Ref. No: Ex/ET/T/224/2019

B.E. (ETCE) 2nd YEAR EXAMINATION 2019
(2nd Semester)

TRANSMISSION LINES AND WAVEGUIDES

Time: Three hours | Full Marks 100

Answer any *five* questions.
All questions carry equal marks.
Assume appropriate values for all universal physical constants.
Use of Smith Chart is allowed.

1. (a) Solve the Telegrapher's Equations for voltage and current along a transmission line to obtain its input impedance in terms of its primary constants and terminal conditions. 12
   (b) Draw typical phasor diagrams for voltage along the line at regular intervals of (1/8)-th wavelength at a particular time instant. Also plot the voltages at that instant against distance along the line. 4
   (c) Repeat the same (1/8)-th of a cycle later. 4

2. (a) Discuss how the location of a telephone line fault may be determined using frequency domain reflectometry. 8
   (b) The diameters of the inner and outer conductor of a coaxial cable operating at 100 MHz are 4mm and 10mm respectively. Its length is 2m and it is connected to another cable connected to a 100Ω load with the same inner conductor but the outer conductor changed to one having diameter 16 mm. Length of the second line is also 2m. Determine the input impedance of the first cable. 12

3. (a) A simulated line is composed of T sections of pure resistance having the series branch impedances as 50Ω each and the shunt branch impedance as 4kΩ. The line is composed of 50 such sections and terminated in its characteristic impedance. Find the values of the terminating impedance and the line loss in dB. 4+6
   (b) A 15m length of 300Ω air line should be connected to a 3m length of 150Ω air line terminated in 150Ω at 50 MHz. Design a quarter wave transformer to ensure proper matching. Also determine the VSWR on the matching section. 6+4

4. (a) Obtain the Z-parameters of a 8 cm long RF cable operating at 3GHz and having primary constants R=0, L=0.001 h/loop km, G=0 and C=0.062μf/loop km. 10
   (b) A generator at 150 MHz drives a 10m long 75Ω coaxial line terminated in a composite load composed of parallel connection of two 50Ω lines of length 0.5m and 1m respectively, each terminated in 50Ω. All lines are filled up with Teflon (ε_r=2.2). Determine the length and location of a 75Ω short circuited shunt stub to produce minimum VSWR on the main line. 10

5. (a) Why different waveguides are used for operation in different microwave frequency bands? 4
   (b) Enlist the different microwave frequency bands along with their frequency ranges. 4
   (c) Why TEM mode of propagation is not sustainable in waveguides unlike other transmission lines? 4
   (d) Is the special theory of relativity violated in waveguides since they support phase velocities higher than that of light in vacuum? Justify your answer. 2
   (e) Describe a scheme to launch TE_{20} mode in a single direction in rectangular waveguides. 6

6. (a) Prove that a circular waveguide is essentially a high pass filter. 10
   (b) Prove that TE_{np} and TM_{np} modes are non-degenerate for circular waveguides. 10

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7. (a) Draw the typical field distribution along a microstrip line and hence show that a magnetic wall exists along it longitudinally halfway through its cross-section. 6

(b) Discuss two modified versions of standard microstrip that ensures higher operating frequency range. 6

(c) What are the suitable characteristics for a substrate to be chosen for microstrip antenna application and what are the suitable characteristics for a substrate to be chosen for microstrip line application? 4

(d) Justify the fact that a narrower microstrip line will have a higher value of characteristic impedance. 4

8. Write short notes on (any *two*)

i) Reflection loss

ii) Distortionless line

iii) Circle diagram 10X2