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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, December 2023

DEPARTMENT OF ELECTRICAL AND ELECTRONICS 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 is the significance of BIL in power system studies  | 2     | CO1 | L2 |
| 2     | Give the mathematical model for lightning discharges.  | 2     | CO1 | L2 |
| 3     | Define the Townsend's second ionization co-efficient   | 2     | CO2 | L1 |
| 4     | A solid specimen of dielectric has a dielectric constant of 4.2 and $\tan\delta=0.001$ at a frequency of 50Hz. If it is subjected to an alternating field of 50kV/cm, calculate the heat generated in the specimen due to the dielectric loss. | 2     | CO2 | L5 |
| 5     | Enlist the advantages of high frequency transformers.  | 2     | CO3 | L2 |
| 6     | Draw an impulse voltage waveform with tolerances as per IS standard.   | 2     | CO3 | L1 |
| 7     | Give the different methods adopted for measuring high impulse currents.  | 2     | CO4 | L3 |
| 8     | How digital techniques improve the quality of high voltage measurements?   | 2     | CO4 | L4 |
| 9     | Calculate the atmospheric correction factors if the dry bulb temperature is 32° C, atmospheric pressure is 750 mmHg and the wet bulb temperature is 25° C  | 2     | CO5 | L5 |
| 10    | Distinguish between type test and routine test.  | 2     | CO5 | L2 |

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

| Q. No      | Questions  | Marks | CO  | BL |
|------------|--|-------|-----|----|
| 11 (a) (i) | Explain with relevant theories the mechanism of lightning discharges.                  | 6     | CO1 | L2 |
| (ii)       | Explain the protection schemes against lightning over voltages.                        | 7     | CO1 | L3 |
| <b>OR</b>  |  |       |     |    |
| 11 (b) (i) | Explain the causes and effect of overvoltage due to switching surges in power systems. | 6     | CO1 | L2 |
| (ii)       | Explain the protection schemes against switching over voltages                         | 7     | CO1 | L3 |

|            |   |    |     |    |
|------------|---|----|-----|----|
| 12 (a)     | From Fundamental gas Laws derive an expression for Paschen's curve.   | 13 | CO2 | L3 |
| <b>OR</b>  |   |    |     |    |
| 12 (b)     | With relevant theories , explain the various breakdown mechanism of solid dielectrics.  | 13 | CO2 | L3 |
| 13 (a) (i) | Explain the working of a multistage cascaded transformer and derive its equivalent circuit parameters.  | 8  | CO3 | L2 |
| (ii)       | An impulse generator has 8 stages with each condenser rated for 0.16 $\mu$ F and 125kV. If the load capacitance is 1000 pF. Find the series resistance and damping resistance needed to produce 1.2/50 $\mu$ s impulse wave. What is the maximum output voltage of the generator if the charging voltage is 120 kV? | 5  | CO3 | L5 |
| <b>OR</b>  |   |    |     |    |
| 13 (b) (i) | Explain the principle of operation of Cockraft-Walton voltage doubler circuit   | 8  | CO3 | L2 |
| (ii)       | Determine the ripple and regulation of a 10 stage Cockraft-Walton voltage doubler circuit having a stage capacitance=0.01 $\mu$ F. Supply voltage =100kV at a frequency of 400 Hz and a load current =10mA  | 5  | CO3 | L5 |
| 14(b) (i)  | Discuss in detail the requirements of a sphere gaps for measurement of high voltages.   | 7  | CO4 | L4 |
| (ii)       | Differentiate the measurement techniques for peak voltage measurement in (a) AC voltage and (b) Impulse voltage   | 6  | CO4 | L4 |
| <b>OR</b>  |   |    |     |    |
| 14 (b)     | Explain with equivalent circuits ,the different potential dividers used in high voltage measurements.   | 13 | CO4 | L4 |
| 15 (a)     | As per relevant standard, explain the dielectric testing of 11 kV polymeric insulator.  | 13 | CO5 | L4 |
| <b>OR</b>  |   |    |     |    |
| 15 (b)     | As per relevant standard , explain the testing of a 11 kV/400 V distribution transformer  | 13 | CO5 | L4 |

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

| Q. No   | Questions   | Marks | CO  | BL |
|---------|---|-------|-----|----|
| 16. (i) | An underground cable of 0.18 mH/km inductance and of 0.5 $\mu$ F/km capacitance is connected to an overhead line having an inductance of 1.26 mH/km and capacitance of 0.009 $\mu$ F/km. Calculate the transmitted and reflected voltage waves, and the junction voltage if the surge of 500 kV travels to the junction (i) along the cable, and (ii) along the overhead line | 15    | CO1 | L6 |

