BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR

B.E. (EE) 8th Semester Final Examination 2012

Subject: High Voltage Engineering

Paper / Code No: EE – 805/1   Branch: Electrical Engineering

Time: 3 Hours   Full Marks: 70

i)   Answer any SIX questions taking THREE from each half
ii) TWO marks are reserved for neatness in each half

FIRST   HALF

1. a) What are electro-negative gases? Why is the breakdown strength of these gases higher than other gases?   [5]

   b) In a laboratory test on a gas a steady state current of 450 µA was established between two parallel plate electrodes separated by a distance of 0.4 cm when 10kV potential difference is applied between the electrodes. When the separation between electrodes is reduced to 0.25 cm, keeping the applied field constant, the gap current reduces to 50µA. Determine the Townsend's first ionization coefficient (α) from the above test data.   [6]

2. a) Following the Paschen's law, derive the critical (p×d) value and minimum sparking potential (V_{bmin}) for a gas.   [5]

   b) The Paschen's constants for air are A = 12, B = 365 and Townsend's 2nd coefficient γ = 0.02.
      (i) Determine minimum breakdown voltage for air.
      (ii) What distance between the electrodes has to be maintained for breakdown to occur at this voltage when pressure is maintained at 760 Torr?   [6]

3. a) Explain how internal discharge phenomenon can lead to breakdown of solid dielectric   [5]

   b) A solid dielectric specimen having dielectric constant of 4.5 has a rectangular shaped internal void of thickness 1.5 mm at the center of the dielectric. The specimen is 2 cm thick and is subjected to a sinusoidal test voltage of 100 kV (rms). If the void is filled with air and breakdown strength of air is considered as 30 kV(peak) / cm, find the voltage at which internal discharge will occur in the void.   [6]

4. a) Discuss how the design of high voltage testing transformers differs from that of power transformers.   [5]

   b) Draw a 3-stage cascaded transformer assembly for generation of high a.c. voltage and show that the setup can only utilize 50% of its total installed kVA capacity.   [6]

5. a) With the help of a neat diagram, define the front and tail times for a standard lightning impulse wave. What are the tolerances allowed on: i) peak value, ii) front-time and iii) tail-time of the wave? [5]

   b) Draw a schematic diagram of Marx circuit for laboratory generation of impulse voltage and describe the functions of the major components of the generator.

[6]

SECOND HALF

6.a) Justify the use of *sphere gap* method for measurement of A.C high voltage . Is it possible to measure high voltages with a particular size of sphere? Explain the principle of measurement of H.V with sphere gap arrangement. [2+1+3]
   b) Describe the construction of a uniform field spark gap and state its advantages and disadvantages. [3+2]

7.a) Explain, with circuit diagram, *Chubb- Fortescue* method of measurement of peak value of a.c voltages. State its limitation. State the purpose of providing damping resistor in the circuit. [3+2+1]
   b) Explain with a neat diagram how a rod gap can be used for measurement of high voltages. Compare its performance with that of a sphere-gap. [5]

8.a) Why are capacitance dividers used for measurement of EHV andUHV ? State its principle operation . Draw its equivalent circuit and phasor diagram [1+2+3]
   b) What is meant by ISOKERANUNIC level? Describe a lightning stroke which is dangerous and abrupt in nature. [1.5+3.5]

9. State the construction and principle of operation of Resistive divider. State its limitations. Why are high voltage resistances helixed and composed of large number of series resistances. State the limitations of this method. [11]

10.a) State the difference between lightning over voltage and switching over voltages from power system point of view. [4]
   b) State the origin of switching surge and the methods to control switching surges. [3+4]

---X---