

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) THIRD YEAR SECOND SEMESTER 2024
High Voltage Engineering

Time: Three hours

Full Marks 100
(50 marks for each part)

Part - I

Use a separate Answer-Script for each part.

Answer any three questions.

Two marks are reserved for well organized answers.

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| 1.a) | State the advantages of glass insulators. Define string efficiency. | 4 |
| 1.b) | Define creepage and protected creepage distance and mention their significances. | 2+2 |
| 1.c) | Each conductor of a 33 kV, 3 – phase system is suspended by a string of three similar insulators, the mutual capacitance of which is 9 times the shunt capacitance between each unit. Calculate the voltage across each insulator and also the string efficiency. | 8 |
| 2.a) | Arcing horns protect the insulators from damage due to flashover - justify. | 3 |
| 2.b) | Mention the effects that are associated with corona formation. Justify the statement - corona is a self-checking process. | 3+3 |
| 2.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°C 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 the visual corona voltage. | 7 |
| 3.a) | Explain the phenomenon of lightning. Also explain the terms direct and indirect lightning strokes. | 6+2+2 |
| 3.b) | Explain what you mean by arcing ground. With the help of circuit diagram and phasor diagram explain the working of Peterson coil. | 6 |

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- 4.a) With the help of volt-time characteristics, explain the insulation co-ordination of substation equipment. 4
- 4.b) Explain what you mean by 'back - flashover'. With the help of an example show that low value of tower footing resistance reduces the chance of occurring back flashover. 3+5
- 4.c) State how the use of grading ring improves the string efficiency. 4
- 5.a) State the requirements of EHV cables. 3
- 5.b) Find out the general expression of surge impedance and hence find the surge impedance in the case of transmission line. 6
- 5.c) An overhead transmission line with surge impedance 500Ω bifurcates into two lines of surge impedance 500Ω and 50Ω respectively. If a surge of 25 kV is incident on the overhead line, determine the magnitudes of voltage and current which enter the bifurcated lines. 7

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(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 properly labelled Cockcroft-Walton voltage doubler circuit and explain its principle of operation under loaded condition. 3+5
- b) A Cockcroft-Walton voltage doubler circuit is used to test a cable at 160 kV. The insulation resistance of the cable is $3 \times 10^7 \Omega/m$ and the length of the cable is 12 m. Stage capacitances are 0.11 μF and 0.12 μF respectively. The doubler is supplied from a 400V/300 kV 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 Chubb-Fortescue peak voltmeter circuit. Describe the principal of operation of this peak voltmeter circuit and discuss about the limitation of peak voltage measurement with this method. 9
- b) With the help of circuit and phasor diagrams explain why capacitive voltage transformers are used in resonant condition. 7
4. a) Briefly discuss about the operation of a multi stage impulse generator circuit with a neat sketch. 10
- b) Why triggering is required in an impulse voltage generator? Describe a typical triggering arrangement for the same. 6

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5. Write short notes on any two of the following: 2×8
- a) Representation of standard lightning impulse voltage waveform by two exponential curves.
 - b) Measurement of high voltage using sphere gap
 - c) Advantages of HVAC generation using series resonance circuit