Exam. Code: 0934
Sub. Code: 6662

2023

B.E. (Electrical and Electronics Engineering)

Fourth Semester

EE-403: Power Systems - I

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Missing data (if any) can be appropriately assumed.***

x-x-x

1 A) Advantages of per unit system. (2)

B) Explain the term line loadability. (2)

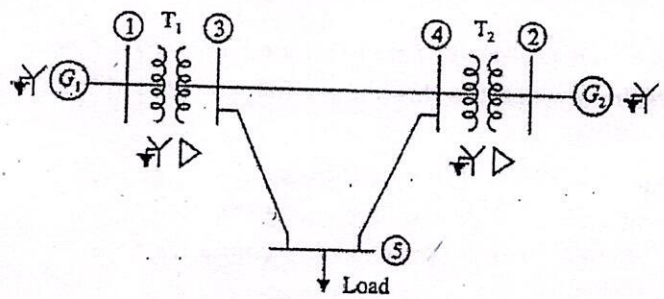
C) Differentiate the stranded and bundle conductors used in transmission lines. (2)

D) Write all the effects of vibrations occur in overhead transmission lines. (2)

E) What is the effect of considering the images of the conductors in the calculation of inductance and capacitance of the transmission lines? (2)

Part A

2 A) A 50-MVA, 1 1-kV, three-phase generator has a sub-transient reactance of 10%. The generator connected to the power system shown has the following specifications: (5)



Generator G_1 : 50-MVA, 1 1-kV, three-phase generator, X" = 0.10 pu

Generator G_2: 40-MVA, 6.6-kV, three-phase generator, X" = 0.12 pu

Transformer T_1: Three-phase transformer, 100 MVA, 1 1/220 kV, X = 0.15 pu

Transformer T_2: Three single-phase units each rated 50 MVA, 6.6/132 kV, X = 0.10 pu

Load: 75 MVA at 0.8 pf lagging

Transmission line: Z_{34} = 30 +j150 Ω; Z_{35} = 20 +j40 Ω; Z_{45} = 25 + j60 Ω

Assuming a volt-ampere base of 150 MVA, compute the pu values for the power system. Draw a single line diagram of the power system and show the pu values of the system parameters.

B) Explain all types of the Conductors used in the power transmission lines with suitable diagrams. (5)

3 A) Draw the cross section of a three-core belted high voltage cable and describe its various parts. (5)

B) What is meant with the grading of the cables? Explain why and how the grading of cables is done. (5)

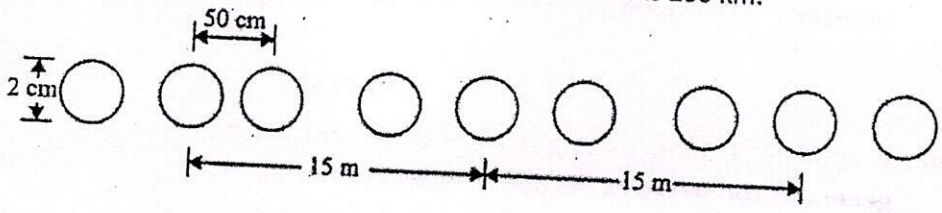
P.T.O.

4 A) Explain in details with suitable diagram all methods used for the improvement in string efficiency of the insulators. (5)

B) Write a short note on the reflection and refraction of travelling waves in transmission lines. (5)

Part B

5 A) A three-phase, 400-kV, 50-Hz, fully transposed circuit is constituted of bundle conductors and is arranged as shown If the outside diameter of each conductor is 2.0 cm, calculate the series resistance, series reactance, and shunt admittance per km when the three conductors share equal currents and equal charge magnitudes. Take the conductor temperature equal to 70°. Assume the following data: resistance at 20°C = 0.22 Ω per km and temperature coefficient of conductor = 0.0043 per °C. Calculate the series resistance, reactance, and shunt admittance if the length of the line is 200 km. (5)



B) What is transposition of a transmission line? Why is it necessary? Derive an expression for the inductance of a three-phase fully transposed line. (5)

6 A) A single-phase, 33-kV line, operating at 50 Hz, is spaced 1.5 m apart and the diameter of the conductors is 10 mm. Determine the capacitance between the conductors and the line charging current. Calculate the conductor capacitance to neutral and the charging current. How does the capacitance and charging current change if the effect of the earth is considered? Assume that the length of the line is equal to 5 km and the ground clearance is 5 m. (5)

B) Derive expressions for the inductance of a conductor due to (i) internal flux and (ii) external flux. (5)

7 A) Derive expressions for the ABCD constants for a lossless long transmission line. Assume distributed parameters for the line. (5)

B) Prove that the voltage at the mid-point of a long line terminated at the receiving end by an inductive shunt reactor X_{LSh}, is a maximum and is given by $V_R/\cos(\beta l/2)$. Take the length of the line equal to l and $V_S/V_R = 1.0$. Also show that the current at mid-point is zero. Assume that the line is loss free. (5)

x-x-x