Total No. of printed pages = 4

EE 181404

Roll No. of candidate

2022

B.Tech. 4th Semester End-Term Examination

POWER SYSTEM – I

(New Regulation and New Syllabus)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following (MCQ/ Fill in the blanks) :   (10 × 1 = 10)

    (i) The phenomenon of rise in voltage at the receiving end of the open-circuited or lightly loaded line is called as

       (a) Proximity Effect

       (b) Skin Effect

       (c) Corona Effect

       (d) Ferranti Effect

    (ii) A 3-phase 4 wire system is commonly used on

       (a) Primary transmission

       (b) Secondary transmission

       (c) Primary distribution

       (d) Secondary distribution

    (iii) By which of the following methods string efficiency can be improved

       (a) Using a long cross arm

       (b) Grading the insulator

       (c) Using a guard ring

       (d) Any of the above

[Turn over

(iv) The use of strain type insulators is made where the conductors are

    (a)   Dead End

    (b)   Road Crossing

    (c)   Intermediate anchor towers

    (d)   All of the above

(v) As the moisture content in the air increases, the disruptive critical voltage

    (a)   Remain constant   (b)   Decreases

    (c)   Increases   (d)   May increase or decrease

(vi) Find the total diameter of the ACSR conductor with 2 layers and the diameter of each strand is 3?

    (a)   9   (b)   10

    (c)   5   (d)   15

(vii) Temperature increase produces which of the following effect on a transmission line?

    (a)   Tension of the conductor and its sag decreases

    (b)   Tension of the conductor and its sag increases

    (c)   Tension of the conductor decreases and its sag increases

    (d)   Tension of the conductor increases and its sag decreases

(viii) The inductance of the line is minimum when

    (a)   G M D is high

    (b)   G M R is high

    (c)   Both G M D and G M R are high

    (d)   G M D is low but G M R is high

(ix) In underground cable, maximum stress is at the

    (a)   Surface of the conductor

    (b)   Centre of the conductor

    (c)   Sheath surface of the cable

    (d)   Between sheath and the conductor

(x) The presence of earth in case of overhead lines

    (a)   Increases the capacitance

    (b)   Increases the inductance

    (c)   Decreases the capacitance and increases the inductance

    (d)   Does not affect any of the line constants

2. (a) Is the GMR less in bundled conductors? If yes, justify. (2)

(b) Derive an expression for the inductance per phase for a 3-phase overhead transmission line when conductors are unsymmetrically placed but the line is completely transposed. (7)

(c) Using the nominal T method find the ABCD parameter of a 3-phase 80 km, 50 Hz transmission line with a series inductance of $0.15 + j\,0.78\ \Omega$ per km and a shunt admittance of 5×10^{-6} mho per km. (6)

3. (a) Show how regulation and transmission efficiency is determined for medium lines using the nominal π method. Illustrate your answer with suitable phasor diagrams. (4+2=6)

(b) Fig 1. Shown below is the arrangement of a double circuit single-phase line. Conductors aa' form one connection and conductors bb' form a return path. If the diameter of each conductor is 2.2 cm, determine the total inductance per km of the line. (5)
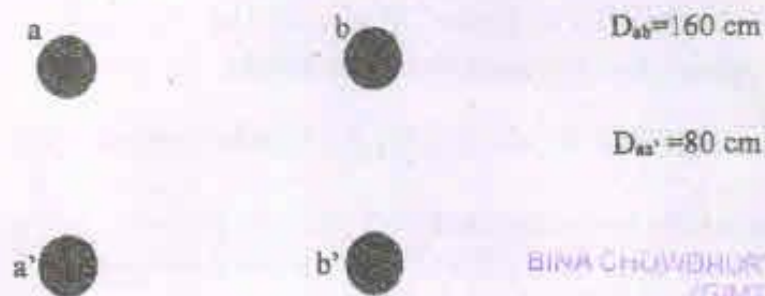
D_{ab}=160 cm

$D_{aa'}$ =80 cm

Fig. 1

(c) A conductor is composed of seven identical copper strands each having a radius 'r' Find the GMR of the conductor. (4)

4. (a) What are corona losses? Explain Peek's formula for calculating the corona loss. (5)

(b) Explain how the corona considerations affect the design of a line. (3)

(c) A 110 kV, 50 Hz, 175 km long three-phase transmission line consists of three 1.2 cm diameter stranded copper conductors spaced in a 2 m delta arrangement. The temperature is 25°C and the barometric pressure is 74 cm. Assume surface irregularity factor m=0.85, m_v = 0.72(local corona) and m_v = 0.82 (general corona).

Find

(i) Disruptive voltage

(ii) Visual corona voltage for local corona

(iii) Visual corona voltage for general corona (7)

5. (a) What is the need for grading insulators? (3)

(b) A string of suspension insulators consists of four units and the capacitance to ground is 12% of its mutual capacitance. Determine the voltage across each unit as a fraction of the operating voltage. Also, determine the string efficiency. (5)

(c) A transmission line has a span of 160 metres between the level supports. With the following data, calculate the height of the conductor above the ground level at which it should be supported if a minimum clearance of 7m is to be left between the ground and the conductor: (7)

Cross-sectional area of the conductor = 2.2 cm²

The density of the material = 8.9 gm/cc

Wind force = 1.6 kg/m run

Ultimate strength = 4980 kg/cm²

The factor of safety = 4

6. (a) Why is sheath used in a cable? What is the function of armour? List the materials used for the insulation of the cable. (1+1+2=4)

(b) What are the different types of laying of underground cables? Explain. (6)

(c) A single-core cable working on 66 kV on the 3-phase system has a conductor diameter of 2 cm and a sheath of the inside diameter of 5·3 cm. If two inter sheaths of diameter 3.1 cm and 4.2 cm are introduced between the core and lead sheath. If the maximum stress in the layers is the same, find the voltage on the inter sheaths. (5)

7. (a) Why are distribution system losses more when compared to transmission losses? (4)

(b) Distinguish between loop distributors and radial distributors? Derive the expression for voltage drop for a uniformly loaded distributor fed at one end. (5)

(c) An electric train taking a constant current of 600A moves on a section of line between two substations 8 km apart and is maintained at 575 V and 590 V respectively. The track resistance is 0.04 ohm/km both go and return. Determine the point of minimum potential along the track and currents supplied by substations at that instant. (6)