NEW SCHEME

EC44

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Fourth Semester B.E. Degree Examination, January/February 2005

BM/EC/EE/TE/ML/IT

Field Theory

Time: 3 hrs.] [Max.Marks : 100

Note: ***1) Answer any FIVE full questions.***
2) Assume the missing data, if any.

1. (a) State and explain Coulomb's law of force between two point charges and mention the units of quantities in the force equation. **(5 Marks)**

(b) Two particles having charges 2 nano Coulomb and 5 nano Coulomb are spaced 80 cm apart. Determine the electric field intensity at a point P situated at a distance 0.5 meters from each of the two particles. Assume the medium to be bakellite having dielectric constant of 5. **(10 Marks)**

(c) Find the electric field strength at the point $M(1,2,-1)$, given the potential $V = 3x^2y + 2yz^2 + 3xyz$. **(5 Marks)**

2. (a) Show that the electric field at any point due to an infinite sheet of charge is independent of the distance to the point from the sheet. **(10 Marks)**

(b) A uniform line charge of linear charge density 25 nano Coulomb/m lies on the line $x = -3m$, $y = 0$ and $z = 4m$ in free space. Find the electric field intensity at a point $(2,15,3)m$. **(5 Marks)**

(c) A point charge of 30 nano Coulomb is located at the origin in Cartesian coordinates. Find the electric flux density D at $(1,3,-4)m$ **(5 Marks)**

3. (a) State Gauss's law. Obtain Gauss's law in point form. **(5 Marks)**

(b) Obtain the boundary conditions for perfect dielectric materials of permittivities ϵ_1 and ϵ_2. **(5 Marks)**

(c) At the boundary between glass ($\epsilon_r = 4$) and air, the lines of electric field make an angle of 40^0 with normal to the boundary. If electric flux density in air is 0.25 micro Coulomb/m^2, determine the orientation and magnitude of electric flux density in air. **(10 Marks)**

4. (a) Using Laplace's equation, derive the expression for the potential at a point in an infinitely long co-axial cable with inner radius a and outer radius b. **(12 Marks)**

(b) A spherical condenser has capacitance of 54 pico farad. It consists of two concentric spheres differeing in radii by 4 cm and having air as dielectric. Find their radii. **(8 Marks)**

5. (a) Obtain the expression for magnetic flux density at a point due to a current carrying straight conductor of finite length. Extend the analysis for the case of infinitely long straight conductor. **(10 Marks)**

(b) Explain the concept of vector magnetic potential. **(5 Marks)**

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(c) A circuit carrying a direct current of 5A form a regular hexagon inscribed in a circle of radius 1m. Calculate the magnetic flux density at the centre of the current hexagon. Assume the medium to be freespace. **(5 Marks)**

6. (a) Obtain the solution of wave equation for uniform plane wave propagating in free space. **(10 Marks)**

(b) Derive wave equation in $\vec{E}$ and $\vec{H}$ for a conducting medium. **(10 Marks)**

7. (a) State and prove Poynting's theorem. **(10 Marks)**

(b) For a uniform plane wave travelling in x - direction in free space, $E_y = 10sin(2\pi \cdot 10^8 t - \beta x)$. Find the phase constant, phase velocity and the expression for H_z, if $E_z = H_y = 0$. **(10 Marks)**

8. Write explanatory notes on :

(a) Statement and proof of divergence theorem.

(b) Uniqueness theorem and its significance.

(c) Maxwell's equation in point and integral forms applicable to time varying fields.

(6+7+7=20 Marks)

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