B.Sc. Semester-V Examination, 2022-23

ELECTRONICS [Honours]

Course ID : 51717 Course Code : SH/ELC/504/DSE-2(T)

Course Title : Transmission Lines, Antenna and Wave Propagation

Time : 1 Hour 15 Minutes Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **three** of the following questions: 1×3=3

   a) In transmission lines, propagation co-efficient $P = \alpha + j\beta$ i.e., P is complex but α and β are real. What are the definitions of α and β?

   b) What are the various secondary line co-efficients in transmission lines?

   c) What are the differences between low frequency and high frequency transmission lines?

   d) Give one practical example for LFT (Low Frequency Transmission) lines.

   e) What is critical frequency for propagation of radio-waves through ionosphere?

   f) What is Secant Law?

2. Answer any **three** of the following questions: 2×3=6

   a) What is Ionosphere? Why is it formed at a certain height in the earth's atmosphere $(60\text{km} - 400\text{km})$? 1+1=2

   b) What is "Skip Distance" in connection with radio-wave propagation? How is it related with Maximum Usable Frequency (MUF)? 1+1=2

   c) What is the function of "Duplex Circuit" in RADAR system? 2

   d) Give the expression for Z_0 (characteristic impedance) and P (Propagation co-efficient) in terms of primary line constants R, L, C and G. 2

   e) What is ducting and duct propagation? How the radio-waves are propagated through the ducts? 1+1=2

   f) What is radio horizon? Explain with a rough sketch. 1+1=2

3. Answer any **two** of the following questions: 5×2=10

   a) Describe briefly the mechanism of reflection of EM waves through Ionosphere.

b) Derive an expression for RADAR range equation for a pulse RADAR system.

c) Derive an expression for the input impedance Z_i of any high-frequency transmission lines in terms of primary and secondary line constants.

d) Find the expression for Voltage and Current at any point X for an infinitely large, finite length transmission line which is terminated with an impedance Z_R.

4. Answer any **one** of the following questions: $6\times1=6$

a) Derive the necessary working formula to show how the refractive index (μ) of any ionospheric layer is related with free electron concentration (N) of the layer. 6

b) What is wave guide? From Maxwell's 2nd and 4th equations $\left[\vec{\nabla}\times\vec{E}=-\mu\frac{\partial\vec{H}}{\partial t} \text{ and } \vec{\nabla}\times\vec{H}=g\vec{E}+k\frac{\partial\vec{E}}{\partial t}\right]$, obtain six field equations in rectangular co-ordinate system, where $\vec{E}$ being the electric field in Y-axis and $\vec{H}$ is the magnetic field along Z-axis. 1+5=6

c) Explain briefly how an ionospheric layer or Chapman layer is formed at a particular height above the earth surface (60 km – 400 km). How this ionospheric layer behaves during day and night? Define Scale Height (H). 2+3+1=6

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