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Reg. No. : .....

Name : .....

Fifth Semester B.Tech. Degree Examination, November 2014
(2008 Scheme)
08.505 : APPLIED ELECTROMAGNETIC THEORY (T)

Time : 3 Hours Max. Marks : 100

Instruction : ***Provide*** *Smith chart to students on their* ***request.***

PART – A

Answer **all** questions.

1. Find the distance between $(5, {}^{3\pi}/_{2}, 0)$ and $(5, {}^{\pi}/_{2}, 10)$ in cylindrical co-ordinates.

2. Find relaxation time for quartz having $\sigma = 10^{-17}$ s/m, $\in_r = 5.0$.

3. A circular loop located on $x^2 + y^2 = 9$, $z = 0$ carries a direct current of 10 A. Determine H at $(0, 0, -4)$.

4. Derive the relationship between E, V and A.

5. In a non-magnetic medium $E = 4 \sin \left(2\pi x 10^7 t - 0.8x\right)_{a_z}$ V/m

   Find a) ε_r η and time average power carried by the wave.

   b) total power crossing 100 cm^2 of the plane $2x + y = 5$.

6. Design a quarter wavelength section to match a thin monopole antenna of length 0.24λ having purely resistive feed point impedance of $R_L \simeq 30\,\Omega$ to a transmission line having characteristic impedance of $Z_0 = 100\ \Omega$ (transmission line).

7. Consider a TV antenna lead in wire of length l = 10 cm having a characteristic impedance of $Z_0 = 300\Omega$, shorted at one end. Find its input impedance at 300 MHz.

8. Define the terms characteristic impedance phase and group velocity.

9. Sketch the field patterns inside wave guide for TM_{11} mode.

10. What is critical about number K_c ? **(10×4=40 Marks)**

P.T.O.

PART – B

Answer **any 2** questions from **each** Module.

MODULE – I

11.a) Given the potential $V = 10/r^2 \sin\theta\cos\phi$ find a) flux density D at $(2, \pi/2, 0)$

b) calculate the workdone in moving a 10μ c charge from A (1, 30°, 120°) to B (4, 90°, 60°). **5**

b) Semi-infinite conducting planes at $\phi = 0$, and $\phi = \pi/6$ are seperated by an infinitesimal insulating gap. If $V(\phi = 0) = 0$ and $V(\phi = \pi/6) = 100$ V. Calculate V and E in the region between the planes. **5**

12. 2 extensive homogeneous isotropic dielectrics meet on plane z = 0. For z > 0, $\varepsilon_{r1} = 4$ and for z < 0, $\varepsilon_{r2} = 3$. A uniform E field exists for $z \geq 0$ by $E_1 = 5ax - 2ay + 3az$ kv/m

Find a) E_2 for $z \leq 0$

b) Angles E_1 and E_2 make with the interface

c) Energy densities (in J/m^3) in both dielectrics.

d) The energy within a cube of side 2m centered at (3, 4, – 5). **10**

13. a) In air $E = \frac{\sin\theta}{r} \cos(6\times10^7 t - \beta_r)\, a\phi$ v/m. Find β and H. **5**

b) A conducting bar slide freely over 2 conducting rails. Calculate voltage induced in bar if

a) bar slides at a velocity $u = 20\, a_y$ m/s and $B = 4a_z$ M Wb/m^2

b) bar slides at a velocity $u = 20\, a_y$ m/s and $B = 4 \cos(10^6 t - y)\, a_z$ M wb/m^2. **5**

MODULE – II

14. a) E-field in free space is $E = 50 \cos(10^8 t - \beta x)\, a_y$ v/m
Find a) Direction of propagation

b) Calculate β and time it takes to travel $\lambda/2$

c) Sketch wave at t = 0, T/4 and T/2. **5**

b) Plane wave propagating through a medium with $\varepsilon_r = 8$, $\mu_r = 2$ has

$E = 0.5\ e^{\frac{-2}{3}} \sin(10^8 t - \beta z)\ a_x$ v/m. Determine a) β, b) loss tangent

c) intrinsic impedance d) wave velocity e) H field. 5

15. In free space ($z \leq 0$) a plane wave with $H_i = 10\cos(10^8 t - \beta z)\ a_x$ m A/M is incident normally on a lossless medium ($\varepsilon = 2\varepsilon_0$, $\mu = 8\ \mu 0$) in the region $z \geq 0$. Determine reflected wave H_r, E_r and transmitted wave H_t, E_t. 10

16. A telephone line has R = 30 Ω / km, L = 100 mH/km, G = 0 and C = 20 μ F/ km at f = 1 kHz.
Find a) Characteristic impedance of line
b) Propagation constant and
c) Phase Velocity. 10

MODULE – III

17. a) A 2m long transmission line operates at $w = 10^6$ rad/s has $\alpha = 8$ dB/m, $\beta = 1$ rad/m, $Z_0 = 60 + j40\ \Omega$. If line is connected to a source of $10 \angle 0°$ V, $Z_g = 40\ \Omega$ and terminated by load $20 + j50\ \Omega$.

Determine
a) Input impedance
b) Sending end currut
c) Current at middle of the line. 4

b) Write notes on lines with losses - DC line, low frequency line and high frequency line. 6

18. A 75 Ω lossless line is matched to a load of 100 – j80 Ω with shorted stub. Calculate stub length, distance from load where stub has to be placed and necessary stub admittance (Use Smith chart). 10

19. Derive the power transmission and attenuation expression for power propagation in waveguide for TE_{10} mode. 10