Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, Dec.2024

DEPARTMENT OF ELECTRICAL AND ELECRONICS ENGINEERING
Semester VII
EE5703 HIGH VOLTAGE ENGINEERING
(Regulation 2019)

Time: 3hrs Max.Marks: 100

| | |
|---|---|
| CO 1 | To teach over voltage phenomenon and insulation coordination in electrical Power systems |
| CO 2 | To impart knowledge on breakdown mechanisms of different dielectrics |
| CO 3 | To learn about high voltage and high current generation techniques |
| CO 4 | To teach the different measurements techniques of high voltages & currents |
| CO 5 | To learn how to conduct dielectric tests on various electrical equipment and about safety precautions in HV Labs |

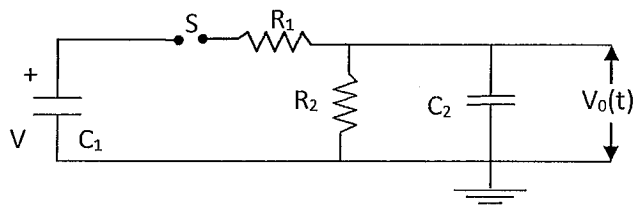
**BL – Bloom's Taxonomy Levels**
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

## PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1 | What are the effects of over voltages on power system? | 2 | CO1 | L2 |
| 2 | Define reflection co-efficient of travelling waves. | 2 | CO1 | L1 |
| 3 | Enlist the different ionization process in gaseous dielectrics | 2 | CO2 | L2 |
| 4 | Indicate the solid insulation application in power cables and HV bushings. | 2 | CO2 | L3 |
| 5 | Give the schematic diagram of a 3 stage cascaded Transformer with isolation transformer connection. | 2 | CO3 | L1 |
| 6 | An 8-stage impulse generator has 0.10μF capacitors. The wave front and the wave tail resistances connected are 450Ω and 3200Ω respectively. If the load capacitor is 200pF, find the front and tail time of the impulse wave produced. | 2 | CO3 | L3 |
| 7 | Derive an expression for the attractive force between the electrodes of an Electrostatic voltmeter | 2 | CO4 | L3 |
| 8 | How digital techniques improve the quality of high voltage measurement? | 2 | CO4 | L4 |
| 9 | Define an impulse voltage waveform as per IS2071. | 2 | CO5 | L1 |
| 10 | Calculate the atmospheric correction factors if the laboratory temperature is $34^0$ C, atmospheric pressure is 750 mmHg and the wet bulb temperature is $25^0$ C. | 2 | CO5 | L3 |

## PART- B (5 x 13 = 65 Marks)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 11 (a) | Explain with relevant case studies the causes, characteristics and protection of switching over-voltages. | 13 | CO1 | L3 |
| | OR | | | |
| 11 (b) (i) | Explain the effect of overvoltage due to indirect lightning strokes. | 5 | CO1 | L3 |
| (ii) | Explain in detail with suitable figures, the functioning of expulsion gaps and protector tubes | 8 | CO1 | L3 |

| | | | | |
|---|---|---|---|---|
| 12 (a) | From the fundamental gas laws , obtain an expression for gaseous breakdown criteria. | 13 | CO2 | L3 |
| | OR | | | |
| 12 (b) | With relevant theories , explain the various breakdown mechanism of liquid dielectrics. | 13 | CO2 | L3 |
| 13 (a) (i) | Explain the working of a multistage voltage doubler circuit. | 6 | CO3 | L4 |
| (ii) | Derive the expression for optimum number of stages of a Cockcroft Walton Voltage multiplier circuit. | 7 | CO3 | L4 |
| | OR | | | |
| 13 (b) | Analyze the circuit given below and hence derive an expression for $V_o(t)$   | 13 | CO3 | L4 |
| 14 (a) | Explain in detail the different measurement techniques adopted in High DC voltage measurements. | 13 | CO4 | L4 |
| | OR | | | |
| 14 (b) (i) | With equivalent circuit, explain how capacitance potential dividers are used for high voltage impulse measurements. | 7 | CO4 | L4 |
| (ii) | Explain in detail how vertical sphere gaps are used for peak voltage measurements in Laboratory | 6 | CO4 | L4 |
| 15 (a) | Explain the testing of a 11 kV/415 V distribution transformer as per IS 2026 clause 13. What are the expected faults. | 13 | CO5 | L4 |
| | OR | | | |
| 15 (b) | As per relevant standard , explain the dielectric testing of a 11 kV polymeric insulator. | 13 | CO5 | L4 |

**PART- C (1 x 15 = 15 Marks)**
(Q.No.16 is compulsory)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 16. (i) | A Rogowski coil is to be designed to measure impulse currents of 10 kA having a rate of change of current of 1011 A/s. The current is read by a VTVM as a potential drop across the integrating circuit connected to the secondary. Estimate the values of mutual inductance, resistance, and capacitance to be connected, if the meter reading is to be 10 V for full-scale deflection. | 9 | CO4 | L5 |
| (ii) | Design an indoor medium sized high voltage laboratory with the safety precautions to be adopted as per Indian standard. | 6 | CO5 | L6 |