



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.*

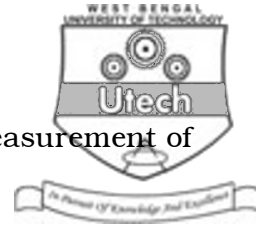
*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

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

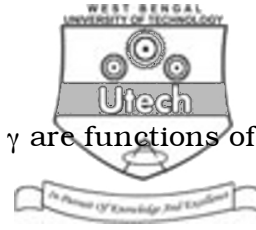
- i) Front time of a standard lightning impulse voltage waveshape is the
  - a) time interval between 10% and 90% of the peak value
  - b) time interval between 30% and 90% of the peak value
  - c) time interval between 5% and 95% of the peak value
  - d) 1.25 times the time interval between 10% and 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  $\alpha$ ,  $\gamma$  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  $1.2/50\mu\text{s}$  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.  $3 \times 5 = 15$

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 its functioning.



**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

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  $0.12 \mu\text{F}$  and 200 kV. The wave-front and the wave-tail resistances are  $1.25 \text{ k}\Omega$  and  $4 \text{ k}\Omega$  respectively. If the load capacitance including that of the test object is  $10 \text{ nF}$ , 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.

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