B.E. (Electronics Engineering / Elect. Telecommunication / Elect. Communication Engineering) Fourth Semester (C.B.S.)

Electromagnetic Fields

NRJ/KW/17/4410/4415

Max. Marks: 80

Notes:

Time: Three Hours

- 1. All questions carry marks as indicated.
- Solve Question 1 OR Questions No. 2.
- 3. Solve Ouestion 3 OR Ouestions No. 4.
- 4. Solve Question 5 OR Questions No. 6.
- Solve Question 7 OR Questions No. 8. 5.
- Solve Question 9 OR Questions No. 10. 6.
- 7. Solve Question 11 OR Questions No. 12.
- 8. Due credit will be given to neatness and adequate dimensions.
- 9. Assume suitable data whenever necessary.
- 10. Illustrate your answers whenever necessary with the help of neat sketches.
- 11. Use of non programmable calculator is permitted.

1. a)

Given points A (2, 5, -1), B (3, -2, 4) and C (-2, 3, 1) find

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- RAB·RAC i)
- Angle between \overrightarrow{R}_{AB} and \overrightarrow{R}_{AC} .
- iii) The length of projection of RAB on RAC
- iv) The vector projection of \vec{R}_{AB} on \vec{R}_{AC} .

b)

Four infinite sheets of charge are located as

$$20 \text{ pc/m}^2$$
 at y = 7, -8 pc/m^2 at y = 3

$$6 \text{ pc/m}^2 \text{ at } y = -1, \text{ and } -18 \text{ pc/m}^2 \text{ at } y = -4$$

Find E at

i) (2, 6, 4)

(0, 0, 0)

iii) (-1, -1.1, 5)

iv) $(10^6, 10^6, 10^6)$

OR

2. a)

- Derive an expression for electric field Intensity at any point due to infinite line charge along z axis.

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Given the flux density $\overrightarrow{D} = \frac{2\cos\theta}{r^3} \overrightarrow{ar} + \frac{\sin\theta}{r^3} \overrightarrow{a\theta} c/m^2$. Evaluate both sides of divergence b) theorem for the region defined by 1 < r < 2, $0 < \theta < \pi/2$, $0 < \phi < \pi/2$.

3. a) State and Explain Biot Savart law.

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- Find the vector magnetic field Intensity in Cartesian coordinate at point (1.5, 2, 3) caused b) by the current filament of 24A in az direction on z axis and extending from
- 7

- i) z=0 to z=6
- ii) z = 6 to $z = \infty$
- iii) $z = -\infty$ to $z = \infty$

- Derive the continuity equation $\nabla \cdot J = -\frac{\partial}{\partial t} \rho v$. 4. a)

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b) State and Explain Ampere's circuital law and stoke's theorem.

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- 5. Derive Maxwell's equation for time varying field in point form and Integral form.
- 13

- OR
- Write short note on conduction current and Displacement current densities.

 Select the value of 1 6. a)

6 7

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- Select the value of k such that each of the following pairs of fields satisfies Maxwell's equation in the region where $\sigma = 0 \ \text{and} \ \rho_v = 0$ i) $\vec{E} = (kx-100t) \ a\hat{y} \ v/m$ b)

$$\overrightarrow{H} = (x + 20t) \text{ a2 A/m}$$

 $\mu = 0.25 \text{ H/m}, \in = 0.01 \text{ F/m}.$

ii) $\overrightarrow{D} = 5x \, a\hat{x} - 2y \, a\hat{y} + kz \, a\hat{z} \, \mu c/m^2$ $\overrightarrow{B} = 2 \, a\hat{y} \, mT$ $\mu = \mu_0$ $\varepsilon = \varepsilon_0$ Prove that an intrinsic impedance of the medium is

$$\vec{B} = 2 \hat{ay} \text{ mT}$$

$$\mu = \mu_0$$

$$\varepsilon = \varepsilon_0$$

$$\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}} \, \Omega$$

7.

- A 9375MHz uniform plane wave is propagating in polystyrene having $\varepsilon_r = 2.56$. If the b) amplitude of \overline{E} is 20V/m and the material is assumed to be lossless. Find
 - The phase constant i)
 - ii) The wavelength in polystyrene
 - iii) The velocity of propagation
 - The intrinsic impedance iv)
 - The propagation constant v)
 - The amplitude of magnetic field intensity vi)

OR

8. a) State and derive Poynting vector theorem.

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- A plane wave of 200MHz travelling in free space impinges normally on a large block of b) material having $\varepsilon_r = 4$, $\mu_r = 9$, $\sigma = 0$ Determine η_1 , η_2 , β_1 , β_2 , reflection coefficient and transmission coefficient.

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9. Derive the Expression for Rectangular waveguide. a)

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$$\lambda_{g} = \frac{\lambda}{\sqrt{1 - (\lambda/\lambda_{c})^{2}}}$$

b) A hollow rectangular waveguide has inner dimensions 7cm×4cm find cut off freq. in T_{E01} , T_{E10} , T_{E11} mode.

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OR

10. Derive the Expression for group velocity and phase velocity in Rectangular waveguide. a)

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b) What will be the cut off wavelength for dominant mode in rectangular waveguide whose breadth s 10cm for 2.5 GHz signal, Calculate.

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- Guide wavelength
- ii) Group velocity
- iii) Phase velocity
- Cut off frequency iv)
- Wave Impedance v)

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Given that average power radiated by a current carrying element is $\frac{\eta}{2} \left(\frac{\text{wI dl } \sin \theta}{4\pi rc} \right)^2$. Find 11. a) the expression for the total radiated power. Thus find radiation resistance.

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b) Explain the concept of "Retarded Magnetic Vector Potential".

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- 12. Define the following terms. a)
 - **Radiation Intensity**
- ii) Directive Gain

Power Gain iii)

- Beam Width iv)
- Front to Back Ratio v)
- vi) Antenna Efficiency
- A monopole antenna of height 10cms operate at a frequency of 300MHz and is situated b) 6 above ground. Find its radiation resistance.

OR
