KUMARAGURU college of technology
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Register Number:……..….

M.E DEGREE EXAMINATIONS: MAY 2016

(Regulation 2015)

Second Semester

COMMUNICATION SYSTEMS

P15COT203:Advanced Radiation Systems

COURSE OUTCOMES

CO1: Describe the various types of microwave antennas.

CO2: Compare the various types of antenna arrays.

CO3: Design of patch antennas for given set of parameters.

CO4: Analyze and compare various types of antennas.

CO5: Compare various polarizations of Electro-magnetic fields emitted by the antennas.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. An antenna of diameter D is operating at wavelength λ. The critical distance beyond which the electrostatic and inductive contribution to the radiated fields can be neglected is CO4 [K_1]

a) $0.62\ D^2 / \lambda$ b) $2D^2 / \lambda$

c) D / λ^2 d) $0.62\ \sqrt{D^3} / \lambda$

2. Match list I with list II and select the correct answer using the codes given below. CO4 [K_1]

List I	List II
A. Inhomogeneous Helmholtz equation	1. $4\pi\ U(\theta, \varphi) / \int U\ d\Omega$
B. Retarded Vector Potential	2. $\Delta^2 F + K^2 F = -\varepsilon M$
C. Directivity	3. $A = \int (\mu / 4\pi R)\ [J]\ dV$
D. Directive gain	4. $4\pi / \theta_E\ \theta_H$ Sr

a) 2 1 3 4 b) 3 4 1 2

c) 2 3 4 1 d) 3 1 2 4

3. The directivity of a linear ,end fire, uniform array of 10 elements with a separation of λ/4 between elements is CO2 [K_2]

a) 100 dB b) 1 dB

c) 4 dB d) 10 dB

4. Consider the following statements with respect to antenna synthesis. CO2 [K_1]

1. The radiation pattern of the digitized discrete-element array will not approximate the pattern of the continuous source.
2. Schelkunoff Polynomial method is suitable for the antenna patterns possessing nulls in the undesired directions.
3. Beam shaping refers the patterns exhibiting desired distribution in the entire visible region.
4. Taylor line source technique can be used for the patterns with narrow beams and low side lobes.

Which of these statements are correct?

a) 1,3 b) 3,4

c) 2,4 d) 1,2

5. If the terminal impedance of the dipole is 73 + j (42.5) Ω then the terminal impedance of the complementary slot antenna will be CO4 [K_2]

a) 363 - j (42.5) Ω b) 73 + j (42.5) Ω

c) 363 - j (211) Ω d) 73 Ω

6. The following items consist of two statements, one labeled as the "Assertion (A)" and the other as "Reason (R). Examine those two statements carefully and select the answers to these items using the codes given below: CO4 [K_2]

Assertion (A) : The slot antenna makes use of the fact that energy is radiated when a high frequency field exists across a narrow slot in a conducting plane.

Reason (R) : Slot antenna radiation from the back side of the conducting plane has the opposite polarity from that of the complementary antenna.

a) both A and R are individually true and R is the correct explanation of A
b) both A and R are individually true but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

7. Consider the following statements with respect to microstrip antenna. CO3 [K_2]

1. Microstrip antennas are low-profile, conformable to planar and nonplanar surfaces.
2. Microstrip antennas dielectric constant range is from 0.2 to 12.2.
3. Arrays of microstrip elements with single or multiple feeds may be used to introduce scanning capabilities and achieve smaller directivities.
4. Analysis of microstrip antenna can be done using transmission line and full wave methods.

Which of these statements are correct?

a) 1,2 b) 1,4

c) 2,3 d) 3,4

8. Match list I with list II and select the correct answer using the codes given below. CO3 [K_2]

List I	List II
A. Microstrip antenna analysis	1. Pyramidal Horn
B. Reflector system analysis	2. Cavity model

C. Optical Telescopes	3. Aperture distribution method
D. Feed for reflectors	4. Cassegrain dual reflector system

a) 2 1 3 4 b) 3 4 1 2

c) 2 3 4 1 d) 3 1 2 4

9. A wave traveling normally out of the page has two linearly polarized components $E_x=2\cos\omega t$; $E_y=3\cos(\omega t+90°)$.The axial ratio and the rotation of E are CO5 [K_3]

a) 1.5,Counter clockwise b) 0.67,Counter clockwise

c) 1.5,Clockwise d) 0.67,Clockwise

10. Which type of polarization is mostly used for satellite radio communications? CO5 [K_2]

a) Elliptical polarization b) Circular polarization

c) Random polarization d) Linear polarization

PART B (10 x 2 = 20 Marks)

11. Review the principle of planar antenna. CO4 [K_2]
12. Calculate the radiation resistance of a dipole antenna λ/8 long. If the equivalent loss resistance accounting for the heat loss in the antenna due to the finite conductivity of the dipole or the losses in the associated dielectric structure is 1.5Ω, what is the efficiency of the antenna? CO4 [K_3]
13. Compare broad side and end fire array. CO2 [K_2]
14. Outline the advantages and disadvantages of Binomial array. CO2 [K_2]
15. State the reasons for the preference of aperture antennas for space applications. CO4 [K_1]
16. Define the duality principle. CO4 [K_1]
17. List out the different configurations of microstrip antenna. Draw any two. CO3 [K_2]
18. What is a dual reflector antenna? Give examples. CO1 [K_2]
19. An elliptically polarized wave travelling in the +z direction in air has x and y components $E_x = 2\sin(\omega t-\beta z)$ V/m, $E_y= 4\sin(\omega t-\beta z+ 75°)$ V/m. Calculate the average power per unit area conveyed by the wave. CO5 [K_3]
20. What are Stokes parameters? CO5 [K_1]

PART C (6 x 5 = 30 Marks)

21. Derive the array factor expression of planar array. CO2 [K_3]
22. Explain the principle of pattern multiplication and find the array factor of a two element array. CO2 [K_2]

23.	Derive the fields radiated from an elemental area of a uniform plane wave.	CO4	[K_3]
24.	Design a rectangular Micro strip antenna using a substrate with dielectric constant of 2.2, h = 0.1588 cm so as to resonate at 2.45 GHz.	CO3	[K_3]
25.	Discuss the working principle of Parabolic reflector antenna with neat diagram.	CO1	[K_2]
26.	Explain the different types of polarization.	CO5	[K_2]

Answer any FOUR Questions
PART D (4 x 10 = 40 Marks)

27.	Deduce expressions for electric field components and magnetic field of an alternating current element at a distance from the element. How does the field radiated at the far zone differ from that near zone?	CO4	[K_3]
28.	Design a seven element broadside array which has the optimum pattern for a side-lobe-level of -20dB.The spacing between elements has to be $\lambda/2$.	CO2	[K_3]
29.	Discuss in detail about Fraunhoffer & Fresnel diffraction with a neat sketch.	CO4	[K_2]
30.	What are the types of Horn antenna? Explain the basic principle and obtain the expressions for fields radiated by a Pyramidal horn antenna.	CO1	[K_2]
31.	Describe in detail the Poincare sphere representation of wave polarization.	CO5	[K_2]

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