

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI • EXAMINATION – SUMMER • 2014

Subject Code: 160904**Date: 28-05-2014****Subject Name: High Voltage Engineering****Time: 10:30 am - 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) A certain dielectric can be considered to be represented by the equivalent circuit shown in figure Q1(a). What is the maximum voltage that can be applied across the dielectric if partial discharges in air are to be avoided. State any assumptions made. **07**
- (b) Draw and discuss about the layout of high voltage laboratory. **07**
- Q.2** (a) A 200 kVA, 230V/50 kV, 50 Hz, testing transformer has an 8% leakage reactance and a 2% winding resistance. An insulator of capacitance 20 nF is to be tested at 300 kV using this transformer as part of the resonance circuit. Determine the value of the inductance (Q-factor = 15) required to obtain resonance. Determine also the value of the input voltage required. **07**
- (b) Show that the deflecting torque of an electrostatic voltmeter is proportional to the product of the square of the applied voltage and the rate of change of capacitance. Also draw a diagram of Abraham Voltmeter and describe its operation principle. **07**
- OR**
- (b) Explain briefly, with the aid of suitable diagrams, why a potential divider connected at the output of an impulse generator needs to be matched to the cable connecting it to an oscilloscope and how matching may generally be achieved. You may select any specific type of potential divider as an example. **07**
- Q.3** A six-stage impulse generator designed to generate the standard waveform (1.2/50 μ s) has a per stage capacitance of 0.06 μ F to be used to test transformers with an equivalent winding to earth capacitance of 1 nF. A peak output voltage of 550 kV is required for testing the transformer. The wave front time is to be defined based on 30% and 90% values. (a) With the aid of appropriate calculations select the values of the resistive elements in the circuit to produce the required waveform. State any assumptions made. **14**
- OR**
- Q.3** (a) Describe briefly 4 processes by which solid insulation may breakdown below their intrinsic strength. **07**
- (b) Describe with the aid of suitable diagrams how the dielectric loss in a lossy capacitor is measured in comparison with a standard lossless capacitor using the x-y mode in the oscilloscope. Show that the area of the ellipse displayed is proportional to the loss. **07**
- Q.4** (a) In a certain Townsend type discharge, the following measurements were made. **07**
- | | | | | | | | | | | |
|--------|----|----|----|----|----|-----|-----|-----|-----|------|
| d (mm) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
| I (pA) | 25 | 35 | 45 | 60 | 80 | 120 | 180 | 300 | 550 | 2000 |
- Deriving any equations used, determine the Townsend's first and second ionization coefficients.
- (b) Explain why a steep fronted surge waveform is more likely to cause damage to the line end turn insulation of a transformer winding rather than elsewhere, **07**

OR

- Q.4 (a)** A ten stage Cockraft-Walton circuit has all capacitors of 0.06 F. The secondary voltage of the supply transformer is 100 kV at a frequency of 150 Hz. If the load current is 1 mA, determine (i) voltage regulation (ii) the ripple (iii) the optimum number of stages for maximum output voltage (iv) the maximum output voltage. **07**
- Q.4 (b)** Derive an expression for the corona inception in a two conductor system with radius of each conductor r and the spacing between the conductors, d . Also describe the process of stable corona formation by discussing the relationship of the corona radius and electric stress at the corona boundary **07**
- Q.5 (a)** Figure Q5 shows a high Voltage Schering Bridge used in a particular measurement. The values of the components at balance are shown on the diagram. Determine the value of the unknown capacitor and its loss tangent. All necessary equations must be derived. **07**
- (b)** Explain with neat sketches the mechanism of lightning discharge. **07**
- OR**
- Q.5 (a)** A peak reading voltmeter is required to measure voltage up to 150 kV. The peak voltmeter uses an RC circuit, a micro ammeter and a capacitance potential divider. The potential divider has a ratio of 1200 : 1 and the micrometer can read up to 10 A. Determine the value of R and C if the time constant of RC circuit is 8 secs. **07**
- (b)** Discuss the effect of (i) nearby earthed objects (ii) humidity and (iii) dust particles on the measurements using sphere gaps. **07**

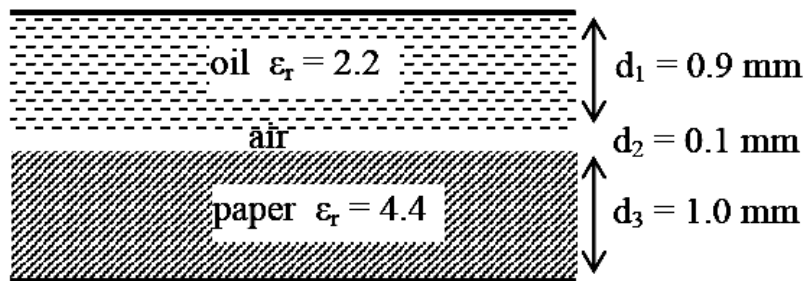


Figure Q1(a)

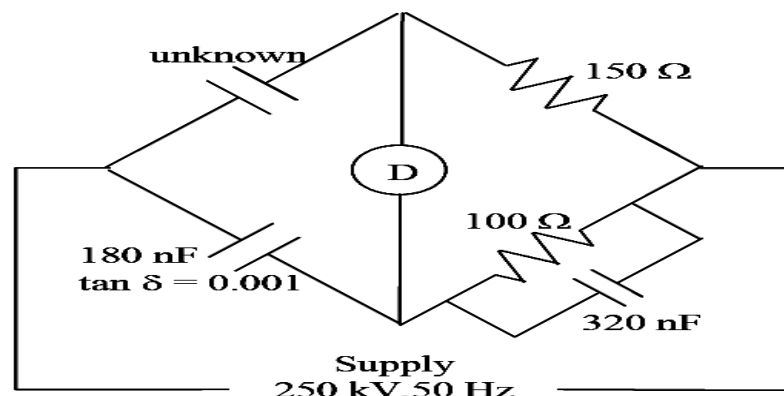


Figure Q5
