(b) (i) Determine the change in the electron density of the E-layer when the critical frequency changes from 4 MHz to 1 MHz between mid-day and sun-set. (9)

(ii) A plane wave at 20 MHz is transmitted to ionosphere and reflected from a height of 500 km from the flat earth. If the refractive index corresponding to maximum electron density is 0.5, determine the horizontal range for which the signal frequency is MUF. (6)

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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Sixth Semester

Electronics and Communication Engineering

EC 6602 — ANTENNA AND WAVE PROPAGATION

(Regulation 2013)

(Common to : PTEC 6602 — Antenna and Wave Propagation for B.E.(Part-Time) Fifth-Semester – Electronics and Communication Engineering Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define radiation intensity.

2. An omnidirectional antenna has uniform radiation in $\theta = 90°$ (horizontal) plane and fall to zero outside that plane. The pattern is constant in the $\phi = 0$ (vertical) plane in the range $60° \leq \theta \leq 120°$. Find the directivity.

3. Write any two differences between slot antenna and its complementary dipole antenna?

4. List the different methods of feeding Microstrip antenna.

5. Draw the radiation pattern for a linear array of two isotropic elements spaced $\lambda/2$ apart and with equal current fed in phase.

6. What is tapering of arrays?

7. Define pitch angle of a helical antenna.

8. What is the need for an Anechoic chamber?

9. What is meant by fading?

10. Determine the maximum range of a Tropospheric transmission for which the transmitting antenna height is 100 m and receiving antenna height is 10 m.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Design a Yagi-Uda array antenna for 145 MHz frequency that has a directivity of 12 dB with six directors Determine the total length of the array Explain its principle of operation. (7)

(ii) The radiation intensity of an antenna is given by $U(\theta) = \cos^4\theta$, $(0^\circ \le \theta \le 90^\circ, 0^\circ \le \phi \le 360^\circ)$. Find

(1) half-power beam width (HPBW) (3)

(2) first-null beam width (FNBW)

(iii) Sketch the radiation pattern of dipole antenna for the following lengths

(1) 0.25 λ

(2) 1.0 λ

(3) 1.5λ. (3)

Or

(b) (i) Determine the directivity of a halfwave dipole. (8)

(ii) A transmitting antenna has an effective height $2/\pi$ times the physical length. This carries a current of 1600 Amps at the base and operating at a frequency of 20 KHz. If the physical length of the antenna is 200 metres and antenna efficiency is 10%. Calculate

(1) Electric field intensity at 350 km

(2) Radiation resistance

(3) Power radiated

(4) Power input in the antenna

(5) The voltage induced in the receiving antenna of 100 metres effective height at a distance of 350 km. (5)

12. (a) Discuss the principle working of Parabolic reflectors. Explain the various feed techniques their relative merits and demerits. Discuss the role of f/d ratio in the parabolic reflectors (f-focal length, D-diameter of reflector). (13)

Or

(b) Explain the principle operation of horn antenna and discuss the various forms of Horn antenna. Obtain the design equations of Horn antenna.(13)

13. (a) (i) Arrive the array factor of a two-element array. For this array, Find the nulls of the total field when $d = \lambda/4$ and the cases $\beta = 0$, $\beta = 90^\circ$ and $\beta = -90^\circ$. (9)

(ii) Define uniform linear array and grating lobes (4)

Or

(b) (i) Explain pattern multiplication. Using the principles of pattern multiplication determine the radiation pattern for eight element linear array, and spaced $\lambda/2$ apart with equal currents fed in-phase. Specify the limitations of this method. (8)

(ii) Obtain the excitation coefficients of a nine element binomial array. (5)

14. (a) With suitable diagram, explain the construction and principle operation of log periodic antenna. (13)

Or

(b) Explain the measurement procedure for gain and VSWR. (13)

15. (a) (i) Derive an expression for the refractive index of the ionosphere in terms of electron number density and frequency. (8)

(ii) Explain the terms : Duct propagation and multi hop propagation. (5)

Or

(b) (i) Describe the significant features of ground wave propagation. (4)

(ii) Explain with the help of suitable sketch, the concept of skip distance and its relation to maximum usable frequency. (9)

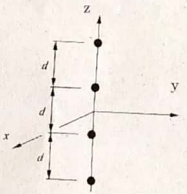
PART C — (1 × 15 = 15 marks)

16. (a) A four-element uniform array has its element placed along the z axis with distance $d = \lambda/2$ between them according to the figure below

(i) Derive the array factor and show that it can be written as $\frac{\sin(2\psi)}{\sin(\psi/2)}$, where ψ is the progressive phase shift between the elements. (6)

(ii) In order to obtain maximum radiation along the direction $\theta = 0^\circ$ where θ is measured from the positive z axis, determine the progressive phase shift ψ. (3)

(iii) Find all the nulls of the array factor. (6)



Or