F 3103 (Pages : 3) Reg. No.....

Name.....

# B.TECH. DEGREE EXAMINATION, NOVEMBER 2014

## Third Semester

Branch—Electrical and Electronics Engineering

ELECTROMAGNETIC THEORY (E)

(Prior to 2010 Admissions—Old Scheme)

[Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

## Part A

*Answer* **all** *questions briefly.*
*Each question carries* 4 *marks.*

1. Show how a point P is represented in a spherical co-ordinate system ?
2. State the various types of charge distributions, giving one example of each.
3. What is divergence ? State expressions for divergence in various co-ordinate system.
4. Define an electric dipole. State expression of $\bar{E}$ due to an electric dipole.
5. Derive an equation for the capacitance per metre length of two long parallel conductors with radius R separated by distance $d$ in air.
6. Explain the concept of field polarization in dielectrics.
7. Explain the concept of steady magnetic field and conduction current.
8. A charged particle passes through a magnetic field without experiencing any force. What can you conclude about the magnetic field ?
9. Explain how Faraday's law can be used to extend one of the Maxwell's equations from static to time-varying electromagnetic fields.
10. If H = 5.5 mA/m in a medium with $\epsilon_r = 3.3$ and $\mu = \mu_0$ at 300 MHz, calculate the average Poynting vector.

(10 × 4 = 40 marks)

## Part B

*Answer* **all** *questions.*
*Each full question carries* 12 *marks.*

11. (a) Given the vector field $\bar{W} = 2x^2y\,\bar{a}_x - 2(z - x)\,\bar{a}_y + 3xyz\,\bar{a}_z$. Find (i) $\bar{W}$ at P (2, – 3, 4) ; (ii) Unit vector in the direction of $\bar{W}$ at $p$ ; (iii)The equation of surface on which the $\bar{W} = 100$ ; and (iv) the $y$-co-ordinate of Q (– 3, $y$, 5) such that $|\bar{W}$ at Q $| = 100$ and $y > 0$.

**Turn over**

(b) Find the electric field intensity at a point (0, 0, 5) meter due to two charges $Q_1 = 0.35\ \mu C$ at (0, 4, 0) and $Q_2 = -0.55\ \mu C$ at (3, 0, 0).

*Or*

12. (a) A uniform line charge of 20 nc/m is located at $y = 3$, $z = 6$ in free space. Find $\bar{E}$ at :

(i) (2, – 1, 4) meter ; (ii)at the point in $z = 0$ plane where the direction of $\bar{E}$ is $0.33\ \bar{a}_y - 0.66\ \bar{a}_z$.

(b) A dipole of moment $\bar{p} = 6\ \hat{a}_z\ \mu c/m$ is located at the origin in free space. Find electric field intensity $\bar{E}$ at (4, 20°, 0°).

13. (a) Verify that the expression for the potential due to an electric dipole satisfies the Laplace equation.

(b) Determine the electric field intensity of an infinitely long, straight, line charge of a uniform density $\lambda$ in air.

*Or*

14. (a) Derive Laplace's and Poisson's equations in relation with electrostatic field.

(b) Given the potential field $V = 50x^2yz + 20y^2$ volts in free space. Find : (i) V at P (1, 2, 3) ; and (ii) $E_p$.

15. (a) Explain the condition at boundary between two dielectrics.

(b) A parallel plate capacitor of 12 cm × 12 cm and $d = 1$ cm is charged to a potential of 1 kV with air as dielectric. Find the energy stored.

*Or*

16. Derive the expression for capacitance of a coaxial cable using Laplace's equation.

17. (a) Calculate the force per unit length between two parallel infinite conductors carrying current I Amp ;-(i) in the same direction ; and (ii) in the opposite direction.

(b) Calculate the inductance of a solenoid, if the radius is 5 cm, length is 40 cm, N = 500, $\mu_r = 1000$ and I = 10A.

*Or*

18. (a) State and explain Ampere's circuital law.

(b) Two narrow circular coils A and B having a common axis, are placed 10 cm apart. Coil A has 10 turns of radius 5 cm with a current of 1.0 A passing through it. If the magnetic field at the centre of the coil A to be zero, what current should be passed through the coil B, if coil B has single turn with radius 7.5 cm ?

19. (a) Starting from Maxwell's equations, derive an expression for wave equation in $\bar{H}$ for uniform plane waves in a conducting medium for sinusoidal time variations of the fields.

(b) Write the phasor form of a uniform plane wave having a frequency of 1 GHz that is travelling in the $+x$ direction in a medium of $\epsilon = 12\,\epsilon_0$ and $\mu = \mu_0$.

*Or*

20. (a) Explain the significance of Poynting vector theorem. Obtain complex Poynting vector theorem.

(b) Explain the concept of uniform plane wave.

(5 × 12 = 60 marks)