

B.E. ELECTRICAL ENGINEERING THIRD YEAR SECOND SEMESTER - 2019**SUBJECT: HIGH VOLTAGE ENGINEERING**

Time: Three Hours

Full Marks 100
(50 Marks for each part)**Use a separate Answer-Script for each part**

Two marks for neat and well-organized answers

Question No.	Part I	Marks
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Answer any three questions

1. (a) Justify the following statement: "Volume of copper is reduced if the transmission line voltage level is increased". 6
- (b) Calculate the maximum voltage across a string of suspension insulators as shown in Fig. 1, if the maximum voltage per unit cannot be allowed to exceed 17.5 kV. Deduce the formula you have used. 4+6

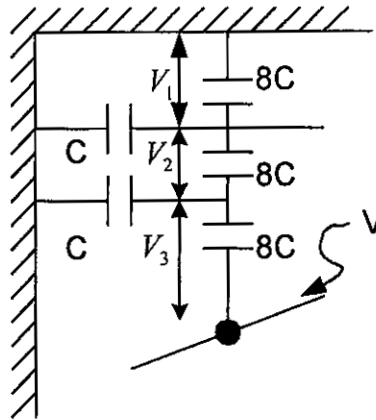


Fig. 1

2. (a) What do you mean by Visual Corona Voltage? Derive the expression of visual corona voltage for a single phase two conductor system. 2+6
- (b) Determine the Disruptive Critical Voltage, the Visual Corona inception voltage, and the power loss in the line due to corona, both under fair weather conditions as well as stormy weather conditions for a 100 km long 3 phase, 132 kV line consisting of conductors of diameter 1.04 cm, arranged in an equilateral triangle configuration with 3 m spacing. The temperature of the surroundings is 40°C and the pressure is 750 torr. The operating frequency is 50 Hz. [The irregularity factors may be taken as $m_d = 0.85$, $m_v = 0.72$]. Consider the Disruptive Critical Voltage under stormy condition becomes 80% of the corresponding value under fair condition. 8

[Turn over

3. (a) What do you understand by transmission and reflection of travelling waves? Explain with a suitable example why tower footing resistance should be kept as low as possible. 4+6
- (b) Find out the general expression of surge impedance and hence find the surge impedance in case of transmission line. 4+2
4. (a) State the limitations of solidly grounded system. 4
- (b) What is the advantage of Peterson Coil in reducing the arcing ground condition? Derive the relationship between the inductive and the capacitive reactance in case of a correctly tuned Peterson Coil. 7
- (c) With the help of volt-time characteristics, explain the insulation co-ordination of substation equipment. 5
5. (a) Explain how the use of a condenser bushing can improve stress distribution. 6
- (b) A single core, lead covered cable is to be designed for 66kV to earth. Its conductor radius is 0.5 cm and its three insulating materials, A, B and C have relative permittivity of 4, 4 and 2.5 with maximum possible stress of 50, 40 and 30 kV/cm respectively. Material A being nearer to the conductor and C being near to the sheath. Find the minimum internal diameter of the lead sheath. 10

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2019

(3rd Year, 2nd Semester)

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Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-II**Answer question No.1 any TWO from the rest**

1. Correct or justify any four of the following 4x5=20
- a) Interleaved winding improves surge potential distribution along a transformer winding.
 - b) Front time of the lightning impulse waveform cannot be controlled only by discharge resistor (R_c).
 - c) Breakdown of sphere gap under impulse voltage is probabilistic in nature.
 - d) Testing transformers require less reinforcement of insulation compared to power transformers.
 - e) Series resonant circuit can only be used to test objects having large capacitance.
2. a) Draw a Cockcroft-Walton voltage multiplier circuit and explain its principle of operation. 6
- b) A Cockcroft-Walton voltage doubler circuit is used to test a cable at 150 kV. The insulation resistance of the cable is $3 \times 10^7 \Omega/m$ and the length of the cable is 15 m. Stage capacitances are $0.15 \mu F$ and $0.12 \mu F$ respectively. The doubler is supplied from a 500V/250 kV testing transformer. Calculate the voltage to be applied to the input of the transformer at 50Hz. 6
- c) Explain with a neat sketch the operating procedure of a vacuum tube diode. 3
3. a) Draw the circuit diagram of a Chuub-Fortescue peak voltmeter circuit. Describe the principal of operation of this peak voltmeter circuit and discuss about the limitation of this peak voltage measurement. 7
- b) With a neat sketch explain the operation of Electrostatic voltmeter. 6
- c) What do you understand by “50 kV, 1.2/50 lightning impulse voltage”? 2

[Turn over

4. a) Briefly explain the procedure of measurement of high voltage using sphere gap. In which conditions external irradiation is required for high voltage measurement using sphere gap. 7
- b) Show that lightning impulse waveform is superposition of two exponential waveform. Explain the significance of damping resistor (R_d) in the impulse generator circuit. 8
5. a) With the help of circuit and phasor diagrams explain why capacitive voltage transformers are used in resonant condition. 7
- 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. 8