BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) 3ʳᵈ YEAR 2ⁿᵈ SEMESTER EXAMINATION, 2019

HIGH VOLTAGE ENGINEERING

Time: Three hours   **Full Marks: 100**
                                                  (50 marks for each part)
              Use a separate Answer - Script for each part.

Part I
Answer *any three* questions.
Two marks are reserved for neat and well organized answers.

1. a)   State the advantages of suspension insulators. Define string efficiency.   4

   b)   State the advantages of glass insulators.   3

   c)   There is a string of 5 identical disc units, each of which can be subjected to a   3+3+3
        power frequency voltage of 30 kV (peak) safely. If the ratio of the pin to earth
        capacitance to the self – capacitance of each disc is 0.17, find the permissible
        string voltage, permissible line voltage and string efficiency.

2. a)   Arcing horns protect the insulators from damage due to flashover - justify.   4

   b)   Corona is a self-checking process – explain.   4

   c)   A three phase 220 kV, 50 Hz, 150 km long overhead line consists of three   8
        conductors, each of 1.05 cm radius spaced 5 m apart in equilateral formation.
        Assuming an irregularity factor of 0.9, calculate corona power loss. Given
        temperature = 27^0c and pressure = 740 mm of Hg. Deduce the expression for
        V_d.

3. a)   Comment on mechanism of lightning discharge.   5

   b)   An overhead transmission line having a surge impedance of 450 Ω runs   7
        between two substations A and B; at B it branches into two lines C and D, of

surge impedances of 400 Ω and 50 Ω respectively. If a traveling wave of magnitude 50 kV travels along the line AB, calculate the magnitude of voltage and current waves which enters the line C and D. Deduce the formulae those have been used.

c) Explain what you mean by direct and indirect lightning strikes. 4

4. a) State why solidly grounded system is not very popularly used in practice. 3

b) A transmission line has a capacitance of 0.1 μF per phase. Determine the inductance of Peterson coil to neutralize the effect of capacitance of (i) complete length of line, (ii) 97% of the line and (iii) 90% of the line. Supply frequency is 50 Hz. Deduce the formula you have used. 9

c) Explain what you mean by insulation co-ordination. 4

5. a) Discuss how ground wire protects line conductors from damage due to lightning overvoltage. 4

b) Explain the working principle of a gas filled protector tube. 4

c) In a co-axial cable the conductor diameter is 10 mm and the inner sheath diameter is 50 mm. There are two layers of insulation, the inner layer with dielectric constant 4 and a maximum working gradient of 6 kV/mm has a radial thickness of 4.6 mm; the outer layer has dielectric constant 2.5 and the maximum voltage gradient 5 kV/mm. Calculate the maximum working voltage for the cable. 8

Ex/EE/5/T/322/2019

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING (EVENING) EXAMINATION, 2019

(3rd Year, 2nd Semester)

HIGH VOLTAGE ENGINEERING

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-II

Answer any _three questions_

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

1. a) With the help of a schematic, explain the working principle of a Cockcroft-Walton voltage doubler circuit. Find the expression of output voltage.   10

   b) A Cockcroft-Walton voltage doubler circuit is used to test a cable at 150 kV. The insulation resistance of the cable is $2 \times 10^7 \Omega/m$ and the length of the cable is 15 m. Stage capacitances are 0.15 µF and 0.20 µF respectively. The doubler is supplied from a 300V/250 kV testing transformer. Calculate the voltage to be applied to the input of the transformer at 50Hz.   6

2. a) Give comparative analysis between a high voltage power transformer and a high voltage testing transformer.   6

   b) With a neat sketch, explain the principle of a three-stage cascade connection in testing transformer for producing high ac power frequency voltage. Why the lowest unit is loaded more?   10

3. a) Draw the circuit diagram of a peak voltmeter that contain a bleeder resistance. Describe the principal of operation of such a peak voltmeter and discuss about the errors associated with peak voltage measurement.   10

   b) With a neat sketch, explain the operation of Electrostatic voltmeter   6

4. a) With a neat sketch explain the operation of a multi stage impulse generator circuit.   8

   b) Discuss the functions of damping and discharge resistance in an impulse voltage generator.   3

   c) Why triggering is required in an impulse voltage generator? Describe a typical triggering arrangement for the same.   5

[Turn over

5. a) With the help of circuit and phasor diagrams explain why capacitive voltage transformers are used in resonant condition. 8

   b) Explain with a neat sketch the operation procedure of a vacuum tube diode. 4

   c) Why series resonance circuit is advantageous for high voltage testing of cables? 4