510607

Roll No. _____ Total No. of Pages: 3

510607

B. Tech. V - Sem. (Main/Back) Exam., (Academic Session 2021- 2022)

Electrical Engineering

5EE5 – 12 Electromagnetic Wave

Time: 2 Hours **Maximum Marks: 80**

Min. Passing Marks:

Instructions to Candidates:

Part – A: *Short answer questions (up to 25 words) 5 × 2 marks = 10 marks. All five questions are compulsory.*

Part – B: *Analytical/Problem solving questions 4 × 10 marks = 40 marks. Candidates have to answer four questions out of six.*

Part – C: *Descriptive/Analytical/Problem Solving questions 2 ×15 marks = 30 marks. Candidates have to answer two questions out of three.*

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

Q.1 State Gauss's law for electromagnetics. [2]

Q.2 What is meant by Transverse Electromagnetic Wave? [2]

Q.3 Determine the propagation constant in free space for the frequency f = 95.5 MHz. [2]

Q.4 State Poynting theorem. [2]

Q.5 Define transmission line. [2]

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PART – B

Q.1 At an operating radian frequency of 500 Mrad/s, typical circuit values for a certain transmission line are R = 0.2 Ω/m, L = 0.25 μH/m, G = 10 μS/m & C = 100 pF/m. Find - [10]

(i) α

(ii) β

(iii) λ

(iv) V_p

(v) Z_0

Q.2 Derive an expression of radiated power & radiation resistance of a Hertzian dipole. [10]

Q.3 Determine the electric field intensity at a distance of 10 km from an antenna having a directive gain of 5 dB and radiating a total power of 20 kW. [10]

Q.4 (a) A lossless transmission line is 80 cm long and operates at a frequency of 600 MHz. The line parameters are L = 0.25 μH/m & C = 100 pF/m. Find the characteristic impedance, phase constant and phase velocity. [5]

(b) A 50 Ω lossless transmission line is terminated by a load impedance, $Z_L = 50 - j75\Omega$. If the incident power is 100 mW, find the power dissipated by the load. [5]

Q.5 For an Electromagnetic Wave propagating in free space, prove that $\frac{E}{H} = \eta$. [10]

Q.6 A metal sheet of Aluminum has a σ = 38.2 M ℧/m and μ_r = 1. Calculate the skin depth δ, the propagation constant γ & velocity of propagation v, at the frequency of 1.6 MHz. [10]

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PART – C

Q.1 Explain the working of rectangular waveguide. What is the frequency range where these waveguides are most suitable? Find the minimum cut-off frequency of a waveguide. Also find it for a waveguide whose cross-section is 25×50 cm^2. [5+3+3+4=15]

Q.2 Derive the general transmission line equations for voltage and current at any point on a line. [15]

Q.3 (a) State and prove the Gauss's law. Consider a spherical shell of charge carrying a surface charge density ρ_s C/m^2. Using Gauss law derive the expression for $\vec{D}$ in all regions. [3+4½ = 7½]

(b) A point charge Q = 30 nC located at the region in Cartesian co-ordinates. Find the electric flux density $\vec{D}$ at (1, 3, –4) m. [7½]

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