Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(ECE-OLD)/SEM-4/EC-404/2012

2012

ELECTROMAGNETIC WAVES & RADIATING SYSTEMS

Time Allotted : 3 Hours *Ful Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) The electric field on equipotential surface is

a) unity

b) always parallel to the surface

c) always perpendicular to the surface

d) zero.

ii) The magnetic field produced by a conductor of infinite length, carrying current I at a distance r is given by

a) $\vec{H} = 2\pi r\vec{I}$ b) $\vec{H} = \frac{\vec{I}}{2\pi r}$

c) $\vec{H} = \frac{\vec{I}}{4\pi r}$ d) $\vec{H} = \frac{2\pi r}{\vec{I}}$.

iii) The energy density in an electrostatic field E is

a) $\frac{1}{2}\varepsilon E^2$ b) εE^2

c) $2\varepsilon E^2$ d) $\frac{1}{2}\varepsilon E$.

iv) The unit of electric field is

a) volt b) volt/m

c) coulomb/m d) henry/m.

v) A circularly polarized light results when

a) magnitudes of two waves are same

b) phases of two waves are same

c) magnitudes of two waves are same but phase difference is 90°

d) magnitudes of two waves are same but phase difference is 0°.

vi) The value of intrinsic impedance of free space is

a) 50 ohms b) 72 ohms

c) 153 ohms d) 377 ohms.

vii) Maxwell's equations are not symmetrical, because

a) isolated magnetic charges do not exist

b) it is difficult to get curl of a vect r in spherical coordinates

c) $\vec{\nabla}.\vec{D} = 0$

d) $\vec{\nabla}.X\vec{H}$ does not exist in free space.

viii) In a transmission line electric energy is transported by

a) the flow of electrons

b) the f ow of electrons and holes

c) the associated electric and magnetic field

d) none of these.

ix) Displacement current can flow through

a) capacitor b) inductor

c) resistor d) none of these.

x) While travelling through free space, electromagnetic wave is incident on another medium. The depth of penetration in the medium will be lowest if the medium is

a) lossless dielectric b) lossy dielectric

c) conductor d) none of hese.

xi) Which of the following antennae, produces radiation field of shape of figure of 8 ?

a) Simple Dipole

b) Simple Dipole with a Reflector

c) Yagi-Uda

d) Horn.

xii) Which one of the following antennae is a Broad Band antenna ?

a) Simple Dipole b) Folded Dipole

c) Yagi-Uda d) Log Periodic.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. a) Divergence of a field is zero and Curl is non-zero. Comment on the nature of the field. 2

   b) Two point charges of Q_1 coulombs each are located at (0,0,1) and (0,0,–1). Determine the locus of th possible positions of a third charge Q_2 where Q_2 may be any positive or negative value, such that the total field $E = 0$ at (0,1,0). 3

3. State and explain Divergence theorem and Stokes, theorem.

4. a) Displacement current is said to be a great contribution of Maxwell. What is displacement current density ? How Maxwell modified one of his equations, valid in static EM fields, r ime varying EM field ? Why is this contribution so important ? 3

   b) Stat and xplain Ampere's circuital law. 2

5. a) What are the characteristics of Smith chart ? 2

   b) Define Reflection Coefficient and VSWR. What are their range of values ? 3

6. a) What is the main function of an antenna ? 2

   b) Define radiation resistance, radiation pattern and half power beam width. 3

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) What do you mean by Electric Potential ? Derive the relation $E = -\vec{\nabla} V$. 4

   b) Given the spherically symmetric potential field in free space, $V = V_0 e^{-\frac{r}{a}}$, find ρ_v, at $r = a$. 3

   c) Write and explain the point forms and int gral forms of Maxwell's equation in time-varying EM field. 8

8. a) Discuss the important features of sky-wave propagation and explain the terms, 'virtual height', 'skip distance' and 'critical frequency'. 6

   b) Explain how troposph ric ducts are formed. 4

   c) Explain what you understand by 'Skip distance' and 'Virtual height'. 5

9. a) What do you understand by line parameters in the context of transmission line ? 2

   b) Draw the equivalent circuit of a transmission line and hence write the transmission line equations for an elemental section of transmission line. 3

   c) Write down & comment on the general solution of transmission line equations. 2

   d) Define the characteristic impedance of a transmission line. 2

   e) Explain the formation of standing wave pattern in a transmission line. 3

f) A transmission line of characteristic impedance 50 ohms is terminated by a resistor of 100 ohms. What will be the VSWR of the line ? Calculate impedance at voltage minimum and maximum positions. 3

10. a) What is meant by Retarded Vector potential ? Explain. 3

b) Explain the concept of Near field and Far field. 3

c) Define and explain directivity of an antenna What is its relation with the gain of antenna ? What is the limit of efficiency factor of antenna ? 6

d) What are Beam Area and Beam Solid Angle ? Find its relation with directivity. 3

11. Write short notes on any *three* of the following : 3 × 5

a) Skin Effect and Skin Depth

b) Impedance Matching and Quarter Wave transformer

c) Horn Antenna Parabolic Reflector and Cassegrain Feed

d) Helmhol z and Laplace's equation and Uniqueness theorem

e) Fading.

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