BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) THIRD YEAR FIRST SEMESTER EXAM 2024

SUBJECT: POWER SYSTEM PLANNING AND DESIGN

Time : Three hours **Full Marks -100**

Use a separate Answer-Script for each part

Part I (50 Marks)

Question No.	*Answer any three questions(2 marks reserved for neat and well organized answers)*	Marks
1. a)	Derive the expression for series and shunt parameters of an equivalent T-model of a transmission line.	6
b)	A three phase 180 km long line has a resistance of 0.03 ohm/km/phase, a reactance of 0.2 ohm/km/phase and a capcitive admittance $j0.5 \times 10^{-6}$ mho/km/phase. Calculate the ABCD parameters using a nominal T-circuit for this line. Also, calculate the sending end voltage, current, and voltage regulation if the line delivers a load of 30 MW, 0.9 power factor lag at 132 kV at the receiving end.	10
2. a)	Derive the inductance per unit length of an overhead transmission line due to internal flux.	6
b)	A 50 Hz, 400 km long line has a series impedance of $z = (0.02 + j0.4)$ ohm/km/ phase and shunt admittance $y = j1.5 \times 10^{-6}$ mho/km/phase. Calculate the ABCD constants of the line.	10
3.a)	Derive the expression for capacitance of an overhead symmetrically spaced three phase line.	8
b)	Derive the inductance per unit length of a single phase overhead transmission line with two composite conductors with identical strands.	8
4. a)	Derive the suitable expression to obtain the variation in voltage and current distribution over a long line. Explain the significance of characteristic impedance loading in connection with long line.	10
b)	Explain the meaning of self GMD and mutual GMD with the help of a suitable example.	6
5.	**Write short notes on any two of the following:**	8×2
a)	Effect of earth on transmission line capacitance	
b)	Ferranti effect	
c)	Skin effect and proximity effect	

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No. of Questions		PART -II Answer any Three (Two marks reserved for well organized answers)	Marks
1)	a)	A transmission line has a span of 275 m between level supports. The conductor has a diameter of 19.53 mm, weighs 0.844 kgf/m and has an ultimate breaking strength of 7950 kgf. Each conductor has a radial covering of ice 9.53 mm thick and is subjected to a horizontal wind pressure of 40 kgf/m2 of the ice covered projected area. If the factor of safety is 2, calculate the deflected sag and the vertical component of the sag. One cubic metre of ice weighs 913.5 kgf.	(8)
	b)	Derive the behavior cubic equation for sag and tension for changes in temperature and loading.	(8)
2)	a)	Explain the factors on which the design of towers depends.	(6)
	b)	What are the main functions and characteristics of line supports?	(8)
	c)	Calculate the clearance of the lowest conductor above ground for a 400 KV transmission line.	(2)
3)	a)	For an insulated cable, prove that $\frac{g_{max}}{g_{min}} = \frac{R}{r}$ where g_{max} and g_{min} are the maximum and minimum stress of the cable and r and R are the radius of conductor and internal radius of sheath respectively. Also derive the expression for the most economical size of cable.	(8)
	b)	Show that the insulation resistance of a cable varies inversely with its length.	(4)
	c)	Explain why the capacitance of cable is much higher than that of an overhead conductor.	(4)
4)	a)	Discuss Murray loop method to locate short circuit fault for an underground cable with necessary circuit diagram.	(6)
	b)	Illustrate the power losses occurring in the dielectric of a cable.	(8)

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	c)	Expand the following terms : (i) CERC according to electricity act (ii) XLPE insulation (iii) AAAC (with respect to conductors) (iv) ABT (with respect to tariff)	(2)
5)		Answer **any four** :	(4×4)
	a)	Illustrate the electrical failures occurring in an insulator.	
	b)	Explain generation guided tariffs.	
	c)	Describe the features of ACSR Conductor.	
	d)	Illustrate plant load factor and availability factor.	
	e)	Illustrate the necessity of load forecasting.	
	f)	Illustrate the advantages of V string insulators in transmission lines.	