

17508

15116

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.  
(2) Illustrate your answers with neat sketches wherever necessary.  
(3) Figures to the right indicate full marks.  
(4) Assume suitable data, if necessary.  
(5) Use of Non-programmable Electronic Pocket Calculator is permissible.

**Marks**

1. (A) Attempt any **THREE** of the following :

**3 × 4 = 12**

- (a) Draw the symbol and state the function of :  
(i) Isolator  
(ii) Circuit breaker  
(iii) Earthing switch  
(iv) Lightning Arrester
- (b) Write any eight causes of fault occurrence in the power system.
- (c) Define the terms related to Protective Relay :  
(i) Selectivity  
(ii) Sensitivity  
(iii) Reliability  
(iv) Speed
- (d) State the External and Internal causes of over-voltages.

(B) Attempt any **ONE** of the following :

**1 × 6 = 6**

- (a) Two 11 kV, 3 $\phi$ ; 3000 kVA generators having subtransient reactance of 15% operate in parallel. Generators supply power to the transmission line through 6000 kVA transformer of ratio 11/22 kV and with a leakage reactance of 5%. Find fault current and fault MVA for 3-phase fault on  
(i) H.T. Side  
(ii) L.T. Side of transformer

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- (b) A 3 $\phi$  transformer having line voltage ratio of 0.4 kV/11 kV is connected Star/Delta and Protective transformers on the 0.4 kV side have a current ratio of 500/5. What must be ratio of the protective transformers on 11 kV side ? Draw a neat circuit diagram and indicate the given values at appropriate places.

2. Attempt any FOUR of the following :

4  $\times$  4 = 16

- (a) Compare the fuse and MCCB on the basis of speed of operation, cost, construction and replacement strategy.
- (b) State the factors to be considered while selecting MCCB for motor protection.
- (c) Write the principle of distance relaying and mention the part of power system at which this type of protection is used.
- (d) Suggest the type of protection for the following abnormalities/faults on alternator :
- (i) Thermal overloading
  - (ii) Stator winding faults
  - (iii) Earth faults on rotor winding
  - (iv) Inter-turn fault
- (e) Distinguish between 'equipment earthing' and 'neutral earthing'.
- (f) Draw a typical waveform of lightning surge and explain it in detail.

3. Attempt any FOUR of the following :

4  $\times$  4 = 16

- (a) Specification of a circuit breaker is given below :  
1500 Amp ; 1000 MVA; 33 kV; 3-phase, 3 secs.  
Determine : (i) Rated symmetrical braking current  
(ii) Rated making current  
(iii) Rated normal current  
(iv) Short time Rating
- (b) Describe with neat sketch the arc extinction in SF<sub>6</sub> circuit breaker.
- (c) Define the terms related to protective relaying :
- (i) Time setting multiplier
  - (ii) Pick up current
  - (iii) Reset current
  - (iv) PSM

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- (d) Why is restricted earth fault protection provided for  $\Delta/Y$  power transformer ?  
Draw the circuit diagram showing restricted earth fault protection for a  $\Delta/Y$  power transformer.
- (e) What are the difficulties experienced while protecting the transformer by differential protection scheme ? How are they overcome ?

4. (A) Attempt any THREE of the following : 3 × 4 = 12

- (a) Draw the construction diagram of ELCB and explain how ELCB gives protection against earth leakage fault.
- (b) A 20 MVA, 11 kV, 3-phase star-connected alternator is protected by differential protection scheme. The star point is earthed through a resistance of 5  $\Omega$ . If CTS have a ratio of 1000/5 and the relay is set to operate when there is an output balance current of 1.5 Amp.  
Calculate the % of each phase of stator winding which is left unprotected.
- (c) Describe with a neat connection diagram the operation of differential protection scheme provided for busbars.
- (d) What are the harmful effects of travelling waves and name the protective devices used for protection against travelling waves.

(B) Attempt any ONE of the following : 1 × 6 = 6

- (a) (i) Describe the behaviour of 3-phase Induction Motor under single phasing. 3
- (ii) Describe with circuit diagram the working of single phase preventer. 3
- (b) Describe with neat diagram, the time graded overcurrent protection of transmission line. State its drawbacks.

5. Attempt any FOUR of the following : 4 × 4 = 16

- (a) Explain the arc extinction methods in circuit breaker.
- (b) Describe with neat sketch the principle of operation of vacuum circuit breaker.
- (c) Describe with neat sketch the operation of Induction type Directional overcurrent Relay.

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- (d) What is 'burden' of CT ? How is it specified ? Why the secondary of a CT should not be open circuited when energised ?
- (e) Describe with block diagram the operation of microprocessor based overcurrent relay.
- (f) State the four advantages of static overcurrent relay over electromagnetic relay.

**6. Attempt any FOUR of the following :**

**4 × 4 = 16**

- (a) With a neat sketch, explain the operation of voltage balanced differential Relay.
  - (b) How are the negative phase sequence currents setup in an alternator ? Suggest the protective scheme for the same.
  - (c) Suggest the type of protection necessary for following abnormal condition/fault in case of power transformer :
    - (i) Over heating
    - (ii) Faults in tap changer
    - (iii) Earth faults
    - (iv) Inter-turn fault
  - (d) What are the limitations of Buchholz relay in case of transformer protection ? State the guidelines for the Installation of Buchholz relay on transformer.
  - (e) What are the requirements of transmission line protection ? Also write about any two abnormalities occur in transmission lines.
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