Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2024
ELECTRONICS AND COMMUNICATION ENGINEERING
(2020 SCHEME)

Course Code : 20ECT401

Course Name: Microwaves and Antennas

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Obtain the relation between gain, directive gain and directivity.
2. Calculate the effective aperture of a short dipole antenna operating at 100 MHz.
3. Differentiate the axial mode and normal mode of operation of a helical antenna.
4. Explain the feeding methods of rectangular patch antenna.
5. Define grating lobes. How it can be eliminated?
6. In a uniform linear array, 4 isotropic radiating elements are spaced λ/4 apart. Find the progressive phase shift required between the elements for forming the end fire main beam at 60^0.
7. Define s-parameter. Summarize the properties of s-matrices for a typical microwave network.
8. Explain Gunn effect.
9. Illustrate the bunching process in two cavity klystron amplifier.
10. Explain the significance of slow wave structures used in microwave circuits

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. Obtain the field equations, radiation resistance and directivity of a short dipole antenna. (14)

OR

12. Obtain the field equations, radiation resistance and directivity of a half wave dipole antenna. (14)

MODULE II

13. a) Design a rectangular patch antenna that resonates at 1.65 GHz using a substrate with a dielectric constant of 10.5, h = 0.126 cm. (8)

b) Explain the working principle of parabolic dish antenna. Write down the expression for directivity, gain and HPBW (6)

OR

14. Illustrate LPDA in detail with its working, operating regions and radiation pattern. Also explain its design steps. (14)

MODULE III

15. a) Explain the principle of pattern multiplication. Obtain the radiation pattern of 8 isotropic point sources fed in phase, spaced $\lambda/2$ apart using the principle of pattern multiplication. (8)
    b) Show that for an array of two isotropic point sources with identical amplitude and phase, have a broadside radiation pattern. (6)

OR

16. Explain Dolph-Chebyshev arrays and the procedure for finding it's array factor in detail. (14)

MODULE IV

17. a) Explain the construction and properties of magic Tee with neat diagram. Derive its scattering parameters. (8)
    b) Explain microwave amplifiers using MESFET in detail. (6)

OR

18. a) Illustrate the working of two hole directional coupler. Derive its scattering parameters. (7)
    b) Illustrate circulator and its working in detail. Derive its scattering parameters. (7)

MODULE V

19. a) Explain the construction and working of a reflex klystron in detail. (8)
    b) A cylindrical magnetron has the following operating parameters:
    Vo = 25 KV, Io = 28 A, Bo = 0.332 Wb/m^2, a = 5 cm, b = 10 cm. Find (6)
    a) Cutoff voltage for a fixed B_o,
    b) Cut of magnetic flux density for a fixed V_o

OR

20. a) Explain the construction and working of a travelling wave tube in detail. (7)
    b) A reflex klystron operates under the following conditions:
    cathode voltage, V_o =600V, R_{sh} = 15 KΩ, oscillating frequency, f_r = 9 GHz, distance between reentrant cavity and repeller, L = 1 mm. Given J(1.832) = 0.582. The tube is oscillating at f_r at the peak of the n = 2 mode or 1 3/4 mode. Assume that the (7)

transit time through the gap and beam loading can be neglected

(i) Find the value of the repeller voltage V_r.

(ii) Find the direct current necessary to give a microwave gap voltage of 200 V.

(iii) What is the electronic efficiency?

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