Enrollment No......................................

Faculty of Engineering
End Sem (Odd) Examination Dec-2019
EC3CO13 Antennas and Propagation

Programme: B.Tech.   Branch/Specialisation: EC

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The radiation pattern of a half-wave dipole has the shape of a **1**
………….
(a) Doughnut   (b) Sphere
(c) Hemisphere   (d) Circular

ii. As the beam area of an antenna decreases, the directivity of the **1**
antenna:
(a) Increases   (b) Decreases
(c) Remains unchanged   (d) Depends on the type of the antenna

iii. If a linear uniform array consists of 9 isotropic elements separated by **1**
$\lambda/4$, what would be the directivity of a broadside array in dB?
(a) 6.53 dB   (b) 7.99 dB   (c) 8.55 dB   (d) 9.02 dB

iv. In a Uniform Linear array all elements are fed with a current of **1**
…………… amplitude.
(a) Equal   (b) Unequal
(c) Both (a) and (b)   (d) None of these

v. Yagi-Uda antenna consists of **1**
(a) Folded Dipole   (b) Reflector
(c) Director   (d) All of these

vi. The radiation pattern of helix in Normal mode is **1**
(a) Bidirectional   (b) Unidirectional
(c) 4 lobed   (d) Omni directional

vii. The efficiency of Micro strip antenna is **1**
(a) High   (b) Very high   (c) Infinite   (d) Low

viii. The widely used shape for patch antennas is **1**
(a) Rectangular (b) Circular
(c) Elliptical (d) Parabolic

ix. The phenomenon of reduction of signal strength due to variation in **1** refractive index is called
(a) Wave tilting (b) Fading
(c) Diffraction (d) Scattering

x. The F2-Layer of Ionosphere exists between **1**
(a) 40 to 90 km (b) 90 to 140 km
(c) 140 to 250 km (d) 250 to 400 km

Q.2 i. Calculate the radiation resistance of current element whose overall **2** length is $\lambda/50$.

ii. Derive the relation between effective area and directivity for **3** Hertzian dipole antenna.

iii. Derive an expression for the vector potential A_z at a point P of large **5** distance r from a half wave dipole placed along the z-axis.

OR iv. Define the followings parameters of antenna **5**
(a) Radiation intensity (b) Antenna efficiency
(c) Directive gain (d) Beam width
(e) Front to back ratio

Q.3 i. State Pattern multiplication. **2**

ii. Write any six differences between broadside array and end-fire array. **3**

iii. Derive the expression for direction of pattern maxima, direction of **5** pattern minima, BWFN and HPBW for an array of n isotropic source of equal amplitude and spacing $\lambda/2$ broadside array.

OR iv. Determine Dolph-chebyshev current distribution for the minimum **5** beam width of a linear in phase broadside array of eight isotropic source. The spacing between the elements is $3\lambda/4$ and the side lobe level is to be 40 dB down.

Q.4 i. Write any two properties of helical antenna. **2**

ii. Find the power gain and directivity of a horn antenna whose **3** dimensions are 10 X 5 cm operating at a frequency of 6 GHz.

iii. Explain the principle of parabolic reflector antenna and discuss **5** different types of feed used with neat diagram.

OR iv. Explain the working, construction and design of Yagi Uda antenna. **5** Show that the impedance of a folded dipole is 292 Ω .

Q.5 i. Mention any four advantages of microstrip antenna. **2**

ii. Define fringing effect in microstrip antenna with neat diagram. **3**

iii. Explain in details all feeding methods of microstrip antenna with neat **5** diagram.

OR iv. Design a microstrip patch with dimensions W and L over a single **5** substrate, whose centre frequency is 10 GHz. The dielectric constant of the substrate is 10.2 and the height of substrate is 0.127 cm. Determine the physical dimensions W and L (in cm) of the patch taking into account fringing fields.

Q.6 i. Define skip distance and virtual height. **2**

ii. Calculate the value of frequency at which an electromagnetic wave **3** must be propagated through the D-region with an index of refraction of 0.5 and electron density of 3.24 x 10^4 electron/m^3.

iii. Derive the expression for the refractive index of the ionosphere. **5**

OR iv. Describe the structure of the atmosphere and explain each layer in **5** detail.

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Marking Scheme
EC3CO13 Antennas and Propagation

Q.1 i.   The radiation pattern of a half-wave dipole has the shape of a **1**
    …………
    (a) Doughnut

  ii.   As the beam area of an antenna decreases, the directivity of the **1**
    antenna:
    (a) Increases

  iii.   If a linear uniform array consists of 9 isotropic elements separated by **1**
    $\lambda/4$, what would be the directivity of a broadside array in dB?
    (a) 6.53 dB

  iv.   In a Uniform Linear array all elements are fed with a current of **1**
    …………… amplitude.
    (a) Equal

  v.   Yagi-Uda antenna consists of **1**
    (d) All of these

  vi.   The radiation pattern of helix in Normal mode is **1**
    (a) Bidirectional

  vii.   The efficiency of Micro strip antenna is **1**
    (d) Low

  viii.   The widely used shape for patch antennas is **1**
    (a) Rectangular

  ix.   The phenomenon of reduction of signal strength due to variation in **1**
    refractive index is called
    (b) Fading

  x.   The F2-Layer of Ionosphere exists between **1**
    (d) 250 to 400 km

Q.2 i.   Radiation resistance of current element whose overall length is $\lambda/50$. **2**
    (As per answer)   2 marks

  ii.   Relation between effective area and directivity for Hertzian dipole **3**
    antenna.   3 marks

  iii.   Expression for the vector potential A_z at a point P of large distance r **5**
    from a half wave dipole placed along the z-axis.
    (Stepwise marking)   5 marks

OR iv.   Define the followings parameters of antenna **5**
    (a) Radiation intensity   1 mark
    (b) Antenna efficiency   1 mark
    (c) Directive gain   1 mark
    (d) Beam width   1 mark
    (e) Front to back ratio   1 mark

Q.3 i.   State Pattern multiplication.(As per answer)   2 marks   **2**

  ii.   Six differences between broadside array and end-fire array.   **3**
    (0.5 mark*6)

  iii.   Expression for direction of pattern maxima   1.5 marks   **5**
    Direction of pattern minima   1.5 marks
    BWFN   1 mark
    HPBW   1 mark

OR iv.   Calculation   3 marks   **5**
    Design   2 marks

Q.4 i.   Two properties of helical antenna.   (1 mark*2)   **2**

  ii.   Power gain   1.5 marks   **3**
    Directivity of a horn antenna   1.5 marks

  iii.   Principle   2 marks   **5**
    Types of feeding   3 marks

OR iv.   The working   1 mark   **5**
    Construction   1 mark
    Design of Yagi Uda antenna   1 mark
    Impedance of a folded dipole is 292 Ω .   2 marks

Q.5 i.   Four advantages of microstrip antenna.   (0.5 mark*4)   **2**

  ii.   Fringing effect in microstrip antenna   2 marks   **3**
    Neat diagram.   1 mark

  iii.   Feeding methods of microstrip antenna with neat diagram.   **5**
    (1.25 mark*4)

OR iv.   Design a microstrip patch   2.5 mark   **5**
    Determine the physical dimensions W and L (in cm) 2.5 mark

Q.6 i.   Skip distance   1 mark   **2**
    Virtual height.   1 mark

  ii.   Correct formula   2 marks   **3**
    Correct answer   1 mark

  iii.   Expression for the refractive index of the ionosphere.   **5**
    (Step wise marking)   5 marks

OR iv.   Structure of the atmosphere and explain each layer in detail.   **5**
    (1 mark*5)

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