

B.E. Seventh Semester (Electrical Engineering) (C.B.S.)  
**High Voltage Engineering**

P. Pages : 2

Time : Three Hours



**NKT/KS/17/7465**

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Due credit will be given to neatness and adequate dimensions.
  9. Assume suitable data whenever necessary.
  10. Use of non programmable calculator is permitted.

1. a) Explain the streamer theory of breakdown in air at atmospheric pressure. **6**  
b) Explain thermal breakdown in solid dielectrics and how it is more significant than other breakdown mechanisms. **7**

**OR**

2. a) What is Townsend's breakdown criterion? Enumerate the limitations of Townsend's criterion. **6**  
b) A solid dielectric specimen of dielectric constant 3 has an internal void of 1.5 mm thickness. The specimen is 10 mm thick and it is subjected to a voltage 80 kV (RMS). If the void is filled with air and the breakdown strength of air is 30 kV (peak)/cm, find the voltage at which internal discharge take place. **7**
3. a) Explain the effect of sudden load rejection on power frequency over voltages. **6**  
b) What is the difference between gap type and gapless type lightning arrestors? Explain with suitable example. **7**

**OR**

4. a) Explain the phenomenon of lightning in detail. **6**  
b) Write short note on- **7**  
i) Rod gaps used as protective devices  
ii) Surge absorber.
5. a) Derive the expression for the voltage and current waves on long transmission lines and obtain the surge impedance of the line. **7**  
b) An underground cable of inductance 0.189 mH/Km and of capacitance 0.3  $\mu$ F/Km is connected to an overhead line having an inductance of 1.26 mH/Km and capacitance of 0.09  $\mu$ F/Km. Calculate the transmitted and reflected voltage and current waves at the junction, if a surge of 200 kV travels to the junction, **7**  
i) Along the cable, and  
ii) Along the overhead line.

**OR**

6. a) A 3-phase single circuit transmission line is 400 Km long. If the line is rated for 220 kV and has the parameters,  $R = 0.1$  ohms/Km,  $L = 1.26$  mH/Km,  $c = 0.009$  nF/Km, and  $G = 0$ , find (a) the surge impedance and (b) the velocity of propagation neglecting the resistance of the line. If a surge of 150 kV and infinitely long tail strikes at one end of the line, what is the time taken for the surge to travel to the other end of the line? 7
- b) Explain the behaviour of travelling waves with voltage and current waveforms for open ended transmission line. 7
7. a) Why a Cockcroft-Walton circuit preferred for voltage multiplier circuits? Explain its working with a schematic diagram. 7
- b) A Cockcroft-Walton type voltage multiplier has eight stages with capacitances, all equal to 0.05 pF. The supply transformer secondary voltage is 125 kV at a frequency of 150 Hz. If the load current to be supplied is 5 mA, find
- i) The percentage ripple, ii) The regulation, and
- iii) The optimum number of stages for minimum regulation and voltage drop. 7
8. a) Explain the cascaded connection of transformers for producing very high a.c voltages. 7
- b) A 100 kV A, 400 V/ 250 kV testing transformer has 8% leakage reactance and 2% resistance on 100 kVA base. A cable has to be tested at 500 kV using the above transformer as a resonant transformer at 50 Hz. If the charging current of the cable at 500 kV is 0.4 A, find the series inductance required. Assume 2% resistance for the inductor to be used and the connecting leads. Neglect dielectric loss of the cable. What will be the input voltage to the transformer? 7
9. a) Describe the generating voltmeter used for measuring high d.c voltages. How does it compare with a potential divider for measuring high d.c voltages? 8
- b) A generating voltmeter has to be designed so that it can have a range from 20 to 200 kV d.c. If the indicating meter reads a minimum current of 2  $\mu$  A and maximum current of 25  $\mu$  A, what should be the capacitance of the generating voltmeter be? 5

**OR**

10. a) Explain the different methods of high current measurement with their relative merits and demerits. 7
- b) What is capacitance voltage transformer? Explain with suitable diagrams how it can be used for voltage measurements in power systems. 6
11. a) The capacitance and loss angle of the above specimen were measured using the same electrode set-up. The capacitance and  $\tan \delta$  with the specimen are 147  $\mu$ F and 0.0012 respectively. The air capacitance of the electrode system was 35 pF. What is the dielectric constant and complex permittivity of Bakelite? 6
- b) Explain the transformer voltage ratio arm bridge for audio frequency range measurements. Discuss its merits and demerits over other methods. 7

**OR**

12. a) Discuss in short the terms normally used with partial discharge phenomenon. 6
- b) The volume resistivity of a Bakelite piece was determined by using standard circular electrodes, a sensitive galvanometer, and a stabilized power supply. When the applied voltage was 1000 V, the galvanometer deflection with the specimen was 3.2 cm. When a standard resistance of  $R_s = 10$  M $\Omega$  is used for calibration, the deflection was 33.30 cm with a universal shunt ratio of 3,000. The diameter of the electrodes is 10 cm, and the thickness of the specimen is 2mm. Find the volume resistivity. 7

\*\*\*\*\*