53 (EC 501) ELMW

2014

ELECTROMAGNETIC WAVES

Paper : EC 501

Full Marks : 100

Time : Three hours

*The figures in the margin indicate full marks
for the questions.*

*Answer **any five** questions.*

1. *(a)* Write the Maxwell's equation in differential
form. From the Maxwell's equation derive
the wave equation in conducting medium.

   12

   (b) An electromagnetic wave of $1 MHz$ is
incident on a material which has a
conductivity of $\sigma = 5.8 \times 10^7 \ mhos/m$ and a
permeability approximately equals to that of
free space.   8

   Find —

   (i) Attenuation constant

     (ii) Type of the material

     (iii) Depth of penetration

     (iv) Phase constant.

2. *(a)* Find the relation of transmitted and reflected fields with incident fields of a wave incident on a perfect dielectric normally.   10

    (b) Find the wave impedance for an electromagnetic wave propagating through two parallel conducting plates in free space in *(i)* TE mode *(ii)* TM mode.   10

3. *(a)* For an electromagnetic wave travelling between two parallel conducting plates derive the expression for different field components within the conductor and above the conductor.   12

    (b) An electromagnetic wave with frequency $9GHz$ is guided between two parallel conducting plates in free space separated by a distance of $1cm$. If the mode of propagation is TE_{10} then find —   8

     (i) Critical frequency

     (ii) Phase constant

     (iii) Phase velocity

     (iv) Wave impedance.

4. Obtain the expression for different field components of an electromagnetic wave travelling through a rectangular waveguide in 20

   (i) TE mode

   (ii) TM mode

5. (a) An electromagnetic wave of frequency 15GHz is propagating through an airfield rectangular waveguide of cross section $3 \times 1 \cdot 5 cm^2$ in dominant mode. Find —

   (i) Cut off frequency

   (ii) Phase constant

   (iii) Wave impedance

   Also find all possible modes of propagation. 10

   (b) Explain the transmission line analogy of an waveguide. 10

6. (a) An electromagnetic wave with frequency 9 GHz is travelling through an air-filled circular waveguide of radius 1cm in dominant mode. Determine — 10

   (i) Cut off frequency

   (ii) Phase constant

(iii) Phase velocity

(iii) Wave impedance

(b) Why TEM mode is impossible in waveguides ? At what condition TEM waves can propagate through a wave guide ?   6

(c) Differentiate between a waveguide and a cavity resonator.   4

7.   Write short notes on : $10 \times 2 = 20$

(a) Polarization of EM waves

(b) Coupling of cavity resonator.

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