SID: 18105061

PUNJAB ENGINEERING COLLEGE (Deemed to be University)
Mid-Term Examination

Programme: **B.E. IInd Sem (Aero, ECE, EE)** Semester: **18192**
Course Name: Electromagnetic Theory Course Code: PYN 106
Maximum Marks: 15 Time allowed: 1.5 Hours

NOTE: 1. All questions are compulsory
2. SHOW ALL CALCULATIONS / STEPS

1	Consider a vector field $\vec{A} = 2y\hat{\imath} + x\hat{\jmath}$. Convert this field into other two coordinate systems and determine its divergence at any point (x,y,z) in all the three coordinate systems.	3
2	Verify divergence theorem for field $\vec{A} = r^2 \cos\theta\, \hat{r} + r^2 \cos\emptyset\, \hat{\theta} - r^2 \cos\theta \sin\emptyset\, \hat{\emptyset}$ using as your volume one octant of sphere of radius R.	3
3	A copper sphere of radius 4 cm carries uniformly distributed charge of 5 μC on its surface in free space. Find (a) $\overrightarrow{D}$ external to sphere (b) total energy stored in the electrostatic field (c) capacitance of the isolated sphere.	3
4	A coaxial cable has inner radius 5 mm and outer radius of 8 mm. if the cable is 3 km long, calculate its capacitance. Assume $\varepsilon = 2.5\varepsilon_o$	3
5	A unit vector directed from region 1 to region 2 at the planar boundary between two perfect dielectrics is given as $\hat{a}_{N12} = -\frac{2}{7}\hat{\imath} + \frac{3}{7}\hat{\jmath} + \frac{6}{7}\hat{k}$. Assume $\varepsilon_{R1} = 3$, $\varepsilon_{R2} = 2$ and $\overrightarrow{E_1} = 100\hat{\imath} + 80\hat{\jmath} + 60\hat{k}\ \frac{V}{m}$. Find $\overrightarrow{E_2}$.	3

SID: 1810506

PUNJAB ENGINEERING COLLEGE (DEEMED TO BE UNIVERSITY), CHANDIGARH

End-Term Examination

Programme: **B.E (Aero, ECE, EE)**
Course Name: Electromagnetic Theory
Maximum Marks: **40**

Year/Semester: 2nd SEM
Course Code: PYN-106
Time allowed: **3 Hours**

Notes:

- All questions are compulsory.
- Unless stated otherwise, the symbols have their usual meanings in context with subject. Assume suitably and state, additional data required, if any.
- The candidates, before starting to write the solutions, should please check the question paper for any discrepancy, and also ensure that they have been delivered the question paper of right course code.

Q.No		Marks
1	Let $V = \frac{sin\theta cos\phi}{r}$, Determine (a) $\nabla \times \nabla V$ and (b) $\nabla \cdot \nabla V$	4
2	Check divergence theorem for the function $\vec{A} = r^2 sin\theta\, \hat{r} + 4r^2 cos\theta\hat{\theta} + r^2 tan\theta\hat{\phi}$ for volume of ice cream cone. Top surface is spherical surface (radius R) and centered at origin.	4
3	Two homogeneous dielectric regions 1 ($\rho \leq 4\ cm$) and 2 ($\rho \geq 4\ cm$) have dielectric constants 3.5 and 1.5, respectively. If $\vec{D}_2 = 12\hat{a}_\rho - 6\hat{a}_\phi + 9\hat{a}_z\ nC/m^2$. Calculate $\vec{E}_1$, $\vec{P}_2$, ρ_{pv2} and energy density for each region.	4
4	Two conducting cones ($\theta = \pi/10$ *and* $\theta = \pi/6$) of infinite extent are separated by an infinitesimal gap at $r = 0$. If $V\left(\theta = \frac{\pi}{10}\right) = 0$ and $V(\theta = \pi/6) = 50\ V$, Find V and **E** between the cones.	4
5	A spherical capacitor with $a = 1.5\ cm$ and $b = 4\ cm$ has inhomogeneous dielectric of $\epsilon = 10\epsilon_0/r$. Calculate the capacitance of the capacitor.	4
6	An infinitely long conductor of radius a carries a uniform current with $\vec{J} = J_0\hat{a}_z$. Find magnetic vector potential for $\rho < a$.	4
7	The xy-plane serves as the interface between two different media. Medium 1 ($z < 0$) is filled with a material whose $\mu_r = 6$ and medium 2 ($z > 0$) is filled with material whose $\mu_r = 4$. If the interface carries current $(1/\mu_0)\hat{a}_y\ mA/m$. And $\vec{B}_2 = 5\hat{a}_x + 8\hat{a}_z$ mWb/m^2. Find $\vec{H}_1$ *and* $\vec{B}_1$	4
8	Two coaxial circular loop wires of radius a and b (b > a) are separated by distance h (h >> a, b). Find mutual inductance between two wires.	4
9	In a free space ($z \leq 0$), a plane wave with $H_i = 10\cos(10^8 t - \beta z)\,\hat{a}_x$ mA/m is incident normally on a lossless medium ($\epsilon = 2\epsilon_0$, $\mu = 8\mu_0$) in a region $z \geq 0$. Determine the reflected wave H_r and E_r and transmitted wave H_t and E_t.	4
10	In a lossless dielectric for which $\eta = 60\,\pi, \mu_r = 1, and\ \vec{H} = -0.1\cos(\omega t - z)\,\hat{a}_x + 0.5\sin(\omega t - z)\hat{a}_y\ A/m$, calculate $\epsilon_r, \omega\ and\ \vec{E}$.	4

S. Sharma