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BIEL-006

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

Term-End Examination

December, 2015

BIEL-006 : ELECTROMAGNETIC FIELD THEORY

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions have same weightage (10 marks).*

1. (a) What are the fundamental properties of electromagnetic waves ? Give the units for (i) Permeability, and (ii) Permittivity. *5*

(b) $A = \hat{x} - \hat{y} + 2\hat{z}$; $B = \hat{y} + \hat{z}$ and $C = -2\hat{x} + 3\hat{z}$.

Find $A \times (B \times C)$ using dot product. *5*

2. (a) Given point $P_1(3, -4, 3)$ and vector $A = 4\hat{x} - 3\hat{y} + 4\hat{z}$ defined in Cartesian coordinates. Express P_1 and A in cylindrical coordinates and evaluate A at P_1. *5*

(b) Distinguish gradient, divergent and curl operators by giving their physical significance. 5

3. (a) State Stokes' theorem and complete the expression

$$\nabla \cdot (\nabla \times A) = \_\_\_\_\_ .$$

Justify the answer with an example. 5

(b) Write Maxwell's equations and give their physical interpretations. 5

4. (a) A ring charge of radius b is characterised by a uniform charge density of positive polarity ρ_l, with the ring in free space and positioned in the X – Y plane. Determine the electric field intensity E at point P(0, 0, h) along the axis of the ring at a distance h from its centre. 5

(b) Derive Poisson's equation and give its one application. What gives rise to the conduction current in a conductor ? 5

5. (a) Write the electric and magnetic boundary conditions for a surface interfacing two media with ε_1, ε_2 and μ_1, μ_1 as their standard meanings. 5

(b) State Biot-Savart law. What do you understand by vector magnetic potential ? Give its unit. 5

6. (a) Draw a transmission line two-port network diagram and write the propagation modes existing in it with complete explanation. 5

(b) For a transmission line with characteristic impedance of 50 Ω and phase constant of 10 rad/m at 700 MHz, find the inductance per metre and the capacitance per metre of the line. Assume R = G = 0. 5

7. (a) Define Standing Wave Ratio and draw the voltage standing wave patterns for the following : 5

(i) Matched load

(ii) Short-circuited line

(iii) Open-circuited line

(b) Using equivalent circuit of a transmission line, derive the expressions for phase and attenuation constant. 5

8. (a) A 50 Ω transmission line is terminated in a load with $Z_L = 100 + j50$ Ω. Find the voltage reflection coefficient and VSWR. 5

(b) What is the significance of a Smith chart ? Write the centre and radius expressions for it. 5

9. (a) Define a waveguide. Draw a comparison between waveguides and 2-wire transmission lines. *5*

(b) Determine the cut-off wavelength for the dominant mode in a rectangular waveguide of breadth 10 cm. For a 2·5 GHz signal propagated in this waveguide in the dominant mode, calculate the guide wavelength, the group velocity and the phase velocity. *5*

10. Write short notes on any ***two*** of the following : *2×5=10*

(a) Displacement Current

(b) Gauss's Law

(c) Cylindrical to Spherical Transformation