SUBJECT CODE:- 256
FACULTY OF ENGINEERING AND TECHNOLOGY
T.E.(EC/ECT/IEC/E&C) Examination Nov/Dec 2015
Electromagnetic Engineering
(Revised)

[Time: Three Hours] **[Max. Marks: 80]**

"Please check whether you have got the right question paper."

N.B
i) Q 1 and Q 6 are compulsory.
ii) Solve any two questions from Q.2, Q.3 Q.4 and Q.5 in section A
iii) Solve any two questions from Q.7, Q.8 Q.9 and Q.10 in section B
iv) Figures to the right indicate full marks.
v) Assume suitable data wherever necessary and mention it clearly

Section A

Q.1 Solve any 2 — 10

a) Explain Gauss Law
b) Derive divergence theorem ($\oint D.ds = \int \nabla.D.dv$)
c) Derive boundary conditions for perfect dielectric materials.
d) Write the table of dot products of unit vectors in cylindrical and rectangular coordinate systems.

Q.2 a) Express in cylindrical components i) The vector from C (3,2,-7) to D(-1,-4,2) ii) A unit vector at D directed towards C iii) A unit vector at D directed towards origin. — 07

b) Given the vectors, r_A=--a_x—3a_y-4a_z and r_B=2a_x+ 2a_y+2a_z and point C(1,3,4) find i) R_{AB} ii)$|r_A|$ iii) a_A d) a_{AB} iv) A unit vector directed from C toward A. — 08

Q.3 a) A uniform volume charge density of 0.2 $\mu C/m^2$ is present throughout the spherical shell extending from r=3 cm to r=5cm. if $\rho_v = 0$ elsewhere find i) the total charge present in the shell and ii)r_1 if half the total charge is located in the region 3cm<r<r_1 — 07

b) Four infinite uniform sheets of charge are located as follows: — 08
20pC/m^2 at y=7, --8pC/m^2 at y=3, 6pc/m^2 at y=--1
And -18 pC/m^2 at y=--4. Find $\bar{E}$ at point (2,6,--4)

Q.4 a) Two uniform line charge 8 nC/m each located at x=1, z=2 and at x=--1, y=2 in free space. If the potential at the origin is 100 V find V at P(4,1,3) — 07

b) Two perfect dielectrics have relative permittivity $\varepsilon_{R1} = 2\ and\ \varepsilon_{R2} = 8$. The planar interface between them is the surface x—y+2z=5. The origin lies in region 1. If $E_1 = 100a_x + 200a_y - 50a_z$ V/m, find $\bar{E}_2$ — 08

Q.5 a) Given the potential V=100(x^2-y^2) and a point P (2,--1,3) that is stipulated to lie on a conductor free space boundary. Find V,$\bar{E}$, $\bar{D}$ and ρ_s at point P. — 10

b) Explain in detail potential gradient — 05

SECTION-B

Q.6 Solve any 2 — 10

a) Derive the equation of standing wave when a uniform plane wave is incident at a perfect dielectric and perfect conductor interface
b) Applying Maxwell equations to boundary conditions between two physical media derive the relationships between E,D,B and H at boundary
c) Using Biot Savart law derive the expression of $\bar{H}$ due to infinitely long straight conductor along the Z axis
d) Write Maxwell's equations in point form and integral form.

Q.7 a) Given point A(1,2,4), B(-2,-1,3) and C(3,1,-2), let a differential element with I=6A and $|dL| = 10^{-4}m$ be located at A. the direction of dL is from A to B. find d$\bar{H}$ at C — 07

b) Find $\bar{H}$ at P(2,3,5) in Cartesian coordinates if there is an infinitely long current filament passing through the origin and point C. the current of 50A is directed from the origin to C where the location of C is (0,0,1) — 08

Q.8 a) Within a certain region $\varepsilon = 10^{-11}$F/m and $\mu = 10^{-5}$H/m. if $B_x = 2 \times 10^{-4}\cos(10^5 t)\sin(10^{--3}y)$ T — 07

i. Use $\nabla \times H = \in \frac{\partial E}{\partial t}$ to find $\bar{E}$

ii. Find the total magnetic flux passing through the surface x=0,0<y<40m, m,0<z<2m at t=$1_{\mu s}$

b) Find the amplitude of the displacement current density i) in the air near a car antenna where the field strength of an FM signal is $\bar{E} = 80\cos(6.277 * 108\, t — 2.092y)a_y$ V/m 08

ii) in an air space within a large transformer where $\bar{H} = 106\cos(377t + 1.2566 * 10 - -6 * z)\, a_y A/m$

Q.9 a) A 9375 MHz uniform plane wave is propagating in polyethylene with $\varepsilon_r = 2.26,\ \ \mu_r = 1$. If the amplitude of electric field intensity is 500 V/m and the material is assumed to be lossless. Find i) phase constant ii) wavelength iii) velocity iv) intrinsic impedance v) propagation constant 07

b) For a 30GHz uniform plane wave calculate the wavelength and attenuation if the wave is propagating in a non magnetic for which i) $\varepsilon_r = 1\ and\ \sigma = 0$ ii) $\varepsilon_r = 1.01\ \ and\ \ \sigma = \frac{10^{-3}S}{m}$ iii) $\varepsilon_r = 2.1\ \ and$ 08

c) $\sigma = 5\ S/m$

Q.10 a) Let $\bar{H} = -y(x^2 + y^2)a_x + x(x^2 + y^2)a_y A/m$ in the z=0 plane for $-5 \leq \times \leq 5m\ and - 5 \leq y \leq 5m$ find the total current passing through the z=0 plane in the az direction inside the rectangle –1<x<1m and –2<y<2m by I=$\oint H.dL$ 10

b) Explain Faraday's law in detail. 05