B.ELECTRICAL ENGG. Examination, 2017
(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 I
Answer *any three* questions.
Two marks are reserved for neat and well organized answers.

1.a) State the advantages of glass insulators. Comment on the use of post   3+2
     insulators.

  b) Explain why the voltage across the insulators of a simple insulator string is   3
     not uniform.

  c) Determine the potential distribution and the voltage across a string of five   4+4
     suspension insulators when the potential across any unit can not exceed 25
     kV. The capacitance of each unit is eight times the capacitance between link
     pin to ground. Also calculate string efficiency.

2.a) Each conductor of a three – phase overhead line has a diameter of 21 mm.   5
     The conductors are arranged in equilateral formation. Find the minimum
     spacing between the conductors if the maximum value of breakdown
     strength of air is 30 kV /cm, the disruptive critical voltage is 230 kV(rms), air
     density factor is 0.98 and irregularity factor 0.95.

  b) Give a short account of corona on hv transmission lines and derive a   8
     formula for the disruptive critical voltage between two smooth circular
     conductors, assuming the breakdown strength of air to be 30 kV$_P$/cm.

  c) Explain why it is stated that corona is a self-checking process.   3

3.a) In a co-axial cable the conductor diameter is 10 mm and the inner sheath   8
     diameter is 50 mm. There are two layers of insulation, the inner layer of
     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

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Ex/EE/T/326/2017

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the maximum voltage gradient 5 kV/mm. Calculate the maximum working voltage for the cable.

b) Explain why three core belted cables are not used beyond 22 kV.   4

c) Mention the requirements of EHV cables   4

4. a) With the help of necessary diagram explain in brief working of gas filled protector tube.   5

b) Clearly explain the terms i) direct lightning strike and ii) indirect lightning strike.   2+3

c) Discuss in brief about the development of switching overvoltage in hv transmission lines.   6

5. Write short notes on any two of the following: 8×2 =16
   i. Peterson coil for system grounding.
   ii. Bewley's lattice diagram.
   iii. Ground wires used in transmission systems.

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2017

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PART-II

Answer question No.1 any *TWO* from the rest

1.   Correct or justify any four of the following   4x5=20

   a)   Series resonant circuit can only be used to test objects having large capacitance.

   b)   Front time of the lightning impulse waveform can be controlled by discharge resistor R_e .

   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)   "Peak voltmeter measures high voltage" - this is one way of direct method of high voltage measurement.

2. a)   Draw a symmetric voltage doubler circuit and explain the principle of its operation.   6

   b)   A Cockcroft-Walton voltage doubler circuit is used to test a cable at 220 kV. The insulation resistance of the cable is $3 \times 10^7 \Omega$ and the length of the cable is 15 m. Stage capacitances are 0.12 µF and 0.15 µF respectively. The doubler is supplied from a 400V/250kV testing transformer. Calculate the voltage to be applied to the input of the transformer at 50Hz.   5

   c)   Explain with a neat sketch the operating procedure of a vacuum tube diode.   4

3. a)   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

   b)   Why controlled triggering is required in an impulse generator? Describe a typical triggering arrangement.   5

   c)   What do you understand by "50 kV, 1.2/50   lightning impulse voltage"?   2

4. a)   Draw the circuit diagram of a Chuub-Fortescue peak voltmeter circuit. Describe the princi 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) Why capacitive voltage transformers (CVT) are used in resonant condition? 2

5. 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.

8

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. 7

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