Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22
Course Code: ECE 214
Course Name: Antenna and Microwave Engineering
Program & Sem: B.Tech (ECE), 6th Semester

Date: 27-04-2022
Time: 1:30-2:30 PM
Max Marks: 30
Weightage: 15%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Scientific calculators are allowed. ***Programmable calculators are not allowed***

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries one marks. (10Qx 1M= 10M)

Q.NO. 1 A narrow and sharp beam indicates _____ (C.O.No.1) [Knowledge]

(a) Low gain (b) High gain (c) Beam area (d) Beamwidth

Q.NO. 2 The impedance component responsible for far-field radiation is (C.O.No.1) [Knowledge]

(a) Antenna radiation resistance R_r (b) Antenna reactance X_L (c) Antenna losses R_L (d) Generator resistance R_g

Q.NO. 3 Antennas cannot radiate DC signals because (C.O.No.1) [Knowledge]

(a)High losses in DC (b) The E- and/or H- fields are not time varying (c) Antenna size should be infinite (d) Both (b) and (c)

Q.NO. 4 Which of the following quantities falls as the inverse square of distance (C.O.No.1) [Knowledge]

(a) Power (b) Power density (c) Power intensity (d) Radiation intensity

Q.NO. 5 An antenna can be classified as (C.O.No.1 & C.O. 2) [Knowledge]

(a) Passive and propagating device (b) Passive and dissipating device
(c) Active and propagating device (d) Active and dissipating device

Q.NO. 6 Relation between Directivity (D) and Beam area (Ω_A) (C.O.No.1) [Knowledge]

(a) $\frac{4\pi}{\Omega_A}$ (b) $\frac{\Omega_A}{4\pi}$ (c) $\frac{U_{max}}{U_0}$ (d) $\frac{\Omega_A}{2\pi}$

Q.NO. 7 The current density most relevant to high frequency antennas is (C.O.No.1) [Knowledge]

(a) Volume current density (b) Surface current density (c) Line current density (d) All of the above

Q.NO. 8 If D is the maximum dimension of an antenna operating at λ wavelength, the location of the radiating near-field is (C.O.No.1) [Knowledge]

(a) $> \frac{2D^2}{\lambda}$ (b) $< 0.62\sqrt{\frac{D^3}{\lambda}}$ (c) Between (a) and (b) (d) None of these

Q.NO.9 Consider a spherical coordinate systems, what is the range of elevation and azimuth angle? (C.O.No.1) [Knowledge]

(a) (0 to π), (0 to 2π) (b) (0 to π), (0 to π) (c) (0 to 2π), (0 to 2π) (d) (0 to 2π), (0 to π)

Q.NO. 10 Which of the relation is true, where G = gain, D = Directivity and e = efficiency of antenna? (C.O.No.1) [Knowledge]

(a) G = e/D (b) G = 2e/D (c) G = 2e $\times$ D (d) G = e $\times$ D

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries five marks. (2Qx5M=10M)

Q.NO.11 The antenna can be represented by its Thevenin's equivalent circuit. Generally, antennas are connected to an AC source with an internal resistance R_g by means of a transmission line. Using a schematic, show the connection of an antenna with an AC generator. Mention the condition (i.e. the relationship between antenna resistance and R_g) for maximum power transfer and the expression for reflection coefficient in the transmission line seen from the generator end. (C.O.No.1) [Comprehension]

Q.NO.12 Suppose you have been asked to design an antenna operating at 100 MHz with a gain of 2.15 dBi. The power supplied to the transmitting antenna is 1KW and the minimum power that is to be delivered to the receiving antenna is 1nW. The transmitting and the receiving antenna are 500 km apart. What should be the minimum gain of the receiving antenna? (C.O.No.1) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries ten marks. (1Qx10M=10M)

Q.NO.13. The power radiated by a lossless antenna is 20 watts. The directional characteristics of the antenna are represented by the radiation intensity of $\boldsymbol{U = U_O Cos^3\theta}$**, (0 ≤ θ ≤ π/2, 0 ≤ ϕ ≤ 2π).** Find the following far-field parameters

(a) Maximum power density at a distance of 1000 m.

(b) Maximum directivity

(c) Maximum Gain and efficiency. (C.O.No. 1) [Application]

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22
Course Code: ECE 214
Course Name: Antenna and Microwave Engineering
Program & Sem: B.Tech (ECE) & 6th Semester

Date: 27-04-2022
Time: 1:30 PM to 2:30 PM
Max Marks: 30
Weightage: 15%

Instructions: *Read the all questions carefully and answer accordingly.*
(i) Scientific calculators are allowed. ***Programmable calculators are not allowed***

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries ONE marks. (10Qx1M= 10M)

1. A mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates is known as_____ (C.O.No.1) [Knowledge]
(a) Radiation Pattern (b) Main lobe (c) Beam area (d) Directivity

2. A _____ is a device that converts a guided electromagnetic wave on a transmission line into a plane wave propagating in free space. (C.O.No.1) [Knowledge]
(a) RADAR (b) Transmitting Antenna (c) Receiving Antenna (d) Transducer

3. Which of the following Law signifies that change in Electric field in space forms a time varying magnetic field? (C.O.No.1) [Knowledge]
(a) Gauss law (b) Faradays law of EM induction (c) Amperes law (d) Biot savart law

4. Consider a spherical coordinate systems, what is the range of elevation and azimuth angle? (C.O.No.1) [Knowledge]
(a) (0 to π), (0 to 2π) (b) (0 to π), (0 to π) (c) (0 to 2π), (0 to 2π) (d) (0 to 2π), (0 to π)

5. Which of the relation is true, where G = gain, D = Directivity and e = efficiency of antenna? (C.O.No.1) [Knowledge]
(a) G = e/D (b) G = 2e/D (c) G = 2e $\times$ D (d) G = e $\times$ D

6. Relation between Directivity (D) and Beam area (Ω_A) (C.O.No.1) [Knowledge]
(a) $\frac{4\pi}{\Omega_A}$ (b) $\frac{\Omega_A}{4\pi}$ (c) $\frac{U_{max}}{U_0}$ (d) $\frac{\Omega_A}{2\pi}$

7. In radio communication link, what is the shape/nature of waves generated by transmitting antenna? (C.O.No.1) [Knowledge]
(a) Plane (b) Spherical (c) Triangular (d)Square

8. According to the geometry, how many steradian are present in a full sphere? (C.O.No.1) [Knowledge]
(a) $\pi/2$ (b) 2π (c) 4π (d) 3

9. The measure of solid angle is (C.O.No.1) [Knowledge]
(a) Degree (b) radian (c) steradian (d) None

10. Antennas cannot radiate DC signals because (C.O.No.1) [Knowledge]
(a) High loss in DC (b) E and H are not changing (c) Low frequency (d) None

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries FIVE marks. (2Qx5M=10M)

11. The effective aperture of an antenna is that region of the receiving antenna which effectively collects the electromagnetic energy from the radiated wave out of the overall antenna region. This means greater the extracting region of the antenna more efficient it is. Another important parameter related to radiation is the Directivity and beam area. Now imagine the scenario when the frequency of the EM wave is kept constant and you are changing the effective aperture of the antenna. How does the directivity property will change and in which proportion? (C.O.No.1) [Comprehension]

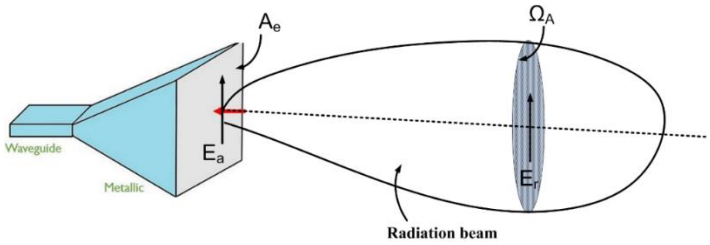

Fig. 1. Diagram showing the effective aperture and radiated beam

12. Let us consider a half wave dipole antenna which is a strategically designed structure in which electric and magnetic fields are initially contained in the transmission line in the form of standing waves and thereafter it separates from the dipole antenna and radiates in the free space as shown in the Fig. 2. If the input frequency of AC voltage source is doubled, what will be the effect on the frequency and wavelength of the radiated fields? What is the condition of I_1 (current) on the dipole structure such that fields are detached? (C.O.No.1) [Comprehension]

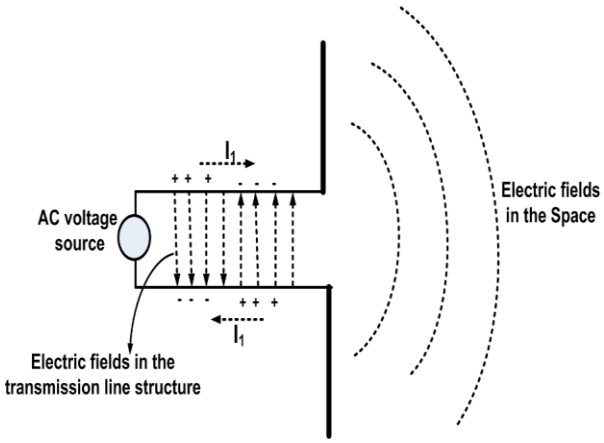

Fig. 2. Diagram showing the general field view of a dipole antenna

Part C [Problem Solving Questions]

Answer the Question. The question carries ten marks. (1Qx10M=10M)

13. The power radiated by a lossless antenna is 10 watts. The directional characteristics of the antenna are represented by the radiation intensity of $\boldsymbol{U = U_O Cos^3\theta}$**, (0 ≤ θ ≤ π/2, 0 ≤ ϕ ≤ 2π).** Find the following far-field parameters

(a) Maximum power density at a distance of 100 m.

(b) Maximum directivity

(c) Maximum Gain and efficiency. (C.O.No. 1) [Application]

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST-2

Winter Semester: 2021 - 22
Course Code: ECE 214
Course Name: Antenna and Microwave Engineering
Program & Sem: B.Tech (ECE), 6th Semester

Date: 02-JUNE-2022
Time: 01:30PM -2:30 PM
Max Marks: 30
Weightage: 15%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Scientific calculators are allowed. ***Programmable calculators are not allowed***

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries ONE marks. (10Qx 1M= 10M)

1 Which one of the following antennas generally have the highest gain? (C.O.No.2) [Knowledge]
(a) Horn antenna (b) Microstrip antenna (c) Yagi-Uda array (d) Helical antenna

2 ___ generally transmit or receive circularly polarized waves (C.O.No.2) [Knowledge]
(a) Horn antennas (b) Microstrip antennas (c) Yagi-Uda arrays (d) Helical antennas

3 Which of the following antennas have a planar structure? (C.O.No.2) [Knowledge]
(a) Horn antenna (b) Microstrip antenna (c) Yagi-Uda array (d) Helical antenna

4 If λ is the operational wavelength, the size of a hertzian dipole antenna is given by (C.O.No.2) [Knowledge]
(a) $\lambda/_{10}$ (b) $\lambda/_{2}$ (c) $\lambda/_{5}$ (d) Depends on frequency

5 ___ is generally used in TV signal reception (C.O.No.2) [Knowledge]
(a) Horn antenna (b) Microstrip antenna (c) Yagi-Uda array (d) Helical antenna

6 The curl of magnetic vector potential is the ___ (C.O.No.2) [Knowledge]
(a) Magnetic field intensity (b) Electric field intensity (c) Magnetic flux density (d) Electric flux density

7 The nature of the electromagnetic wave radiated from any antenna at an infinite distance can be approximated as a (C.O.No.2) [Knowledge]
(a) Spherical wave (b) Linear wave (c) Circular wave (d) Plane wave

8 Impedance of free space is given by (C.O.No.2) [Knowledge]
(a) 377 ohm (b) 366 ohm (c) 355 ohm (d) 344 ohm

9 Which antenna is treated as flared out waveguide (C.O.No.2) [Knowledge]
(a) Microstrip antenna (b) Helical antenna (c) Yagi-uda antenna (d) Horn antenna

10 The dominant nature of power in the vicinity of an antenna is (C.O.No.2) [Knowledge]

(a) Dissipating power (b) Active power (c) Reactive power (d) Radiative power

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FIVE marks. (2Qx5M=10M)

11 A Hertzian dipole is commonly defined as an electrically-short and infinitesimally-thin straight filament of current, in which the density of the current is uniform over its length. Suppose a hertzian dipole is situated at the origin as shown in the figure below. In these antennas, normally the E-field dominates the H-field by several orders of magnitude in the near-field region. What is the reason behind such a phenomenon? What will be the ratio $\left|\frac{\vec{E}}{\vec{H}}\right|$ in the far field-region?.

(C.O.No.1) [Comprehension]

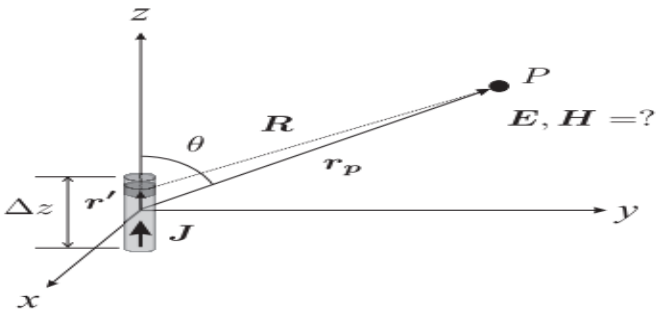

Fig. 1. Diagram showing the position of Hertzian dipole at origin.

12 Microstrip antennas are low-profile antennas. A metal patch mounted at a ground level with a dielectric material in-between constitutes a Microstrip or Patch Antenna. These are very low size antennas having low radiation. Suppose, now you decrease the permittivity of the substrate. Will the radiation increases or decreases and why? What will be the effect on the frequency of operation?

(C. O. No. 2) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TEN marks. (1Qx10M=10M)

13. Design a 20 turn helical antenna as shown in Fig.2, which is operating in the axial mode at a frequency of 2.5 GHz. Determine the circumference of the helix and the pitch angle if the length of one turn is 13 cm. (C. O. No. 2) [Application]

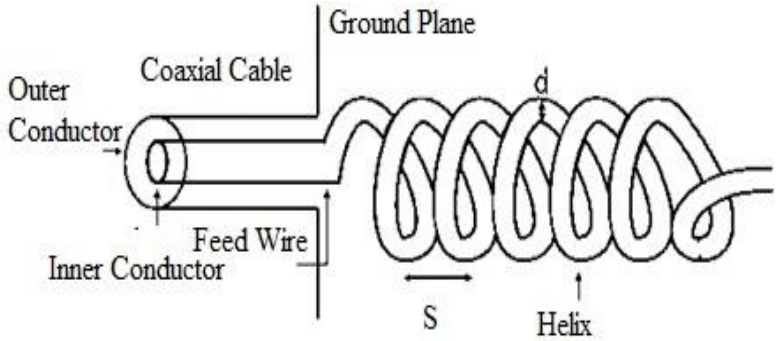

Fig. 2. Diagram showing helical antenna.

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

ENDTERM EXAMINATION

Winter Semester: 2021 - 22
Course Code: ECE 214
Course Name: Antenna and Microwave Engineering
Program & Sem: B.Tech (ECE), 6th Semester

Date: 4th July 2022
Time: 9:30 AM to 12:30 PM
Max Marks: 100
Weightage: 50%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Scientific calculators are allowed. ***Programmable calculators are not allowed***

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (15Qx 2M= 30M)

Q.NO. 1 The term $1/r^2$ in the electric and magnetic field equation of a hertzian dipole is termed as (C.O.No.2) [Knowledge]
(a) Induction field (b) Magnetostatics field (c) Radiation field (d) Electrostatic field

Q.NO. 2 The curl of magnetic scalar potential is related to (C.O.No.2) [Knowledge]
(a) Magnetic flux density (b) Electric field intensity (c) Magnetic field intensity (d) Electric flux density

Q.NO. 3 MSAs are light weight, smaller size and lesser volume. These can be easily mounted to any desired shape. Microstrip antennas are also known as (C.O.No.2) [Knowledge]
(a) Patch antenna (b) slot antenna (c) Logarithmic antenna (d) reflector antenna

Q.NO. 4 Which mode of radiation occurs in a helical antenna due to smaller dimensions of helix as compared to a wavelength? (C.O.No.3) [Knowledge]
(a) Normal mode (b) Axial mode (c) Conical mode (d) None of the above

Q.NO. 5 The term $1/r^3$ in the electric and magnetic field equation of a hertzian dipole is termed as (C.O.No.2) [Knowledge]
(a) Magnetostatics field (b) Electrostatic field (c) Radiation field (d) Induction field

Q.NO. 6 A narrow and sharp beam indicates _____ (C.O.No.2) [Knowledge]
(a) Low gain (b) High gain (c) Beam area (d) Beamwidth

Q.NO. 7 The impedance component responsible for far-field radiation is (C.O.No.1) [Knowledge]
(a) Antenna reactance (b) Radiation resistance (c) Antenna losses R_L (d) Generator resistance

Q.NO. 8 An antenna can be classified as (C.O.No.1) [Knowledge]
(a) Passive and propagating device (b) Passive and dissipating device
(c) Active and propagating device (d) Active and dissipating device

Q.NO. 9 Impedance of free space is given by (C.O.No.3) [Knowledge]
(a) 355 ohm (b) 366 ohm (c) 377 ohm (d) 344 ohm

Q.NO. 10 The Dominant mode in rectangular waveguide is (C.O.No.4) [Knowledge]

(a) TE_{11} (b) TM_{11} (c) TE_{10} or TE_{01} (d) TEM_{10}

Q.NO. 11 Which of the relation is true, where G = gain, D = Directivity and e = efficiency of antenna? (C.O.No.3) [Knowledge]

(a) G = e/D (b) G = 2e/D (c) G = e × D (d) G = 2e × D

Q.NO. 12 Ground waves are required relatively high transmitted power and these waves are gliding over the surface. Generally ground wave propagation will be done by vertical polarization. If the distance between the transmitter and receiver increases the strength of ground wave signal will _____ (C.O.No.3) [Knowledge]

(a) Increases (b) no change (c) Decreases (d) Data inadequate

Q.NO. 13 For a microwave antenna operating at a frequency of 3GHz.Obtain the distance beyond which only far field exists. (C.O.No.1) [Knowledge]

(a) 10 dB (b) 20 dB (c) 15 dB (d) Data inadequate

Q.NO. 14 The dominant nature of power in the vicinity of an antenna is (C.O.No.1) [Knowledge]

(a) Dissipating power (b) Active power (c) Radiative power (d) Reactive power

Q.NO.15 Which of the following exhibits perpendicular nature in TEM wave? (C.O.No.3) [Knowledge]

(a) Magnetic field (b) Electric field (c) Direction of propagation (d) All of the above

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries TEN marks. (4Qx10M=40M)

Q.NO.16 The ionosphere is where Earth's atmosphere meets space. Along with the neutral upper atmosphere, the ionosphere forms the boundary between Earth's lower atmosphere and the vacuum of space. We generally use ionospheric layers for long distance communication where we first send signal towards ionosphere. Can you explain with proper diagram how the EM waves are reflected and on which parameter the angle of reflection depends? (C.O.No.3) [Comprehension]

Q.NO.17 An antenna called as "**Antenna-A**" has 3 major elements namely: driven element, reflector and director. It is designed to operate in very high and ultra-high frequency bands (30MHz - 3GHz) and is famous for its high gain and directivity. Another antenna called as "**Antenna-B**" which popular for low profile applications, is often manifested as rectangular cavity with open sidewalls where the fringing fields through the open sidewalls are responsible for radiation. Identify the antennas and comment over their construction very briefly. (C. O. No. 2) [Comprehension]

Q.NO.18 A Hertzian dipole is commonly defined as an electrically-short and infinitesimally-thin straight filament of current, in which the density of the current is uniform over its length. Suppose a hertzian dipole is situated at the origin as shown in Fig.1. Can you identify which field components have zero value at any point P (r, θ, ϕ) in the spherical coordinates and which components have non-zero values. Write down their equations at any distance r_p. (C.O.No.2) [Comprehension]

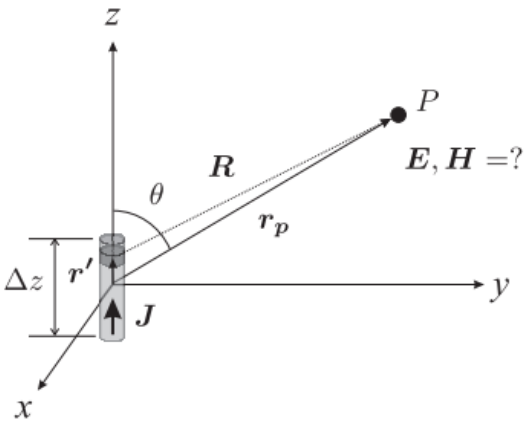

Fig. 1. Diagram showing the position of Hertzian dipole at origin.

Q.NO.19 The Friis Transmission Equation is used to calculate the power received from one antenna when transmitted from another antenna separated by some distance. Suppose you have been asked to design an antenna operating at 1 GHz with a gain of 25 dB. What power should be supplied to the transmitting antenna such that and the minimum power that is delivered to the receiving antenna is 10.8 mW. The transmitting and the receiving antenna are 0.5 km apart. The gain of the receiving antenna is 20 dB. (C.O.No.1) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries FIFTEEN marks. (2Qx15M=30M)

Q.NO.20.The inner dimensions of a rectangular waveguide is given as a × b = $\frac{20}{3}\times\frac{20}{4}$ cm which is completely filled with a dielectric of ε_r= 4. Now, EM Waves of free space wavelength shorter than "*x*" cm can be propagated in the TE11 mode. Determine the value of *x.* (C. O. No. 4) [Application]

Q.NO.21. A high frequency long distance communication link is to be established between two points on the earth which are 2000 Km away. If the angle of incidence for the transmitted signal (towards ionospheric layer) is 60°and maximum density of electrons present in the ionosphere region is 16 × 10^{12} electrons /CC. Calculate the actual height between the earth surface and ionosphere from where the reflection is taking place? (C. O. No. 3) [Application]