

[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
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15216

B. Tech 6th Semester Examination

Switch Gear & Protection (OS)

EE-6001

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt Five questions in all, selecting one question from each Section A, B, C and D. Section E is compulsory.

SECTION - A

1. (a) What is an IDMT characteristic? Explain how this is achieved in practice. (10)
- (b) What is meant by 'directional feature' of a directional over-current relay? Describe the construction, principle of operation and application of a directional over-current relay. (10)
2. (a) Explain clearly the basic principle of operation of a differential relay. Explain the working of this type of relay for (i) an internal fault and (ii) a through fault. (10)
- (b) A 20 MVA transformer which may be called upon to operate at 30% overload, feeds 11 kV busbars through a circuit breaker. Other circuit breakers supply outgoing feeders. The transformer circuit breaker supply outgoing feeders. The transformer circuit breaker is equipped with 1000/5 A CT and feeder circuit breakers with 400/5 A CTs and all sets of CTs feed induction type over current relays. The relays on the feeder circuit breakers have a 125% plug setting and a 0.3 time setting. If a three phase fault

[P.T.O.]

2

15216

current of 5000 A flows from the transformer to one of the feeders, find the operating time of the feeder relay, the minimum plug setting of the transformer relay and its time setting assuming a discriminative time margin of 0.5 second. (Given time of operation are 2.8s and 7.0s for PSM of 10 and 3.33 respectively). (10)

SECTION - B

3. (a) Explain the principle of Merz-Price system of protection used for power transformers. What are the limitations of this scheme and how are they overcome? (10)
- (b) A 6.6 kV, 5MVA star connected alternator has a reactance of 1.5 ohm per phase and negligible resistance. Merz-Price protection scheme is used which operates when the out of balance current exceeds 25% of the full load current. The neutral of the generator is grounded through a resistance of 8 ohms. Determine the proportion of the winding which remains unprotected against earth fault. Show that the effects of the alternator reactance can be ignored. (10)
4. (a) Describe the construction, principle of operation and applications of Buchholtz relay. Why is this form of protection an ideal protection scheme? (10)
- (b) Explain carrier current protection through suitable schematic diagram used for the protection of high voltage lines. How it is different from pilot wire relaying? (10)

SECTION - C

5. (a) Describe the various types of comparators and their applications. Discuss the effect of voltage transients on Static relays. (10)
- (b) With the help of neat block diagram, explain the functioning of a static over-current relay without time delay. Explain function of each block. (10)

3

15216

6. (a) What kind of over voltages occur on the transmission lines? How transmission lines are protected against these voltages? (10)
- (b) Describe the construction, principle of operation and application of an HRC fuse. (10)

SECTION - D

7. (a) What are arc interruption theories? Explain high resistance interruption and current zero interruption. (10)
- (b) In a system of 132 kV, the line to ground capacitance is 0.01 μ F and inductance is 5 henries. Determine the voltage appearing across the pole of a C.B. if a magnetizing current of 5A (instantaneous value) is interrupted. Determine also the value of resistance to be used across the contacts to eliminate the restriking voltage. (10)
8. Write short notes on any TWO of the followings:
- (i) Bulk Oil Circuit breaker.
- (ii) Air Blast Circuit Breaker.
- (iii) Vacuum Circuit Breaker. (2 \times 10=20)

SECTION - E

9. Attempt all subparts of below mentioned questions.
- (1) For a 50 Hz, 220 kV system with a reactance of 3 ohm and capacitance of 0.015 μ F.
- (i) The natural frequency of oscillation is _____.
- (ii) Maximum restriking voltage is _____.
- (iii) Average RRRV is _____ (3)

[P.T.O.]

4

15216

- (2) An OCB is rated at 1500 A, 2000MVA, 33 kV, 3 sec.
- (i) Rated normal current is _____.
- (ii) Rated symmetrical short circuit current is _____.
- (iii) Making current is _____.
- (iv) Short-term rating is _____ (4)
- (3) There is a problem of high transient over voltages while interrupting _____ (1)
- (4) For protection of short lines against ground faults where arc resistance is comparable to the impedance of the line, the preferred relay is _____ (1)
- (5) Pilot relaying schemes are used for protection of _____ (1)
- (6) A list of relays and power system components protected by them are given in group I and group II. Match them.

Group I

Group II

- | | |
|---------------------------------|------------------------------|
| (i) Buchloz relay | (a) Transformers |
| (ii) Under frequency relay | (b) Induction motor |
| (iii) Distance relay | (c) Bus bars |
| (iv) Differential relay | (d) switching/impulse surges |
| (v) Lightning arrestor | (e) Alternators |
| (vi) Phase reversal relay | (f) Transmission lines |
| (vii) Split -phase relaying | (g) Against inrush current |
| (viii) Harmonic restraint relay | (h) inter-turn fault |
| (ix) HRC fuses | (i) Against lightning |
| (x) Ground wire | (j) switching devices |

(10)