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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

July / August 2017 Supplementary Semester Examinations

Course:FIELDS AND WAVES — Duration: **3 hrs**
Course Code: **15ES3GCFAW** — Max Marks: **100**

Date: 31.07.2017

Instructions: Answer 5 full questions.

UNIT 1

1 a With usual notations derive boundary conditions at the boundary between a dielectric and a conductor in an electric field. **8**

b Find E at (0,0,5)m due to Q_1=0.35μC at (0,4,0)m and Q_2=-0.55 μC at (3,0,0)m **8**

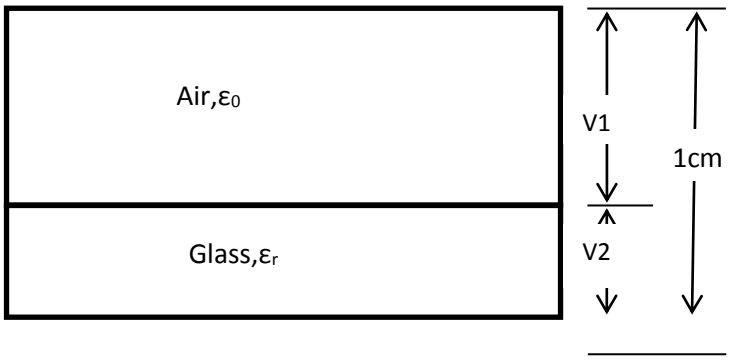
c Derive Maxwell's first equation as applied to the electrostatics,using Gauss's law **4**

OR

2 a Charge is distributed uniformly along an infinite straight line with constant density ρ_l.Develop the expression for E at the general point P. **8**

b With usual notation derive the continuity equation of current **4**

c A parallel plate capacitor with a separation d=1cm has 29kV applied when free space is the only dielectric.Assume that air has a dielectric strength of 30kV/cm.Show why the air breaks down when a thin piece of glass(εr=6.5) with a dielectric strength of 290kV/cm and thicknesses d2=0.20cm is inserted as shown in figure. **8**



UNIT 2

3 a A radial field $\vec{H}$=(2.39x10^6/r) cosϕ $\hat{a}_r$ A/m exists in free space.Find the magnetic flux ϕ crossing the surface defined by –π/4≤ϕ≤ π/4 , 0≤z≤ 1m. **6**

b State and explain Ampere's circuital law. **6**

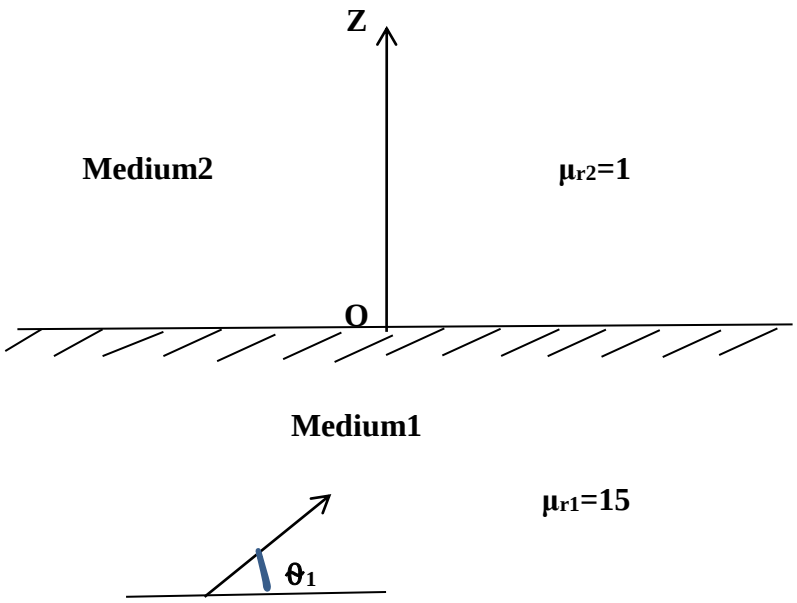
c Obtain the vector magnetic potential A in the region surrounding an infinitely long,straight,filamentary current I. **8**

UNIT 3

4 a Given E=Em sin (ωt-βz) $\hat{a}_y$ in free space,find D,B and H. **5**

b List Maxwell's equation in point form and integral form.. **8**

c In region 1 of figure,$B_1=1.2a_x + 0.8\ a_y + 0.4a_z$ (T).Find H_2(i.e, H at Z=+0) and the angles between the field vectors and a tangent to the interface. **7**



UNIT 4

5 a Derive the point and integral form of Poynting theorem **8**

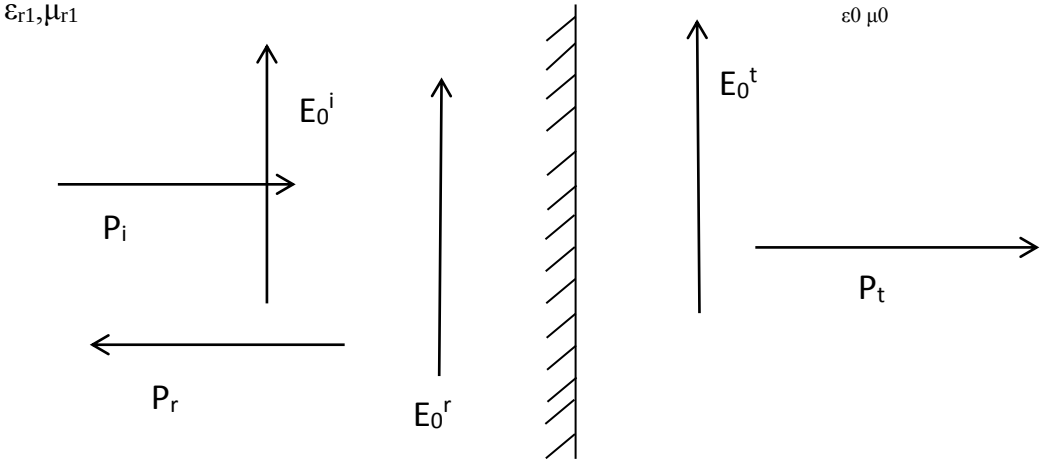
b Find the skin depth δ at a frequency of 1.6MHz in aluminum, where σ=38.2MS/m and μr=1.Also find γ and the wave velocity u. **4**

c An H field travels in the $-\hat{a}_z$ direction in free space with a phase shift constant of 30 rad/m and an amplitude of (1/3π) A/m.If the field has the direction $-\hat{a}_y$ when t=0 and z=0,write suitable expressions for E and H.Determine the frequency and wavelength. **8**

UNIT 5

6 a What is a standing wave?Define SWR.What is its relationship with reflection coefficient **10**

b Determine the amplitudes of the reflected and transmitted E and H at the interface shown,if E_0^i =1.5x10^{-3}V/m in region 1,in which ε_{r1}=8.5,μ_{r1}=1 and σ_1=0.region 2 is free space.Assume normal incidence. **10**



OR

7 a Discuss the reflection of uniform plane waves at normal incidence. Hence derive expressions for transmission and reflection co-efficient. **10**

b A 300MHz uniform plane wave travelling in free space strikes a large block of copper(μ_r=1,ε_r=1 and σ=5.8x10^7 S/m) normal to the surface. If the surface of the copper lies in the yz plane and the wave is propagating in x-direction. Write the complete time domain expre for incident, reflected and transmitted waves. **10**

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