Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30541

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Seventh Semester

Electronics and Communication Engineering

EC 8701 — ANTENNAS AND MICROWAVE ENGINEERING

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Gain and Directivity of antenna.
2. What is mean by Near Field and Far-Field regions?
3. Find radiation resistance of a loop antenna with diameter 0.5 m operating at 1 MHz.
4. List the important advantages of microstrip antennas.
5. Define pattern multiplication.
6. How to reduce the side lobe levels of an antenna?
7. What are slow wave structures? Give examples.
8. A directional coupler is having coupling factor of 20 dB and directivity of 40 dB. If the incident power is 100 mW. What is coupled power?
9. What are the considerations in selecting a matching network?
10. Define unilateral power gain.

PART B — (5 × 13 = 65 marks)

11. (a) With a neat illustration, explain the concept of

(i) Radiation pattern (5)

(ii) Antenna Temperature (4)

(iii) Aperture Efficiency (4)

Or

(b) (i) Explain the radio communication link with transmitting antenna and receiving antenna. (6)

(ii) Discuss the importance of impedance matching in antennas. (7)

12. (a) Explain the working principle of parabolic reflectors. Explain the various feed techniques with their relative merits and demerits. Discuss the role of f/d ratio in the parabolic reflectors.

Or

(b) Explain Rumsey's principles and describe the design procedure for the construction of log periodic antenna.

13. (a) Derive array factor of a uniform linear array and also explain its significance.

Or

(b) Derive the field equations for array of two-point sources with spacing $\frac{\lambda}{2}$ with equal amplitude and phase. Also, derive the direction of maximum, minimum and half power point directions.

14. (a) Explain the working of magic tee and also derive scattering matrix for it.

Or

(b) Explain the working principle of gunn diode and describe its various modes of operations.

15. (a) The S-parameters for a transistor is given below. Determine its stability and draw the input and output stability circles using smith chart.

$S_{11} = 0.385\angle -53^\circ, S_{12} = 0.045\angle 90^\circ, S_{21} = 2.7\angle 78^\circ$ and $S_{22} = 0.89\angle -26.5^\circ$.

Or

(b) An RF amplifier has the following S-parameters: $S_{11} = 0.3\angle -70^\circ$, $S_{21} = 3.5\angle 85^\circ$, $S_{12} = 0.2\angle -10^\circ$ and $S_{22} = 0.4\angle -45^\circ$. Furthermore, the input side of the amplifier is connected to a voltage source with $V_S = 5\ V$ and source impedance $Z_S = 40\ \Omega$. The output is utilized to drive an antenna which has an amplifier of $Z_I = 73\ \Omega$. Determine transducer gain G_T, unilateral transducer gain G_{TU}, available gain G_A, Operating gain G.

PART C — (1 × 15 = 15 marks)

16. (a) Design a transistor oscillator at 4 GHz using a GaAs FET in a common gate configuration, with a 5 nH inductor in series with the gate to increase the instability. Choose a terminating network to match to a 50 Ω load and an appropriate tuning network. The S-parameters of the transistor in a common source configuration are $(Z_0 = 50\ \Omega)$: $S_{11} = 0.72\angle -116^\circ$, $S_{21} = 2.6\angle 76^\circ$, $S_{12} = 0.03\angle 57^\circ$ and $S_{22} = 0.73\angle -54^\circ$.

Or

(b) A GaAs FET is blased for minimum noise figure and has the following S parameters and noise parameters at 4 GHz $(Z_0 = 50\ \Omega)$: $S_{11} = 0.6\angle -60^\circ$, $S_{21} = 1.9\angle 81^\circ$, $S_{12} = 0.05\angle 26^\circ$ and $S_{22} = 0.5\angle -60^\circ$, $F_{min} = 1.6\ dB$, $\Gamma_{opt} = 0.62\angle 100^\circ$, $R_N = 20\ \Omega$. For design purposes, assume the device is unilateral and calculate the maximum error in G_T resulting from this assumption. Then design an amplifier having a 2 dB noise figure with the maximum gain that is compatible with this noise figure.

———————