Total No. of printed pages = 8

**EE 131504**

Roll No. of candidate | | | | | | | | | | |

**2017**

**B.Tech. 5th Semester End-Term Examination**

**Electrical**

**POWER SYSTEM – I**

Full Marks – 100 Time – Three hours

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

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

1. Choose the correct answer for the following questions : $(10 \times 1 = 10)$

   (a) Power is transmitted at a high voltage to

   (i) Reduce the transmission losses

   (ii) Reduce the transmission time

   (iii) Increase system reliability

   (iv) Reduce skin effect

**[Turn over**

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(b) The parameters of a transmission line are

(i) R, L, C, X

(ii) R, L, C, G

(iii) R, Y, X, L

(iv) R, Y, C, G

(c) Which type of system is generally adopted for distribution of electric power?

(i) 3-phase 3-wire

(ii) 2-phase 3-wire

(iii) 3-phase 4-wire

(iv) None of these

(d) Ferranti effect is more observed in

(i) Short line

(ii) Medium line

(iii) Long line

(iv) Both (i) and (ii)

(e) One of the methods for reducing corona loss is

(i) Using bundled conductors

(ii) Using composite conductors

(iii) Decreasing supply frequency

(iv) None of these

(f) What type of insulator will be used if the direction of transmission line is changed?

(i) Pin type

(ii) Strain type

(iii) Suspension type

(iv) Shackle type



(g) On what basis is the insulation level of a 400 kV, EHV overhead transmission line decided?

(i) Lightning over voltage

(ii) Corona inception voltage

(iii) Switching over voltage

(iv) Radio and TV interference

(h) Capacity grading of cables means

(i) Use of dielectrics in different concentrations

(ii) Introduction of capacitance at various lengths of cable to counter the effect of inductance

(iii) Use of dielectrics of different permittivities

(iv) Grading according to capacitance per km length of the cable

(i) A synchronous condenser is a

(i) Synchronous generator

(ii) Paper condenser

(iii) Synchronous motor

(iv) None of these

(j) The ratio of puncture voltage to flashover voltage of a line insulator is

(i) Equal to 1

(ii) Lower than 1

(iii) Much greater than 1

(iv) None of these

2. (a) Draw the single line diagram of a typical power system showing various voltage levels for generation, transmission and distribution. (3)

(b) Compare a typical DC. two wire system (one conductor earthed) with an AC. 3-phase 4-wire overhead system in terms of their relative copper efficiency. (4)

(c) Differentiate between bundled conductors and composite conductors. (3)

(d) What is a ring distributor? A 2-wire D.C. ring distributor is 300 m long and is fed with 240 V at point A. At point B, 150 m from A, a load of 120 A is taken and at point C, 100 m in the opposite direction a load of 80 A is taken. The resistance per 100 m of single conductor is 0.03 Ω. (Fig. 1)

Find (i) Current in each section of the distributor, (ii) Voltage at points B and C. (5)

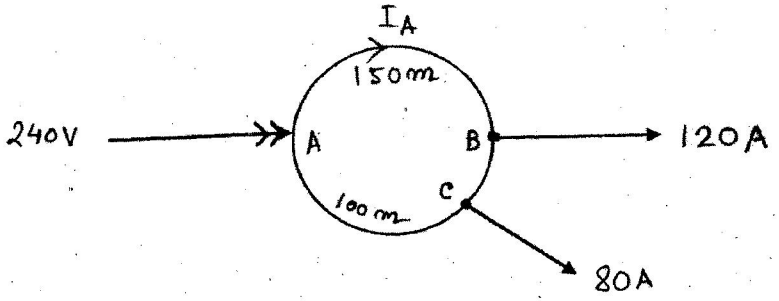


Fig. 1



3. (a) What is proximity effect? How does it affect the current distribution of two current carrying nearby conductors? (2)

(b) Derive an expression for inductance of a single phase two wire line. Also modify the expression incorporating the concept of GMR. (5)

(c) Calculate the inductance per phase per meter of the horizontal arrangement of conductors for 3-phase double circuit line as shown in Fig. 2. The radius of each conductor is 4.5 cm. (5)

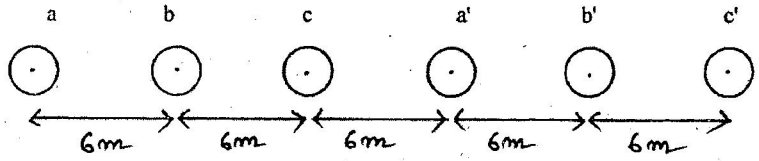


Fig. 2

(d) Explain the 'method of image'. Mention the effect of earth on the capacitance of transmission line. (3)

4. (a) Derive the ABCD parameters of the nominal-$\pi$ configuration of medium transmission line. (4)

(b) What is Ferranti effect? How does it occur? (2)

(c) Mention a few advantages of using power circle diagrams. (3)

(d) A 100 km long, 3-phase, 50 Hz transmission line has the following constants :

Resistance/phase/km = 0.1 Ω

Reactance/phase/km = 0.5 Ω

Susceptance/phase/km = $10 \times 10^{-6}$ S

If the line supplies a load of 20 MW at 0.9 p.f. lagging at 66 kV at the receiving end, calculate by nominal-pie method : (i) Sending end power factor, (ii) Regulation, (iii) Transmission efficiency. (6)

5. (a) Define sag. Derive the expression of sag for a transmission line when the two supports are at equal level. (5)

(b) An overhead transmission line at river crossing is supported from two towers at heights of 40 m and 90 m above the water level, the horizontal distance between the towers being 400m. If the maximum allowable tension is 2000 kg, find the clearance between the conductor and water at a point mid-way between the towers. Weight of conductor is 1 kg/m. (5)

(c) Write a short note on any *one* of the following : (5)

(i) Stringing chart,

(ii) Effect of ice loading on sag.

6. (a) Define the term corona. What are the factors that affect the corona formation? (5)

(b) What are the advantages and disadvantages of corona? (5)



(c) Determine the critical disruptive voltage and corona loss for a three phase line operating at 110 kV which has conductor of 1.25 cm diameter arranged in a 3.05 m delta. Assume air density factor of 1.07 and the dielectric strength of air to be 21 kV/cm. (5)

7. (a) Name the different types of insulators used in power systems. Give the applications of each insulator. (5)

(b) What is string efficiency of line insulators in a transmission line? Discuss briefly the methods of improving string efficiency. (5)

(c) An insulator string consists of three units, each having a safe working voltage of 15 kV. The ratio of self-capacitance to shunt-capacitance of each unit is 8 : 1. Find the maximum safe working voltage of the string. Also calculate the string efficiency. (5)

8. (a) Write a brief note on the importance of voltage control in a modern power system. (5)

(b) Explain with a neat sketch the working of the on-load tap changing transformer for voltage control. (5)

(c) Discuss why series compensation increases the power transmission capacity of a line. (5)

9. (a) Compare the merits and demerits of underground cable systems over overhead systems. (5)

(b) Explain the following :

(i) Capacitance grading,

(ii) Intersheath grading. (5)

(c) Calculate the capacitance and charging current of a single core cable used on a 3-phase, 66 kV, 50 Hz system. Given the length of the cable 1 km, having a core diameter of 10 cm and impregnated paper insulation of thickness 7 cm. Take the relative permittivity of insulation as 4. (5)