USN | | | | | | | | | | |

10ES36

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. State and prove gauss law for electrostatics. **(06 Marks)**

b. If $E = (-8xy\hat{a}_x - 4x^2\hat{a}_y + \hat{a}_z)$ V/mt. Find the work done in carrying a 6 C charge from A(1, 8, 5) to B(2, 18, 6) along the path $y = 3x + 2$, $z = x + 4$ **(06 Marks)**

c. Four point charges each 20 μc are at A(4, 0, 0), B(–4, 0, 0), C(0, 4, 0), D(0, - 4, 0) respectively. Find the force on a 200 μC point charge at (0, 0, 3). **(08 Marks)**

2 a. Derive an equation for divergence of flux density in differential form, and hence explain Gauss divergence theorem. **(08 Marks)**

b. A 15 nC point charge is at the origin in free space. Calculate v_1 if point P is located at (2, -3, -1). Also calculate v_1 at P if $v = 0$ at (6, 5, 4) **(06 Marks)**

c. Deduce an expression for energy and energy density in an electro static field. **(06 Marks)**

3 a. Using Poisson's equation, obtain the expression for junction potential in a p-n junction. **(08 Marks)**

b. Derive Laplace's equation and hence write the expression for Laplacian of V in cylindrical and spherical co-ordinates. **(06 Marks)**

c. Find E at P(3, 1, 2) for the field of two co-axial conducting cylinders. V = 50 V at r = 2 m, V = 20 V at r = 3 m. **(06 Marks)**

4 a. Derive an expression for magnetic flux density ($\vec{B}$) due to straight conductor of finite length. **(06 Marks)**

b. If $\vec{H}$ in a region is $2x\hat{a}_y + (3y - 2)\hat{a}_z$, find the current density at the origin. **(06 Marks)**

c. Given the magnetic field $\vec{H} = 2r^2(z+1)\sin\phi\hat{a}_\phi$, verify Stoke's theorem for the portion of cylindrical surface defined by $r = 2$, $\frac{\pi}{4} < \phi < \frac{\pi}{2}$, $1 < z < 1.5$. **(08 Marks)**

PART – B

5 a. Find the magnetic flux density due to long current carrying conductor using vector magnetic potential. **(08 Marks)**

b. Derive the expression for boundary conditions, if the field lines are tangent and normal to the boundary line between two media's in static magnetic field. **(06 Marks)**

c. A solenoid with air core has 2000 turns and a length of 500 mm, core radius 40 mm. Find its inductance. **(06 Marks)**

6 a. Derive the modification of Ampere's circuit law to suit for time varying conditions. **(06 Marks)**

b. Explain Maxwell's equations in point and integral form. Establish relationship between conduction current density and displacement current density for the given field $E = E_0 \sin \omega t$ **(08 Marks)**

c. Do the fields $E = E_m \sin x \sin t \hat{a}_y$ and $\vec{H} = \frac{E_m}{\mu} \cos x \cos t \hat{a}_z$. Satisfy Maxwell's equations. Verify. **(06 Marks)**

7 a. Derive an expression for electric and magnetic wave equations. **(06 Marks)**

b. For an electromagnetic wave propagating in free space, show that $\frac{E}{H} = \eta$. **(08 Marks)**

c. Find skin depth and surface resistance of copper conductor at 100 MHz having conductivity $\sigma = 5.8 \times 10^7$ ℧/m and $\mu_r = 100$. **(06 Marks)**

8 a. Explain the reflection of uniform plane wave with normal incidence at a plane dielectric boundary. **(10 Marks)**

b. Write short notes on:
(i) Reflection co-efficient.
(ii) Standing wave ratio. **(10 Marks)**

* * * * *