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| Programme: | B.E. | Branch | ECE |
| Academic Year: | 2017-2018 | Year/Semester/Section | II Year/ III Sem/I & II |
| Course Code: | **161EC33** | Course Name | **ELECTROMAGNETIC FIELDS**  |
| Course Tutor(s): | Section I: Mrs. P.Krishnaleela AP/ECE Section II: Dr.P.Ranjith kumar ASP/ECE  |

**QUESTION BANK**

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| **UNIT- I STATIC ELECTRIC FIELDS** |
| **PART - A** |
|  | Define electric field intensity. |
|  | A uniform spherical volume charge distribution contains a total charge of 10-8C. If the radius of this spherical volume is 2×10-2m. Find volume charge density ρV. |
|  | Relate solenoidal and irrotational vectors. |
|  | Translate the Cartesian co-ordinates x = 100, y = 50, z = 100 into spherical co-ordinates. |
|  | Apply the principle of superposition in electric fields. |
|  | Define Coulomb’s law in vector form. |
|  | Define Gauss’s law.  |
|  | Define electric flux and electric flux density. |
|  | Identify the divergence of the vector in three coordinate systems. |
| **PART-B** |
|  | Determine the electric field intensity at P (-0.2, 0, -2.3), due to a point charge of 5nc at Q(0.2,0.1,-2.5) in air. All dimensions are in meters. | 8 |
|  |  Illustrate an expression for electric filed due to continuous charge distribution.  | 8 |
|  | Two charges 4 x $10^{-8}$ & 6 x $10^{-5}$ C are spaced 10 cm apart. (i) Find the force of interaction in vacuum. (ii) Find the force of interaction in kerosene (εr = 2). | 8 |
|  | If F= $ 4xy \overbar{a}\_{x}+ y^{2} \overbar{a}\_{y}+2yz \overbar{a}\_{z}$ , then find the divergence F and curl F. | 8 |
|  | Explain the effect of field of line charge.  | 8 |
|  |  Demonstrate the cylindrical coordinate system through differentials elements. | 8 |
|  | Illustrate an expression of electric filed intensity due to a sheet of charge.  | 8 |
|  | Find the force on a charge $Q\_{2}$ = 20 µc at point (2, 0, 0) due to a charge $Q\_{1}$= 10 µc at point (1, 0, 0) in free space. Dimensions are in meters. | 8 |
|  | Illustrate an expression for electric flux density of the volume charge. | 8 |
|  | Define and prove Gauss’s law and Describe any one of the application of Gauss’s law.  | 16 |
| **UNIT-II DIVERGENCE, ENERGY AND POTENTIAL** |
| **PART-A** |
|  | Define Divergence theorem.  |
|  | Distinguish between potential & potential difference. |
|  | Define current density. |
|  | Define boundary conditions. |
|  | What is meant by potential gradient? |
|  | Illustrate an expression of displacement current in electric field. |
|  | What is meant by divergence in a field?  |
|  | Develop Poisson’s equation from Gauss’s law. |
|  | Compare between conservative and non-conservative property. |
| **PART-B** |
|  | Define and prove the divergence theorem.  | 8 |
|  | If a potential V = $x^{2}$yz +A$y^{3}$z, find the value of A so that Laplace equation is satisfied and electric field at (2,-2, 1). | 8 |
|  | What are the energy stored in electric field. | 8 |
|  | Explain in detail about potential gradient.  | 8 |
|  | Find the Laplace of the potential function V = $2x^{2}$+$y^{2}-z^{2}$. | 6 |
|  | Compute the boundary conditions of the normal and tangential components of electric field at the interface of two media with different dielectrics.  | 16 |
|  | Determine the Laplacian operator from poisson’s and Laplace’s equation. | 8 |
|  | Given potential V=$\frac{100sinθ}{r^{2}}$ in free space. Find the electric potential and field intensity at the point located at r= 3m, θ= 60 and Φ= 25. | 8 |
|  | Using Divergence theorem evaluate $∯\_{}^{}\overline{A}. \overbar{ds}$ where A= $ 2xy \overbar{a}\_{x}+ y^{2} \overbar{a}\_{y}+4yz \overbar{a}\_{z}$ and S is a surface of a cube bounded by x=0,x=1 ,y=0,y=1 and z=0,z=1 | 8 |
|  | i) A potential field is given as . Let point *P(0.1,π/12, π/24)* be located at a conductor free space boundary. At point P, find the magnitudes of  a) Voltage (*V* ) b) Electric field intensity *(E)*  c) Electric field density *(D )* d) Surface charge density *(ρs)* | 12 |
| **UNIT-III STEADY MAGNETIC FIELDS** |
| **PART-A** |
|  | Define Biot-Savart’s law. |
|  | Define Ampere’s circuital law. |
|  | How will you show that divergence of a curl of a vector is zero using Stoke’s theorem? |
|  | Find the maximum torque on an150 turns rectangular coil, 0.58m by 0.9m carrying a current of 2A in the field of flux density 5 web/m2. |
|  | Define Stoke’s theorem. |
|  | Categorize the magnetic material based on its behavior. |
|  | Define magnetic field intensity and state its unit. |
|  | What is the permeability of the magnetic material whose susceptibility is *χ = 46?*  |
|  | What is meant by flux density in magnetic field? |
|  | Relate magnetic field intensity and magnetic flux density. |
| **PART-B** |
|  | Formulate the normal and tangential components of magnetic field at the interface of two media with different magnetic materials in a boundary. | 16 |
|  | Obtain an expression of magnetic field intensity due to a finite wire carrying a current I. |  8 |
|  | Extrapolate the torque on a loop carrying a current I with magnetic moment. |  8 |
|  | Define Ampere’s circuital law and explain any two applications of Ampere’s Circuital law. |  16 |
|  | Let $\vec{A}$= (3y-z)$\vec{ax}$+2xz $\vec{ay}$ Web/m in a certain region of free space a) Show that $∇$.A = 0. b) At P(2, -1, 3) determine $\vec{A}$,$ \vec{B}$,$\vec{ H}$ and $\vec{ J}$. |  16 |
|  | In cylindrical coordinates $\vec{j}$=10$e^{-100r}\vec{aφ}$ A/$m^{2}$ find the current crossing through the region 0.01$\leq r\leq $0.02 m, 0<z$\leq $1 m and intersection of this region with the constant plane. | 8 |
|  | Evaluate both sides of the stokes theorem for the field $\vec{H}$=2xy $\vec{a\_{x}}$ -6$y^{2}\vec{ a\_{y}}$ A/m and the rectangular path around the region, 2$\leq $x$\leq $5, -1$\leq $y$\leq $1, z=0.Let the positive direction of $\vec{ds}$ be $\vec{az}$. | 8 |
|  | At a point p (x, y, z) the components of vector magnetic potential $\vec{A}$ are given as Ax= 4x+3y+2z, Ay= 5x+6y+3z and Az= 2x+3y+5z. Determine B at point p and state its nature. |   8 |
|  | Solve the Laplace equation for the potential field in homogeneous region between two concentric conducting spheres with radii *a* and *b* , such that *b > a* , if *V=0* at *r=b* and *V=V0* at *r=a*. Find the capacitance between the two concentric spheres. |  16 |
| **UNIT-IV ELECTROMAGNETIC FORCE AND TIME VARYING FIELDS** |
| **PART-A** |
|  | What is mean by Pointing vector? |
|  | Define Lorentz force equation. |
|  | Define Snell’s law. |
|  | Define Faraday’s law. |
|  | What is mean by Power vector? |
|  | What is point form of Maxwell’s equations? |
|  | Define Pointing theorem. |
|  | What is integral form of Maxwell’s equations? |
| **PART-B** |
|  | Develop the point and integral form of Maxwell’s equation in static and time varying fields.  |  8 |
|  | Criticize a Lorentz force equation for a moving charge and utilize a force on a differential current element. |  16 |
|  | Find the skin depth at a frequency of 2 MHz for aluminum where σ = 3.2 Ms/m & µr = 1. |  8 |
|  | Determine the displacement current within a parallel plate capacitor where ε= 10ε0, A = 0.01 m2, and d = 5 cm and the capacitor voltage is 100sin(314t) volts. |  8 |
|  | Explain Faraday’s law for electromagnetic induction | 16 |
|  | Explain pointing theorem and pointing vector. | 16 |
|  | Explain in detail about the power vector | 8 |
| **UNIT-V ELECTROMAGNETIC WAVES** |
| **PART-A** |
|  | Calculate the characteristics impedance of free space. |
|  | Find the velocity of a plane wave in loss less medium having relative permittivity of 4 and relative permeability of 1.2. |
|  | Illustrate the principle of Skin Effect. |
|  | What is mean by Brewster angle? |
|  | What is meant by Wave Equation? |
|  | Define law of reflection. |
| **PART-B** |
|  | Illustrate an expression for propagation of wave in free space(or) wave equation  | 16 |
|  | Discuss the Wave Propagation in Lossy dielectrics and Lossless Dielectrics | 16 |
|  | Discuss the Plane waves in free space and plane waves in good conductors | 16 |
|  | A sinusoidal plane wave is transmitted through medium those electric field strength is 10 Kv/m and relative permittivity of the medium is 4. Determine the rms power flow/unit area? |  8 |
|  | A polystyrene has a relative permittivity of 2.7. If a wave is incident at an angle of θi = 30 from air into polystyrene. Calculate the angle of transmission. |  8 |
|  | Explain normal incidence of reflection of plane waves on perfect conductor. |  16  |
|  |  Explain oblique incidence of reflection of plane waves on perfect conductor. | 16 |