SPECIAL SUPPLE B.TECH/EE/7TH SEM/ELEC 4102/2018

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) Liquids with solid impurities will have
(a) higher dielectric strength
(b) lower dielectric strength with negative polarity at all pressure
(c) higher dielectric strength with negative polarity at all pressure
(d) none of the above.

(ii) Identify the material with highest electric strength at identical condition
(a) Air at NTP (b) Transformer oil at NTP
(c) Paper without impregnation (d) Asbestos.

(iii) The process of ionization is brought about by
(a) positive ions only (b) photons only
(c) metastable only (d) all the above.

(iv) The accepted value of the dielectric strength of transformer oil is
(a) 30 kV/cm for one minute (b) 30 kV
(c) 30 kV/cm (d) 30 V/cm.

(v) Space charge-field is responsible for breakdown in
(a) Townsend's theory (b) Streamer's theory
(c) Paschen's theory (d) none of these.

(vi) Capacitance voltage divider cannot be used for measuring high
(a) A.C voltage (b) D.C voltage
(c) impulse voltage (d) all of these.

(vii) Conduction in vacuum is due to
- (a) presence of metallic electrodes
- (b) presence of insulating surface
- (c) both (a) & (b)
- (d) none of the above.

(viii) The most important factor that affects the electric strength of a liquid dielectric is the presence of
- (a) electrode material
- (b) shape of the enclosure
- (c) fibrous material
- (d) moisture.

(ix) The mechanism responsible for dielectric loss in a dielectric is/are
- (a) conduction
- (b) polarization
- (c) ionization
- (d) all the above.

(x) Loss-tangent of dielectric used in a cable when capacitance C and resistance R are imagined in series is
- (a) ωCR
- (b) $^1/_{\omega CR}$
- (c) $\omega^2 CR$
- (d) $^{\omega}/_{CR}$

Group – B

2. (a) A point charge of 1μC is kept on the surface of a conducting sphere of radius r = 1 cm, which can be considered as point charge at the centre of the sphere. Calculate the field and potential at a distance of 0.5 cm from the surface of the sphere. Also find the capacitance of the sphere.

(b) What is a return stroke? Sketch a typical lightning current wavefrom.

(4 + 3 + 2) + (2 + 1) = 12

3. (a) The electric flux density in free space is given by $\vec{D} = e^{-y}(\cos x\vec{i} - \sin x\vec{j})$. Prove that the field region is charge free.

(b) State the experimental facts leading to Simpson's theory on charge generation on a cloud.

5 + 7 = 12

Group – C

4. State and explain Paschen's law. Derive expressions for $(pd)_{min}$ and V_{bmin}.

(2 + 2 + 5 + 3) = 12

5. What are partial discharges? Differentiate between internal and external discharges. Develop and draw equivalent circuit of insulating material during partial discharge?

(2 + 4 + 4 + 2) = 12

Group – D

6. What is Cascaded transformer? Explain why Cascading is done? Describe with net diagram a three stage Cascaded transformer. Label the power rating of various stages of the transformer.

(2 + 3 + 5 + 2) = 12

7. (a) Explain with the help of a schematic diagram the working of a Cockroft-Walton voltage multiplier circuit.

   (b) Find the expression for ripple in output voltage.

8 + 4 = 12

Group – E

8. (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 Hg and temperature is 350^0 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

9. Draw and discuss Chubb-Fortescue Circuit for measurement of peak value of A.C voltages and discuss its advantages over other methods.

(3 + 6 + 3) = 12