KUMARAGURU college of technology
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Register Number:……..

B.E DEGREE EXAMINATIONS: JUNE 2015

(Regulation 2009)

Third Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE104: Electromagnetic Fields

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which of the following is not a scalar field?
   a) Humidity of a city
   b) Temperature distribution in your classroom
   c) Atmospheric pressure in a given region
   d) Wind velocity of atmosphere
2. The distance between the points A(2, π/6,0) and B(1,π,2) is ----------
   a) 2.53
   b) 3.53
   c) 4.53
   d) 3.83
3. If $\vec{A}$ is vector magnetic potential, then ----------
   a) ∇ x A =0
   b) ∇ x A = B
   c) ∇ x B = A
   d) ∇ . A = B
4. The magnetic field intensity of any point P due to infinite long straight filament is given as -----
   a) $\vec{H} = \frac{1}{2\pi\rho}\vec{a}_\phi$
   b) $\vec{H} = \frac{I}{2\pi\rho}\vec{a}_\phi$
   c) $\vec{H} = \frac{1}{4\pi\rho}\vec{a}_\phi$
   d) $\vec{H} = \frac{1}{\pi\rho}\vec{a}_\phi$
5. The capacitance of a parallel plate capacitor having stored energy of 5µJ with a voltage between the plates of 4V is ----------
   a) 0.5µF
   b) 0.625µF
   c) 5µF
   d) 6.25nF
6. The product of number of turns and the flux linking them is called as ----------
   a) Flux linkage
   b) Magnetic flux density
   c) Flux density
   d) Electric flux density
7. The ratio of displacement current to the cross sectional area of plates of capacitor is called ------
   a) Conduction current density
   b) Displacement current density

c) Convection current density d) Conduction Current

8. Maxwell's third equation for air medium is

a) $\nabla \times A = B$ b) $\nabla . B = 0$

c) $\nabla . D = 0$ d) $\nabla . D = \rho$

9. The wave equation for free space in terms of $\vec{E}$ is ----------

a) $\nabla^2 \vec{E} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}$ b) $\nabla^2 \vec{E} = \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t^2}$

c) $\nabla \vec{E} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}$ d) $\nabla \vec{E} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}$

10. Which one of the following is correct for a good conductor?

a) $\frac{\sigma}{\omega\varepsilon} >> 1$ b) $\frac{\sigma}{\omega\varepsilon} << 1$

c) $\frac{\sigma}{\omega\varepsilon} = 1$ d) $\sigma = 0$

PART B (10 x 2 = 20 Marks)

11. Convert the point P (2, 3,-1) from Cartesian to Cylindrical co-ordinate system.
12. State Coulombs law of electric force.
13. State Biot –Savart's Law.
14. State Ampere's circuital law.
15. Find the magnitude of D for a dielectric material in which E = 0.15 mV/m and $\chi_e = 4.25$.
16. Obtain an expression for continuity equation for current.
17. Write down the expressions for Instantaneous, complex and average poynting vectors.
18. For a lossy dielectric σ = 5 s/m and ε_r =1. The electric field intensity E = 100 $\sin 10^{10}$ t. Find J_C and J_D
19. Write down the maxwell's equations for non-conducting medium in phasor form.
20. Define Depth of penetration.

PART C (5 x 14 = 70 Marks)

21. a) i) Transform the following vector to cylindrical coordinates at that point specified (7)

$A = 4\ a_x - 2\ a_y - 4\ a_z$ at P(-2,-3,4)

ii) Obtain the expression for Electric field intensity due to charges distributed uniformly on finite line. (7)

(OR)

b) i) State coulombs law. Given $Q_1 = 2 \times 10^{-9}$ C, $Q_2 = -0.5 \times 10^{-9}$ C. Find the force on Q_2 if $R_{12} = 4 \times 10^{-2}$ m. (7)

ii) State Gauss law. Calculate the Electric field intensity of an infinite sheet of charge using Gauss law. (7)

22. a) Using Ampere's circuital law, find the magnetic field intensity due to a co-axial cable carrying a steady current I, lying along z-axis.

(OR)

b) i) Derive an expression for a torque on a closed rectangular loop carrying current I. (10)

ii) Obtain the Lorentz force equation for a moving charge which experiences both electric and magnetic force. (4)

23. a) i) Derive the expression for the capacitance of a parallel plate capacitor. (7)

ii) Check whether the potential fields given below satisfy the Laplace's equation (7)

i) $V = 2x^2 - 3y^2 + z^2$ ii) $V = \rho \cos\phi + z$

(OR)

b) i) Derive the boundary conditions of the normal and tangential components of magnetic field at the interface of two different magnetic materials. (10)

ii) Calculate the inductance of a solenoid of 300 turns wound tightly on a cylindrical tube of 5 cm diameter. The length of the tube is 50 cm and the solenoid is in air. (4)

24. a) Derive Maxwell's equations in integral and point form for a conducting and non-conducting media.

(OR)

b) i) Define Poynting vector and prove that the electromagnetic power flow is the product of electric and magnetic field intensities. (10)

ii) In a free space, $E=150\sin(\omega t-\beta z)a_x$ V/m. Find the average power passing through a rectangular area of sides 30mm and 15 mm in z = 0 plane. (4)

25. a) Using Maxwell's equations, derive the electromagnetic wave equations for a conducting and non-conducting medium.

(OR)

b) i) Define Polarization. What are its types? Explain any two. (7)

ii) Derive the expression for the resultant electric and magnetic field strengths of a EM wave which is incident normally upon the surface of a perfect conductor. (7)

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