Total number of printed pages – 8

B. Tech

CPEE 5303

FIFTH SEMESTER EXAMINATION – 2005

TRANSMISSION AND DISTRIBUTION

Full Marks – 70

Time : 3 Hours

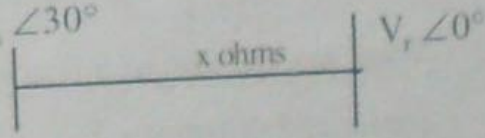
The figures in the right-hand margin indicate marks.

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

1. Answer the following : 2×10

   (a) What is the GMR of a 3-stand conductor in terms of the diameter d of an individual strand ?

   (b) Find A, B, C, D constants for a short transmission line.

   (c) 

P.T.O.

For the transmission line shown above what are active and reactive power transmitted ?

(d) Find z_0 (characteristic impedance) of 300 km long line, if total impedance $z = 52 + j\,200\Omega$ and shunt admittance $y = 1.5 \times 10^{-3} \angle 90^\circ$ S.

(e) What is the maximum DC voltage obtained in a HVDC transmission system, if V_{L-L} (AC voltage) = 400 kV.

(f) If the voltage across the units of 2-unit suspension insulator are 60% and 40% of the line voltage, what is the ratio of the capacitance of the insulator to that of its capacitance to earth ?

(g) What is loss tangent of the dielectric of a single core cable ?

(h) Find the inductance of a Pelerson coil for a 11 kV, 60 Hz generator (take line to neutral capacitance = 4 μF) grounding.

(i) What are the design differences between a feeder and distributor ?

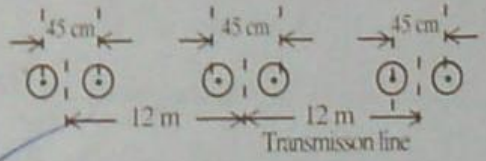
(j) What are the factors that affect corona power loss ?

2. (a) A 400 kV, 60 Hz, 3-phase line has 2-subconductors per phase and is arranged in a horizontal configuration as shown below. Take the radius of each sub-conductor of the bundle as 1.6 cm. Centre to centre distance between adjacent phases = 12 m, distance between bundle conductors = 45 cm.

Find :

(i) the inductance and capacitance per phase per km of the line.

(ii) total charging MVAr of the line. 6



(b) A 3-phase overhead line consist of 3 conductors in equileteral triangle configura-

tion with 2.44 m spacing. The conductor diameter is 1.04 cm and surface factor m is 0.85. Air temp = 21.1°C, Air pressure = 74 cm of Hg. Find visual critical corona voltage. 4

3. (a) Explain Ferranti effect in a long transmission line with phasor diagram. 3

(b) A 300 km, 132 kV, 3-phase overhead line has a total series impedance of $z = 52 + j\ 200\Omega$ per phase and total shunt admittance $y = j\ 1.5 \times 10^{-3}$ S per phase to neutral. The line supplies a 40 MVA, 0.8 p.f. lagging load at 132 kV.

Find :

(i) sending end voltage

(ii) % voltage regulation.

Use Nominal π to compute A, B, C, D constants of the line. 7

4. (a) What are the different methods to improve string efficiency of a string of suspension insulators ? 3

(b) A suspension string has 3 identical units, each of which has a flash over voltage of 11 kV. Each unit has self capacitance C Farads and shunt capacitance of the joint to metal work is 0.26 C and to earth 0.15 C, respectively. Using a guard ring, the shunt capacitance of the metal work of the lowest insulator to the line increases to 0.35 C.

Find :

(i) the flashover voltage of the string

(ii) string efficiency. 7

5. (a) Derive mathematical expression for taking into account the effect of Ice and Wind in sag calculations of a transmission line. 3

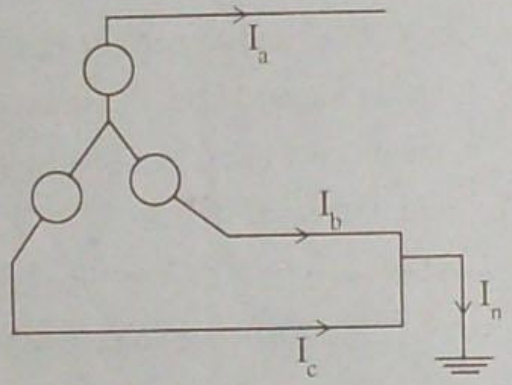
(b) An overhead line over a river crossing is supported by two towers 50 m and 80 m above water level. The horizontal span is 300 m. If the weight of conductor is 0.83 kg/m and tension in the conductor is 2000 kg.

Find :

(i) the height of the midpoint of the line above water level. 7

6. (a) For a 3-phase system shown below, the phase currents are :

$I_a = 0$, $I_b = 91.65 \angle 160.9°$, $I_n = 60 \angle 90°$



Determine the symmetrical components of the current $I_a \left(I_a^1, I_a^2, I_a^0\right)$. 6

(b) The positive, negative, and zero – sequence reactances of a 11 kV generator are $x_1 = 3.4\Omega$, $x_2 = 0.85\Omega$, $x_0 = 2.4\Omega$. Generator neutral grownding reactance $x_g = 0.4\Omega$. For a single line to ground fault, find the fault current. Assume the generator to be unloaded. 4

7. (a) Describe an experiment to determine the capacitance of a 3-core belted cable. 3

(b) A single core cable for a 3-phase 66 kV system has a conductor of 1 cm radius and a sheath of inside radius of 2.65 cm. It is required to have 2 intersheaths, so that the stress varies between the same maximum and minimum values in 3 layers of the dielectric. Calculate :

(i) the positions of intersheaths

(ii) maximum and minimum stress and voltages with and without intersheaths. 7

8. (a) State and explain Kelvin's law. $2\frac{1}{2}$

(b) Why 3-phase, 4-wire AC system is used for power distribution ? $2\frac{1}{2}$

(c) A single phase one km long distributor has a resistance of 0.2Ω and reactance of 0.3Ω. At the far end the voltage V_B is 240 V and the current is 100A at 0.8 p.f. lagging. At the

midpoint a, the current is 100A at 0.6 p.f. lagging with respect to voltage V_a.

(i) Find the voltage at the feeding point A.

(ii) Calculate the power loss in the distributor. 5