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Question Paper Code: AEEB47



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022

Regulation: R18

## POWER SYSTEM PROTECTION

Time: 3 Hours (ELECTICAL AND ELECTRONICS ENGINEERING) Max Marks: 70

Answer FIVE Questions choosing ONE question from each module

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

### MODULE – I

- (a) Explain the phenomenon of current chopping in a circuit breaker. What measures are taken to reduce it? [BL: Understand| CO: 1|Marks: 7]

(b) In a 132kV system, the inductive reactance and capacitance per phase upto the location of the circuit breaker is  $5\Omega$  and  $0.02 \mu\text{F}$  respectively. A resistance of  $500\Omega$  is connected across the contacts of the circuit breaker. Determine its natural frequency of oscillation and damped frequency of oscillation and critical resistance. [BL: Apply| CO: 1|Marks: 7]
- (a) Describe the construction, operating principle and applications of vacuum circuit breaker with a neat sketch. [BL: Understand| CO: 1|Marks: 7]

(b) In a power system the RMS voltage is 38.1kV, L is 10mH and C is  $0.02\mu\text{F}$ . Determine i) Restriking voltage across the circuit breaker ii) Frequency of restriking voltage transient iii) Average rate of restriking voltage up to peak restriking voltage iv) Maximum RRRV [BL: Apply| CO: 1|Marks: 7]

### MODULE – II

- (a) With the help of neat diagram, demonstrate the construction and working of an induction type reverse power or directional power relay. [BL: Understand| CO: 2|Marks: 7]

(b) A relay is connected to 400/5 ratio current transformer with current setting of 150%. Calculate the plug setting multiplier when circuit carries a fault current of 4000A. [BL: Apply| CO: 2|Marks: 7]
- (a) Illustrate with the help of neat diagram the construction of reactance relay. Obtain the conditions for the operation of reactance relay and plot the relay characteristic on R-X plane. [BL: Understand| CO: 2|Marks: 7]

(b) The current rating of an overcurrent relay is 5A. The relay has a plug setting of 150% and time setting multiplier of 0.4. The CT ratio is 400/5. Determine the operating time of the relay for the fault current of 6000A. At TSM =1, operating time at various PSM are given in Table 1. [BL: Apply| CO: 2|Marks: 7]

Table 1

PSM	2	4	5	8	10	20
Operating time in seconds	10	5	4	3	2.8	2.4

**MODULE – III**

5. (a) Interpret the following corresponding to gas insulated substation i) Busbar ii) Earthing switch. [BL: Understand| CO: 3|Marks: 7]
- (b) How substations are classified according to constructional features? Explain an indoor substation layout by drawing key diagram showing all equipment. [BL: Understand| CO: 3|Marks: 7]
6. (a) Summarize the following with respect to grounding i) Arc suppressing coil grounding ii) Reactance grounding. [BL: Understand| CO: 4|Marks: 7]
- (b) Why gas insulated substations are used? Explain an indoor substation layout by drawing key diagram showing all equipment. [BL: Understand| CO: 4|Marks: 7]

**MODULE – IV**

7. (a) What is inter turn fault protection? Outline the various abnormal running conditions which exist in a generator. [BL: Understand| CO: 5|Marks: 7]
- (b) An 11kV,100 MVA alternator is grounded through a resistance of  $5\Omega$ .The CTs have a ratio 1000/5.The relay is set to operate when there is an out of balance current of 1A.What percentage of the generator winding will be protected by the percentage differential scheme of protection. [BL: Apply| CO: 5|Marks: 7]
8. (a) Demonstate with the help of neat diagram the construction and working of Buchholz relay. [BL: Understand| CO: 5|Marks: 7]
- (b) A 3-phase, 11kV/33kV, star-delta connected power transformer is protected by differential protection. The C.Ts the LV side a current ratio of 400/5. What must be C.T's on HV side? [BL: Apply| CO: 5|Marks: 7]

**MODULE – V**

9. (a) Describe the construction and principle of operation of zinc oxide surge arrester? What are its advantages over conventional arresters? [BL: Understand| CO: 6|Marks: 7]
- (b) Explain the term insulation coordination. Describe the construction of volt-time curve and terminology associated with impulse testing. [BL: Apply| CO: 6|Marks: 7]
10. (a) Discuss how a substation and the equipment in the substation are protected from lightening strokes? [BL: Understand| CO: 6|Marks: 7]
- (b) What is a ground wire? List the requirements to be satisfied by ground wires to provide efficient protection to lines against direct lightning stroke. [BL: Apply| CO: 6|Marks: 7]

