

HIGH VOLTAGE ENGINEERING (ELEC 4102)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
 - (i) The line losses are ____ proportional to the transmission voltage.
 - (a) inversely
 - (b) directly
 - (c) not
 - (d) cubically.
 - (ii) The dielectric strength of air under normal conditions is around
 - (a) 30 kV/cm
 - (b) 100 kV/cm
 - (c) 150 kV/cm
 - (d) 60 kV/cm.
 - (iii) Sphere gap voltmeter when measuring a.c voltage, it measures ____
 - (a) RMS value
 - (b) average value
 - (c) peak value
 - (iv) The sparking potential across a spark gap in a gaseous medium is a function of ____
 - (a) the gas pressure alone
 - (b) the gap length alone
 - (c) the ratio of gas pressure to gap length
 - (d) the product of gas pressure and gap length.
 - (v) With the increase in thickness of specimen, breakdown strength
 - (a) increases
 - (b) remains same
 - (c) decreases
 - (d) none of the above.
 - (vi) Suspension type insulator are used for voltage above
 - (a) 11 kV
 - (b) 33 kV
 - (c) 230 kV
 - (d) 400 kV.

- (vii) An Electrostatic voltmeter (ESV) measures ____
 - (a) peak value of a. c voltage
 - (b) rms value of a.c voltage
 - (c) average value of a.c voltage
 - (d) instantaneous value of a.c voltage.
- (viii) The most important factor that affects the electric strength of a liquid dielectric is ____
 - (a) electrode material
 - (b) shape of the enclosure
 - (c) fibrous material
 - (d) moisture.
- (ix) The process responsible for dielectric loss in a dielectric are ____
 - (a) conduction
 - (b) polarization
 - (c) ionization
 - (d) all the above.
- (x) BIL of 33 kV line is
 - (a) 75 kV
 - (b) 125 kV
 - (c) 150 kV
 - (d) none of the above.

Group – B

2. (a) Define voltage gradient and dielectric strength.
- (b) Differentiate between breakdown voltage and dielectric strength.
- (c) The field strength on the surface of 2 cm radius is equal to the Corona-inception gradient in air of 30 kV/cm. Find the charge on sphere which is supposed to be at its centre.

2 + 2 + 3 + 5 = 12

3. (a) The potential field at any point in a space connecting a dielectric material of permittivity 4.5 is given by $\Phi = (4x + 2xy + 3y^2)$ V, where x, y, z are in meters. Calculate the volume charge density at a point p (4, 5, 2).
- (b) Explain why is corona not observed in a uniform field.

8 + 4 = 12

Group – C

4. Define Townsend's first and second ionization coefficients. Explain the Townsends criterion for a spark.
5. (a) Define intrinsic strength of a solid insulating material.

(3 + 3 + 6) = 12

- (b) What are pure liquid dielectrics and how are commercial liquid dielectrics different from them?
- (c) Explain the breakdown in commercial liquid dielectric.

$$2 + (2 + 2) + 6 = 12$$

Group – D

6. (a) Derive the expression of voltage regulation for a Testing Transformer.
- (b) A 550 V/250 kV testing transformer is required to test a cable. The test voltage level is 125 kV and the short-circuit impedance of the transformer is 20%. Calculate the voltage to be applied to the primary to conduct the test.

$$6 + 6 = 12$$

7. Describe the construction, principle of operation and application of a multistage Marx's Surge Generator. Draw its electrical equivalent circuit diagram.

$$(4 + 4 + 2 + 2) = 12$$

Group – E

8. (a) Explain with neat diagram the principle of operation of an Electrostatic Voltmeter.
- (b) Discuss its advantages and limitations for high voltage measurements.
9. (a) Determine the breakdown voltage for air gaps of 2 mm and 12 mm lengths under uniform field and standard atmospheric conditions. Also, determine the voltage if the atmospheric pressure is 750 mm of Hg and temperature 35°C.
- (b) What are the requirements of a sphere gap for measurement of high voltage? Discuss the effect of dust particles on the measurements using sphere gap.

$$(2 + 2 + 2) + (4 + 2) = 12$$