Indian Institute of Engineering Science and Technology, Shibpur
M.E. (ETC) 2nd Semester Final Examination, May 2014

ANTENNA ENGINEERING FOR MODERN COMMUNICATION
(ETC - 1034)

Full Marks - 70 Time -- 3 Hrs.

All questions carry equal marks
Answer any **FIVE** questions

1.(a) . Deduce the expressions of radiated field components of a half wave dipole antenna assuming sinusoidal current distribution and calculate the radiation resistance of the said antenna...

(b) . A magnetic field strength of 5μA/m is required at a point on $\theta=\pi/2$, which is 2 Km from an antenna in air. Neglecting ohmic loss, how much power must the antenna transmit if it is

(i). A hertzian dipole of length $\lambda/25$?
(ii). A half wave dipole?
(iii). A quarter wave monopole?
(iv) A 10 turn loop antenna of radius $\lambda/20$?

(c) . The radiation intensity of a certain antenna is

$$U(\theta,\phi) = 2\sin\theta \sin^3\phi \; ; \quad 0\le\theta\le\pi, \quad 0\le\phi\le\pi$$
$$= 0 \; ; \quad \text{elsewhere.}$$

Determine the directivity of the antenna. **(8+4+2)**

2. Define antenna polarization. A right circularly polarized antenna has Electric field of $(\mathbf{a}\theta - \mathbf{j}\mathbf{a}\varphi)/\sqrt{2}$. Calculate the polarization efficiency of the antenna if the incident electric field is right circularly polarized and the linearly polarized in the θ direction. What is meant by Isotropic radiator and omni-directional radiation? **(4+6+4)**

3. (a) Derive the resultant field for a two element dipole array placed along x axis. Calculate the array factor for an N element array and sketch the normalized field pattern taking α =0, N = 2, d = $\lambda/2$ where symbols have their usual significance.

(b) What is steering vector? Discuss briefly the architecture of a Smart Antenna System. **(3+5+3+3)**

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4. (a) Analyze Rectangular Microstrip Patch Antenna by 'Transmission Line Model' with suitable illustration and mathematical interpretation in the light of fringing effects, effective length, resonant frequency, effective width and conductance.

\ (b) Outline a design procedure for the said patch antenna based on (a) above.

(c) Design a microstrip antenna using a substrate (PTFE) with dielectric constant 2.55 and thickness 1.56 mm so as to resonate at 3.0 GHz.. (Consider loss tangent as 0.001)

(10+2+2)

5. (a) Describe the radiation mechanism of a rectangular microstrip antenna using 'Cavity Model' clearly discussing field configurations(modes). .

(b) How do you define 'Quality factor' of a microstrip antenna? How does it influence the bandwidth? **(12+2)**

6. (a) Briefly explain the near field and far field concept of antenna radiation and describe why far field measurements are preferred.

(b) Explain different techniques of Antenna Gain Measurement. **(7+7)**

7. (a) Write down the Finite Difference approximation of Laplace equation($\nabla^2\varphi = 0$) in two dimensions .How do you solve the potential of a Node which is at the corner of dielectric inhomogenity ?

(b) Analyze the transmission line using one dimensional FDTD method, assume TEM-wave propagation along the x-direction in the transmission line.

(c) Define Functional in Computational Electromagnetics ? **(7+5+2)**

8. Write short notes on the following : (any two):

a) Small Loop Antenna
b) Surface-Wave and Leaky-Wave Antenna
c) Fractal Antennas
d) Anechoic Chamber and Absorbing Materials **(7+7)**

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