



## Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025 High Voltage and Power System Protection

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. What is Paschen's law? How do you account for the minimum voltage for breakdown under a given "pxd" condition? (08 Marks)
- b. Derive an expression for the current in the air gap that is  $I = I_0 e^{\alpha d}$  considering Townsend's first ionization co-efficient. (07 Marks)
- c. In an experiment in a certain gas it was found that the steady state current is  $5.5 \times 10^{-8}$  A at 8 kV at a distance of 0.4 cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1 cm results in a current of  $5.5 \times 10^{-9}$  A. Calculate Townsend's primary ionization coefficient  $\alpha$ . (05 Marks)

**OR**

- 2 a. Explain the following breakdown mechanism in solid:
  - i) Electromechanical breakdown
  - ii) Thermal breakdown. (08 Marks)
- b. Explain briefly suspended particle theory of breakdown in liquid dielectric. (06 Marks)
- c. Explain streamer theory. (06 Marks)

### Module-2

- 3 a. Explain with a neat sketch, how 3-stage cascaded transformer generates HVAC. (08 Marks)
- b. Explain the principle of a resonant transformer. (06 Marks)
- c. With a neat sketch, explain the Marx circuit arrangement for multistage impulse generator. (06 Marks)

**OR**

- 4 a. Explain the principle of operation of an electrostatic voltmeter for measurement of very high dc and ac voltages. (07 Marks)
- b. With a neat sketch, explain the working of Rogowski coil for high impulse current measurement. (06 Marks)
- c. Explain discharge detection using straight detectors for partial discharge measurement. (07 Marks)

### Module-3

- 5 a. Draw the schematic diagram of numerical relay and briefly explain the functions of its various components. (06 Marks)
- b. Briefly explain the essential qualities of a protective relays. (05 Marks)
- c. Derive an expression for torque produced by an induction relay. (09 Marks)

## OR

- 6 a. Explain the various time-current characteristics of over current relays. (08 Marks)  
 b. Discuss a protective scheme for ring main feeders. (06 Marks)  
 c. Explain the operating principle of reverse power or directional relay with neat diagram. (06 Marks)

Module-4

- 7 a. With a neat sketch, explain the principle of operation, torque equation and operating characteristics of impedance relay. (08 Marks)  
 b. Define the term pilot with reference to power line protection. List the different types of wire pilot protection scheme and explain any one of the scheme. (08 Marks)  
 c. Explain the MHO relay characteristics in the R-X diagram. (04 Marks)

## OR

- 8 a. Explain the protection of a generator against:  
 i) Stator inter turn fault  
 ii) Loss of excitation. (08 Marks)  
 b. With schematic diagram, explain balanced (opposed) voltage differential protection. (06 Marks)  
 c. Give notes on frame leakage protection. (06 Marks)

Module-5

- 9 a. Define: i) Restriking voltage ii) Recovery voltage. Derive the expression for restriking voltage and rate of rise of restriking voltage. (10 Marks)  
 b. With the help of neat diagram, explain the working of cross-blast and axial-blast circuit breakers. (10 Marks)

## OR

- 10 a. Explain the lightning phenomena with the help of relevant diagrams. (06 Marks)  
 b. Write short notes on:  
 i) Klydonograph  
 ii) Magnetic link. (06 Marks)  
 c. Explain the term insulation coordination. Describe the construction of volt-time curve and terminology associated with impulse testing. (08 Marks)

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