

2124  
B.E. (Electrical and Electronics Engineering)  
Seventh Semester  
EE-711: Electrical Insulation in Power Apparatus and Systems

Time allowed: 3 Hours

Max. Marks: 50

**NOTE:** Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following:-

- a) Illustrate with examples how dielectric properties influence the selection of insulation materials in power systems.
- b) How is insulation coordination achieved in practice? Provide examples from power system equipment.
- c) Describe the implications of thermal and electrical stresses on insulation integrity.
- d) Define Townsend's first and second ionization coefficients. Explain its criteria for a spark.
- e) Explain why grounding is important in a H.V. laboratory. (5x2)

**UNIT - I**

- II. a) Explain Paschen's law and its implications in designing gas-insulated systems.  
b) Discuss the role of impurities and temperature in liquid breakdown phenomena. (2x5)
- III. a) Describe the ageing mechanisms in dielectric materials. How do they affect the lifespan of insulating materials?  
b) Discuss the significance of streamer theory in the breakdown of gaseous insulators. (2x5)
- IV. a) A cylindrical void in solid insulation has dimensions  $d = 2\text{mm}$ ,  $h = 0.5\text{mm}$ . The relative permittivity of material is 3 and breakdown voltage of air is 30 kV/cm. Calculate the voltage at which partial discharge initiates in the void.  
b) For a 220 kV system, a surge arrester has a residual voltage of 550 kV for a 10 kA lighting impulse. If the basic insulation level (BIL) is 1050kV, determine the safety margin. (2x5)

P.T.O.



(2)

**UNIT - II**

- V. a) Describe the tests performed to evaluate the insulation of power transformers.  
b) Draw Chubb-Fortescue circuit for measurement of peak value of ac voltage. (2x5)
- VI. a) Draw the neat sketch of Vande Graff generator. Explain its working and factors that limit the maximum voltage obtained?  
b) Explain the working principle and applications of electrostatic voltmeters and potential transformers. (2x5)
- VII. a) A cable with a length of 500m has a leakage current of 2mA when tested with a voltage of 10kV. Calculate insulation resistance per unit length.  
b) A capacitive voltage divider consists of  $C_1 = 100\text{pF}$  and  $C_2 = 10\text{pF}$ . If the input voltage is 100 kV, calculate the output voltage across  $C_2$ . (2x5)

x-x-x