BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) THIRD YEAR SECOND SEMESTER
Examination 2023

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) Mention the advantages and disadvantages of HVDC Transmission.   4

 b) Explain why the voltages across the individual discs in a string of suspension insulators are not equal. With reason, suggest one practical method of improving the voltage distribution across the discs.   2+4

 c) In a string of five identical disc units, each disc can be subjected to a power frequency voltage of 30 kV (peak) safely. If the ratio of the pin to earth capacitance to that of self-capacitance of each disc is 0.17, find the voltage of the three–phase system which can be safely insulated by this string. Calculate string efficiency.   4+2

2. a) Arcing horns protect the insulators from damage due to flashover - justify.   3

 b) Mention the effects that are associated with corona formation. Justify the statement - corona is a self-checking process.   6

 c) A three phase 220 kV, 50 Hz transmission line has conductors spaced in 5 meters at the corners of a delta. Each conductor has a radius of 1 cm with surface irregularity factor of 0.92. Weather conditions are: temperature 40^0C and pressure 75.2 cm of Hg. Find the corona loss/km of the transmission line if there is an over voltage of 1.8 p.u. For a surface correction factor of 0.82 calculate visual corona voltage.   7

[Turn over

3. a) Discuss the behaviour of a travelling wave when it reaches the end of a (i) open circuited transmission line (ii) short circuited transmission line.   3+3

    b) 'Low tower footing resistance reduces the chance of back flashover' – explain with example.   6

    c) With the help of a neat diagram explain the working principle of a protector tube.   4

4. a) State the limitation of solidly grounded system. Explain what is meant by insulation co-ordination.   3+4

    b) Explain in brief what do you mean by arcing ground phenomenon.   3

    c) A 33 kV, 50 Hz network has the capacitance to neutral of 1.0 μF per phase. Calculate the value of the inductance that is to be added to prevent the arcing ground condition. Draw the phasor diagram.   6

5. a) With help of a neat diagram explain the stress distribution in a bushing. State how stress distribution improves in a condenser bushing.   3+3

    b) State why three core belted cables are not used beyond 22kV.   3

    c) Explain the process of void formation and cable breakdown.   7

Ex/EE/5/T/322/2023

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION, 2023

(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 reserved for neatness and well organized answers)

1. a) Give a 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 a.c. power frequency voltage. Why the lowest unit is loaded more?   10

2. a) Draw a two stage symmetric voltage multiplier circuit for HVDC generation and explain the principle of its operation.   4+4

   b) A Cockcroft-Walton voltage doubler circuit is used to test a cable at 180 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 0.1 μF and 0.15 μF respectively. The doubler is supplied from a 500V/250kV testing transformer. Calculate the voltage to be applied to the input of the transformer at 50Hz.   8

3. a) Draw the circuit diagram of a peak voltmeter that contain a bleeder resistance. Describe the principle of operation of such a peak voltmeter and discuss about the errors associated with peak voltage measurement.   9

   b) With a neat sketch explain the operation of electrostatic voltmeter.   7

4. a) Briefly discuss about the operation of a multi stage impulse generator circuit with a neat sketch.   8

   b) Discuss the functions of damping and discharge resistor 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

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