

B.Tech. DEGREE EXAMINATION, NOVEMBER 2017

Third/Fourth/Fifth Semester

15EC304 – ANTENNA AND WAVE PROPAGATION

(For the candidates admitted during the academic year 2015 – 2016 onwards)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 45 minutes and OMR sheet should be handed over to hall invigilator at the end of 45th minute.
- (ii) **Part - B** and **Part - C** should be answered in answer booklet.

Time: Three Hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer ALL Questions

- The basic equation of radiation can be expressed as
(A) $P = I^2 R$ (B) $\dot{V} = \dot{I} R$
(C) $\dot{I} L = Q \dot{V}$ (D) $C = Q / \dot{V}$
- The characteristic impedance of free space is
(A) 277Ω (B) 377Ω
(C) 120Ω (D) $120\pi^2\Omega$
- Inductive field varies inversely proportional to
(A) r (B) r^3
(C) $(r)^{1/2}$ (D) r^2
- Steradian is a measurement of
(A) Plane angle (B) Linear angle
(C) Solid angle (D) Horizontal angle
- Which among the following is regarded as a condition of an ordinary endfire
(A) $\alpha = \pm\beta d$ (B) $\alpha \neq \pm\beta d$
(C) $\alpha < \beta d$ (D) $\alpha > \beta d$
- In binomial array the central elements are excited
(A) Uniformly (B) Strongly
(C) Weakly (D) Null current
- In broadside array, all the elements in the array should have
(A) Equal amplitude, same phase (B) Equal amplitude, opposite phase
(C) Unequal amplitude, same phase (D) Unequal amplitude, opposite phase
- Fourier transform method is used for
(A) Positioning null points (B) Beam shaping
(C) Decreasing number of minor lobes (D) Increasing the number of minor lobes

9. Which mode of radiation occurs in an helical antenna due to smaller dimensions of helix as compared to a wavelength.
- (A) Axial mode (B) Normal mode
(C) Moderate mode (D) Normal and axial mode
10. The radiation resistance of a circular loop of a turn is 0.01Ω . Then the radiation resistance of four turns of a such a loop will be
- (A) 0.01Ω (B) 0.02Ω
(C) 0.04Ω (D) 0.08Ω
11. The most commonly used mobile antenna is
- (A) Dipole (B) V antenna
(C) Dish antenna (D) Whip antenna
12. In a yagi-uda antenna, maximum direction of radiation is towards the
- (A) Director (B) Driven element
(C) Sky (D) Reflector element
13. For radiation patter measurements, the distance of the far field region is
- (A) $r > \frac{D^2}{2\lambda}$ (B) $r > \frac{2D^2}{\lambda}$
(C) $r > \frac{D^2}{\lambda}$ (D) $r > \frac{D}{\lambda}$
14. Anticlockwise rotation of electric field with time is called
- (A) Linear polarization (B) Right hand polarization
(C) Left hand polarization (D) Non linear polarization
15. VSWR is given by
- (A) $\frac{V_{\min}}{V_{\max}}$ (B) $\frac{V_e}{V_i}$
(C) $\frac{V_i}{V_r}$ (D) $\frac{V_{\max}}{V_{\min}}$
16. Aperture efficiency of an antenna is
- (A) The ratio of power gain to directive gain (B) Ratio of effective area to physical area
(C) Ratio of maximum effective area to physical area (D) Physical area to effective area
17. Virtual height of ionosphere is measured by an instrument
- (A) Radar (B) Ionosonde
(C) Tachogenertor (D) Altimeter
18. The relative permittivity of the ionosphere is
- (A) More than 1 (B) Equal to 0
(C) Equal to 1 (D) Less than 1

19. Duct propagation is useful
 (A) To reduce the effect of curvature of earth
 (B) To create shadow zones
 (C) To lower the frequency
 (D) Lower the distance of transmission
20. Skywave propagation is used at the frequency range
 (A) Less than 2MHz
 (B) Greater than 30MHz
 (C) Between 2MHz to 30MHz
 (D) Between 30MHz to 300MHz

PART - B ($5 \times 4 = 20$ Marks)
 Answer ANY FIVE Questions

21. The field pattern of antenna is given by $E(\theta) = \cos \theta \cos 2\theta$, for $0^\circ \leq \theta \leq 90^\circ$.
 Find (i) Half power beam width (ii) Beam width between first nulls.
22. Derive the expression for Friis transmission equation.
23. Explain about the concept of pattern multiplication.
24. Determine the length L , H-plane aperture and flare angles θ_E and θ_H of a pyramidal horn for which E-plane aperture $a_E = 10\lambda$. Let $\delta = 0.2\lambda$ in the E-plane and 0.375λ in the H-plane.
25. Write short note on phase measurement.
26. What is meant by critical frequency? Calculate critical frequency of E-layer for which maximum ionic density is given by 1.7×10^6 electrons/cc.
27. Define Virtual height. Find virtual height of a particular layer with a pulse of a given frequency is transmitted upward is received back after a period of 5 milliseconds.

PART - C ($5 \times 12 = 60$ Marks)
 Answer ALL Questions

28. a. Derive the expression for electric field and magnetic field components of a small current element.

(OR)

- b.i. State and prove reciprocity theorem. (8 Marks)
- ii. A thin dipole antenna is $\frac{\lambda}{12}$ long, if its loss resistance is 1.5Ω . Find the radiation resistance and efficiency. (4 Marks)

29. a. Derive the expressions for minor lobe pattern maxima, minima beam width between first nulls of broadside array with 'n' point sources.

(OR)

- b.i. What is meant by binomial array and derive the values of current amplitudes for 7-element array.

- ii. Design an array, if the array factor of the linear array has zeros at $\phi = 90^\circ, 180^\circ, 270^\circ$ and the elements are spaced at $\frac{\lambda}{4}$.

30. a.i. Explain in detail the construction and various regions of operations of log periodic antenna. (10 Marks)

- ii. List the applications of Yagi-Uda antenna. (2 Marks)

(OR)

b.i. Design a rectangular microstrip patch antenna using a substrate with dielectric constant of 2.2, $h = 0.16\text{cm}$, so as to resonant at 10GHz. Find width of the patch antenna, effective dielectric constant and actual height. (8 Marks)

- ii. Prove that input impedance of folded dipole antenna of length $\lambda / 2$ is four times greater than that of an isolated element of same length. (4 Marks)

31. a.i. Explain in detail how the impedance of an antenna is measured using slotted line method. (8 Marks)

- ii. Write short note on typical sources of noise in antenna measurement. (4 Marks)

(OR)

b.i. Explain various methods of gain measurement with necessary diagrams and equations. (8 Marks)

- ii. Write short note on antenna efficiency measurement. (4 Marks)

32. a. Explain the characteristics exhibited by the waves in different modes of propagation and in different frequency ranges.

(OR)

b.i. Derive the expression for refractive index of ionosphere. (8 Marks)

- ii. Derive the relationship between maximum usable frequency and critical frequency. (4 Marks)

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