Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EE)/SEM-7/EE-704A/2011-12

2011
HIGH VOLTAGE ENGINEERING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Front time of a standard lightning impulse voltage waveshpe is the

      a) time interval between 10% and 90% of the peak value

      b) time interval between 30% and 90% of the peak value

      c) time interval between 5% and 95% of the peak value

      d) 1.25 times the time interval between 10% and 90% of the peak value.

ii) Sphere gap method is used for the measurement of

a) RMS value of AC voltage

b) average value of AC voltage

c) peak value of impulse voltage

d) RMS value of impulse voltage.

iii) Capacitance voltage transformer (CVT) when tuned, does not have

a) Ratio error

b) Temperature error

c) Phase angle error

d) Ratio error and phase angle error.

iv) The minimum breakdown voltage of air in uniform field at NTP is

a) 30 kV/cm b) 300 kV/cm

c) 30 V/cm d) 50 kV/cm.

v) Electrostatic voltmeters can measure

a) only DC voltage

b) only impulse voltage

c) both DC and AC voltages

d) AC, DC and impulse voltages.

vi) All parameters remaining same, the breakdown voltage is

a) lower with negative polarity at all pressures

b) higher with negative polarity at all pressures

c) higher with negative polarity at low pressures

d) same for both positive and negative polarities, at all pressures.

vii) Townsend's ionization co-efficients α, γ are functions of

a) applied voltage

b) pressure and temperature

c) electric field

d) ratio of electric field to pressure.

viii) A trigatron gap is used with

a) *dc* voltage doubler circuit

b) cascade transformer unit

c) impulse voltage divider

d) impulse voltage generator.

ix) Most of the insulation failures of solid dielectrics in high voltage system is due to

a) Intrinsic breakdown

b) Electromechanical breakdown

c) Thermal breakdown

d) Chemical breakdown.

x) The Chubb-Fortescue peak-reading voltmeter cannot measure the peak voltage correctly if the voltage wave-form

a) is sinusoidal

b) is non-sinusoidal

c) has two half cycles that are not identical

d) none of these.

xi) A standard 1.2/50μs lightning impulse wave can be mathematically represented by

a) an exponentially decaying function

b) a double-exponential function

c) an exponentially growing function

d) a logarithmic function.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Justify or correct the following statement with appropriate reasoning : "In a multistage impulse generator, the spark-gap distances are arranged in increasing order."

3. Give labelled diagrams for the equivalent circuit and the phasor diagram (under resonance condition) for a capacitive voltage transformer.

4. What are the advantages of series resonant circuit over testing transformer ?

5. Explain in brief the theory of corona formation.

6. Draw a voltage doubler circuit for generating high *dc* voltages, and explain is functioning.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) How are the wave-front and the wave-tail times controlled in impulse voltage generator ?

   b) An impulse voltage generator has 12 stages, with each capacitor rated at 0.12 μF and 200 kV. The wave-front and the wave-tail resistances are 1.25 kΩ and 4 kΩ respectively. If the load capacitance including that of the test object is 10 nF, find the wave-front and the wave-tail times and the peak voltage of the impulse wave generated. 8 + 7

8. Point out the problems encountered when designing potential dividers for high voltage impulse measurements, using CRO. Explain how the problems may be minimized by using mixed R-C potential dividers. What is meant by L-peaking in the low voltage arm of the divider ? 6 + 7 + 2

9. a) Give a neat well-labelled schematic diagram for cascade connection of transformers for *ac* high voltage generation. Explain its operation.

   b) Discuss the advantages and limitations of electrostatic voltmeters for high voltage measurement. 10 + 5

10. a) Explain the methodology for lightning impulse testing of high voltage transformers.

    b) Explain the following terms with reference to high voltage testing :

        (i) Withstand voltage

        (ii) Wet and dry power frequency tests. 10 + (2 + 3)

11. Write short notes on the following : 3 × 5

    a) Time-lag for breakdown of gases

    b) Streamer theory of breakdown in gases

    c) Paschen's law.