with neat diagram. [7]





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**PART-A (14 Marks)**

1. a) What is the effect of power factor of the circuit on RRRV? [3]
- b) Write about a time delayed over current relay with the general time equation. [3]
- c) What is the role of negative sequence relay in the protection of the alternator? [2]
- d) Write short notes on resetting ratio. [2]
- e) What are the advantages of digital relaying? [2]
- f) Write the classification of lightning strokes. [2]

**PART-B (4x14 = 56 Marks)**

2. a) Derive the expression of re-striking voltage transient. [7]
- b) For a 132kV system, the reactance and capacitance up to the location of the circuit breaker is 5 ohms and 0.018 micro farads respectively. Find the frequency of transient oscillation, the peak value of the re-striking voltage and the peak value of RRRV. [7]
3. a) Explain in detail about the time current characteristics of IDMT relay. [7]
- b) Draw and explain the induction cup reactance relay. [7]
4. a) A 3 phase, 10MVA, 6.6kV generator is delivering a load of 7.5 MW at 0.6 power factor. Find the value of neutral resistance if 15% of the winding is unprotected. The relay setting is 20%. The per phase reactance is 10%. [7]
- b) A 3 phase transformer having a line voltage ratio of 400V/33kV is connected in star- delta. The CTs on the 400V side have a ratio of 800/5. Find the ratio of CTs on the 33kV side? Draw the connection diagram also. [7]
5. a) Discuss about the protection of parallel feeders by using the directional relays. [7]
- b) Discuss the need of carrier aided protection for the transmission lines. [7]
6. a) Explain the operation of level detector and zero crossing detectors with circuit diagrams. [7]
- b) Draw and explain the operational block diagram of micro processor based static relay. [7]
7. a) Explain how the substations are protected by using over head ground wires? [7]
- b) What is an impulse wave and give the specifications of standard impulse test wave? [7]