Ref. No: Ex/ET/PC/B/T/224/2024

B.E.Tel.E. 2nd YEAR EXAMINATION, 2024
(2nd Semester)

TRANSMISSION LINES AND WAVEGUIDES

Time: Three hours | Full Marks 100

No. of questions		Marks

Answer any *five* questions.
Consider $\varepsilon_0=8.854X10^{-12}F/m$ and $\mu_0=4\pi X10^{-7}H/m$
Values of other universal physical constants may be assumed, if necessary.
Usage of Smith Chart is permitted.

1.(a)	Consider a lossless coaxial air line with inner conductor radius 'a' and outer conductor radius 'b'. Calculate its series inductance per unit length and shunt capacitance per unit length.	8+8
(b)	Hence show how its characteristic impedance would change if the inner conductor is made thicker without changing the external dimensions.	4
2.(a)	Solving the Telegrapher's equation, derive an appropriate expression for the input impedance along a line.	14
(b)	What do you mean by a smooth line? Is an infinite line smooth? Justify your answer.	6
3.(a)	A generator of 1V, 1kHz and internal resistance 50 Ω supplies power to a 50 km open wire line terminated in a 230 Ω resistance. The line parameters are R=19.4 Ω/km, L=0.00367 h/km, G=$9.8X10^{-4}$ S/km & C=0.00835 μf/km. Calculate the insertion loss in dB deriving all necessary formulae.	16
(b)	Why is it preferred to express the loss in dB?	4
4.(a)	Obtain the T-section lumped equivalent circuit of a transmission line.	10
(b)	Describe the frequency domain reflectometry procedure to locate an underground line fault.	10
5.(a)	An antenna, as load to a line, produces a VSWR of 2.8 with a voltage minimum at 0.12λ from the antenna terminals. Find the antenna impedance if R_0=300 Ω for the line.	8
(b)	Design an appropriately located short circuited stub for matching the antenna to the line,	12
6.(a)	Discuss how to plot a Smith chart grid.	12
(b)	A 15m long RF cable with R_0=300 Ω is to be connected to a 3m long 150 Ω line terminated by an 150 Ω resistor. Find the length and characteristic impedance of a quarter wave transformer designed for the system. Also find the VSWR along all line segments involved.	8
7.(a)	What is the cutoff frequency of a WR62 rectangular waveguide, whose inner cross sectional dimensions are 0.622"X0.311"? Derive all relations you use.	18
(b)	For which microwave frequency band of operation is it suited?	2
8.	Write short notes on any *two* of the followings	
(a)	Circle diagram of dissipationless lines	
(b)	Excitation of waveguides	
(c)	Distortion along a telephone cable	10X2