Ex/EE/PC/B/T/312/2024

B.E ELECTRICAL ENGINEERING THIRD YEARFIRST SEMESTER EXAMINATION, 2024

POWER SYSTEM PLANNING AND DESIGN

Time: Three hours | Full Marks: 100

(**50** marks for this part)

Use a separate Answer-Script for each part

PART –I

Answer any five

		Marks
1.a)	Briefly discuss different types of vibration in transmission lines.	6
b)	Differentiate between horizontal configuration and vertical configuration of line conductors.	4
2.a)	What is ruling span and why is it important?	3
b)	An overhead line with stranded copper conductor of size 7/3.45 mm and cross sectional area 64.55 mm^2 has a span of 160m of between level supports. The sag is 3.96 m at -5.5°C with 9.53 mm thick ice coating and wind pressure of 40 kgf/m^2 of projected area. Considering the weight of the conductor to be 0.594kgf/m, modulus of elasticity to be 12700 kgf/mm^2, coefficient of linear expansion to be 1.7 x 10^{-5}/°C and density of the ice to be 913.5 kgf, calculate the temperature at which the sag will remain the same under conditions of no ice and no wind.	7
3.a)	Discuss the advantages and disadvantages of suspension insulators.	6
b)	Describe the features of All Aluminum Alloy Conductor.	4
4. a)	Discuss the functions of sheath and armouring of a cable.	6
b)	The capacitance measured between any two cores of a three phase belted cable is 0.3μF/km. Calculate the charging kVAr taken by a 5km length of this cable when connected to an 11kV, 50Hz supply.	4
5.a)	What are the different types of faults that occur in a cable? How are they identified?	7
b)	How does the charging current affect the network?	3

[Turn over

6.a) Derive the equation showing that the insulation resistance of a cable varies inversely as the length. 5

b) Discuss the advantages of using PVC insulation over the other cable insulation materials. 5

7.a) Explain how the power factor of a consumer can be improved economically? 8

b) Explain why consumers having poor load factor should pay more? 2

8. The average demand of an industrial estate for the last five years is given below. Using the method of linear regression estimate the prospective demands for 2024 and 2025. If the data for 2023 is not available, estimate the demand for the same two years by using the same method. 10

Year	2019	2020	2021	2022	2023
Demand (MW)	90	105	118	134	151

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PART II

Figures in the margin indicate full marks

Group-A

Answer any three of the following questions

1. (a) Explain why the inductance of bundled conductor lines is less than single conductor lines. (4)

(b) Write down the expression for the magnetic flux linkage of a solid round conductor, considering all flux upto a distance d. Hence derive an expression for the flux linkage of any conductor in a group of several conductors carrying a network current zero. (6)

2. (a) Derive the expression for the capacitance of three phase, asymmetrically spaced and transposed double circuit line. (5)

(b) Fig. 1 below shows the arrangement of a single phase double circuit overhead transmission line. Conductors a, a′ form one circuit and conductors b, b′ form return circuit. If the diameter of each conductor is 2.2 cm determine the total inductance per km per phase of the line. (5)

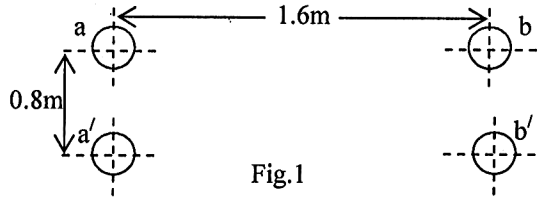

Fig.1

3. Discuss with the help of mathematical derivation, how ground affects the capacitance of a three phase, asymmetrically spaced and transposed overhead transmission line conductors. (10)

4. (a) Explain with suitable derivation how transposition of power transmission line helps to reduce electromagnetic interference on communication lines. Under what conditions transposition of power transmission lines will not be effective? (3+2)

(b) What do you understand by tuned power lines? Determine the length of a 50 Hz transmission line for tuning. (2+3)

Group-B
Answer any two of the following questions

5(a) What do you understand by performance of transmission lines? Explain 'lumped parameter' and 'distributed parameter' of a transmission line. (2+3)

(b) Determine the velocity of travelling waves in overhead transmission lines. Why the velocity of the same is less in underground cables? (3+2)

6. (a) Determine the equivalent ABCD parameters of two transmission lines when they are connected in i) cascade and ii) parallel. (6)

(b) The resistance, inductance and capacitance of a three phase 132 kV, 50Hz transmission line are 0.2Ω, 1.3mH and 0.01μF respectively. Determine the magnitude of the incident voltage and reflected voltage at the receiving end under no-load condition. (4)

7. (a) Define voltage regulation of a transmission line. (2)

(b) A 30 km long three phase overhead transmission line delivers 2 MW at 11kV at a power factor 0.95 lagging. Line loss is 5% of the power delivered. Line inductance is 1.5mH per phase per km. Calculate (a) sending end voltage and voltage regulation (b) power factor of the load to make the voltage regulation zero with the help of relevant phasor diagram and (c) the value of capacitor to be connected at the receiving end to reduce regulation to zero. (8)