

**B.Tech 7th Semester Exam., 2020**

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**PROTECTION OF POWER  
APPARATUS AND SYSTEM**

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Answer any seven of the following as directed : 2×7=14

- (a) What is meant by impulse ratio of any lightning arrester?
- (b) What is the difference between a lightning arrester and a surge absorber?
- (c) Which of the gases are employed in commercial gas-blast circuit breakers?

- (d) Where is negative phase sequence relay employed?
- (e) What is meant by relay setting?
- (f) What is meant by rated voltage of a circuit breaker?
- (g) A relay is connected to a 400/5 A current transformer and set for 150%. The primary fault current of 2400 A needs a plug setting multiplier of
  - (i) 2
  - (ii) 4
  - (iii) 6
  - (iv) 8

(Choose the correct answer)

- (h) Which type of connection is employed for current transformer for the protection of star-delta connected 3-phase transformer?
  - (i) Delta-delta
  - (ii) Delta-star
  - (iii) Star-star
  - (iv) All of the above

(Choose the correct answer)

( 3 )

(i) A relay used on short transmission lines is

(i) reactance relay

(ii) mho relay

(iii) impedance relay

(iv) None of the above  
(Choose the correct answer)

(j) Lightning arrester should be located

(i) away from the circuit breaker

(ii) near the transformer

(iii) near the circuit breaker

(iv) None of the above  
(Choose the correct answer)

2. (a) Explain various ratings of a circuit breaker in detail. 6

(b) In a short-circuit test on a 132 kV, 3-phase system, the breaker gave the following result—p.f. of the fault 0.4, recovery voltage 0.95 of full line value, the breaking current is symmetrical and the restriking transient had a natural frequency of 16 kHz. Determine the rate of rise of restriking voltage. Assume the fault is grounded.

AK-21/322

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( 4 )

3. (a) Show how the restriking transients can be damped by connecting a resistor across the contacts of a circuit breaker. 7

(b) A circuit breaker is rated 2500 A, 1500 MVA, 11 kV. In a 3-phase oil circuit breaker determine the rated normal current, breaking current, making current and short time rating current. 7

4. (a) Discuss different methods of interrupting the arc in circuit breakers. Explain two main theories of current zero interruption. 7

(b) Determine the inductance of Peterson coil to be connected between the neutral and ground to neutralize the charging current of overhead line having the line to ground capacitance of 0.15  $\mu\text{f}$ . If the supply frequency is 50 Hz and the operating voltage is 132 kV, then find the kVA rating of the coil. 7

(a) Discuss the necessary circuit diagram and the principle of operation of an induction disc relay. What are the advantages of induction cup relays over induction disc relays? 7

21/322

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Q. A circuit breaker is connected with 100 MVA transformer at 220 kV. The magnetizing current of a transformer is 5% of the full load current. Determine the maximum voltage which may appear across the gap of the breaker when the magnetizing current is interrupted at 53% of its peak value. The stray capacitance is 2500  $\mu\text{F}$  and the inductance is 30 H.

(a) Describe the principle of a directional overcurrent relay. How does it help in discrimination in protection of parallel feeders and ring mains? 7

(b) In a 220 kV system, the reactance and capacitance up to the location of circuit breaker is 8 ohms and 0.025 microfarad respectively. A resistance of 600 ohms is connected across the contacts of the circuit breaker. Determine the— 6

- (i) natural frequency of oscillation;
- (ii) damped frequency of oscillation;
- (iii) critical value of resistance which will give no transient oscillation;
- (iv) value of resistance which will give damped frequency of oscillation and one-fourth of the natural frequency of oscillation. 8

7. (a) Explain a loss of excitation relay used for alternator protection. 6

(b) An IDMT relay operates in 5 seconds and 3 seconds for PSMs of 4 and 10 respectively. The relay is used to protect a feeder through a 1000/5 A CT. Calculate the time of operation of the relay when the feeder current is 1500 A. The relay has a plug setting of 75% and time setting of 0.4. The nominal current rating of the relay is 5 A. 8

8. (a) Describe the construction, principle of operation and application of—

(i) rod gaps;

(ii) expulsion gap;

(iii) valve-type lightning arresters. 6

(b) State the various causes of overvoltages in a power system. Name the various devices used for protection against over-voltage due to lightning. Explain the working principle of thyrite arrester with the help of neat sketch. 8

( 7 )

Write short notes on the following :

- (a) Current chopping
- (b) Peterson coil
- (c) Time-graded protection of feeders
- (d) Insulation coordination

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