B.E. ELECTRICAL ENGINEERING EXAMINATION, 2024

(4th Year, 2nd Semester)

HIGH VOLTAGE TECHNIQUE - II

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-I

Answer all questions

(Two marks are reserved for neatness and well organized answers)

1. a) Explain the operation of (i) Expulsion Tube Lightning Arrestor and (ii) Gapless Lightning Arrestor. (CO2) **8**

   b) Explain the following terms related to surge diverters. **8**
   Discharge Current; Discharge Voltage (or Residual voltage); Power frequency spark over voltage; Impulse spark over voltage. (CO2)

or

   a) Explain the following terms related to insulation co-ordination. **8**
   Effectively Earthed System; Insulation Level; Statistical Impulse Voltage; Rated Short Duration Power Frequency Withstand Voltage. (CO2)

   b) A transformer has an impulse insulation level of 1000 kV and is to be operated with an insulation margin of 14% under lightning impulse conditions. The transformer has a surge impedance of 1400 Ω and is connected to a transmission line having a surge impedance of 450 Ω. A short length of overhead earth wire is to be used for shielding the line near the transformer from direct strikes. Beyond the shielded length, direct strokes on the phase conductor can give rise to voltage waves of the form $1000\ e^{-0.06t}$ kV (where t is expressed in μs). If the corona distortion in the line is represented by the expression $\frac{\Delta t}{x} = \frac{1}{B}\left[1 - \frac{e_0}{e}\right]$ μs/ m , where B = 105 *m/μs* and e_0 = 220 kV, determine the minimum length of shielding wire necessary in order that the transformer insulation will not fail due to lightning surges. (CO2) **8**

2. Describe the experimental procedure to perform the wet power frequency voltage withstand test of a line insulator according to IS 731. Explain the condition of the insulators, the method of supporting the insulator, and the correction factor associated with this experimental setup. (CO3) **16**

or

Describe the chopped lightning impulse voltage withstand test performed on transformers and answer the questions (i) to (iv) associated with this test. (CO3) **16**

   i) Connection of this test setup with neat diagram

   ii) Sequence of application of impulse voltages

iii) Necessity of application of chopped impulses

iv) Detection of failure after chopped lightning impulse test

3. a) Describe with the help of a schematic how polarization and depolarization current (PDC) measurement can be performed on transformers. (CO3)   8

  b) What is recovery voltage measurement? Explain the concept of recovery voltage spectra and central time constant. (CO3)   8

or

 . a) Describe in brief the basic theory of Frequency Domain Spectroscopy method (CO3)   8

  b) A lightning arrestor is required to protect a 5 MVA, 66/11 kV transformer which is effectively earthed in the system. The transformer is connected to a 66 kV, 3 phase system which has a BIL of 350 kV. Select a suitable lightning arrestor. (CO2)   8

Ex/EE/PE/B/T/421B/2024

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2024

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Time: Three Hours   Full Marks: 100

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PART-II

Answer *any three* questions

Two Marks are reserved for neat and well-organized answer script

Assumption of suitable values wherever required carries weightage

1. a) Compare different types of grounding systems in a High Voltage Laboratory with proper schematics.   7

   b) Which type of grounding would you prefer for a high voltage laboratory?   3

   c) List the common test facilities that are required to be provided in a typical high voltage laboratory.   6

2. a) Explain the modern type of triggering arrangement of a high voltage impulse generator with proper illustration. Show the output waveform and the average current consumption.   8

   b) The high voltage arm of a resistance-capacitance type high voltage divider has fifteen 120 ohms resistors with 20 pF capacitors to ground from each of the junction points. The low voltage arm resistance is 5 ohms. Determine the capacitance needed in the low voltage arm for correct compensation. Draw the distributed network and approximate equivalent circuit.   8

3. a) Describe a technique of high voltage impulse measurement where the photographic method can be used. Explain how both the magnitude and polarity of a high voltage impulse can be ascertained using this method.   5+5

   b) How can a Lichtenberg pattern can be utilized in a decorative medium? Provide proper sketches.   6

[Turn over

4. a) Is it possible to measure high voltage DC without any direct contact between the voltage source and the measuring instrument? Explain your answer with proper justifications. 2+8

   b) A non-contact voltage measuring instrument with a six-pole synchronous motor drive has to be designed so that it can have a range of 20-200 kV DC. If the indicating meter reads a minimum current of 2 μA, what should be the capacitance of the instrument? Also, give the maximum range of the indicating instrument. 6

5. Show how the capacitance and dielectric dissipation factor can be evaluated in a high voltage Schering bridge in the case of a grounded capacitor with proper derivation. Draw the schematic. 16

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