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Question Paper Code : 60538

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Seventh Semester

Electronics and Communication Engineering

EC8701 — ANTENNAS AND MICROWAVE ENGINEERING

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Directivity and effective area.
2. What is Link Budget? Mention the factors that affect link budget?
3. Compare uniform and tapered apertures.
4. Mention the types of feeding structures used for a micro strip patch antenna?
5. Calculate the Null to null beam width of 8 element broad side array when the spacing between the individual elements is $\lambda/2$.
6. What is beam steering and beam forming?
7. The S parameters of a microwave device are given by $S_{11} = S_{22} = 0$; $S_{12} = S_{21} = 0.707$. Identify the type of device.
8. Define the terms frequency pushing and pulling in Magnetron.
9. Calculate the nodal quality factor for $Z = (30 + j30)\Omega$.
10. Define available power gain and noise figure.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Explain in detail about radiation from a half wave dipole ($\lambda/2$ antenna) and derive its radiation resistance. (9)
- (ii) Calculate the radiation resistance of an antenna which is radiating 1000 watts and drawing a current of 5A. (4)

Or

- (b) (i) What is impedance matching? Briefly explain about the techniques used to provide the impedance matching. (9)
- (ii) A radio link has a 15 W Transmitter connected to an antenna of 2.5 m^2 effective aperture at 6 GHz. The receiving antenna has an effective aperture of 0.5 m^2 and is located at a 14 Km Line of sight distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver. (4)
12. (a) (i) What are the different types of horn structures? With neat diagram explain about Horn antenna and derive its design equations. (9)
- (ii) Design a rectangular Microstrip Patch Antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, $h=1588 \text{ cm}$ so as to resonate at 10 GHz. Find width and effective dielectric constant of the patch. (4)

Or

- (b) (i) With neat necessary diagrams, explain parabolic reflector antenna and its different types of feeding system. (9)
- (ii) Design the Log Periodic Dipole Array having a directivity of 8.5 dB over a frequency range of 10 MHz to 30 MHz. Assume $T = 0.895$, $\sigma = 0.166$. (4)
13. (a) (i) Derive the expression for the array factor of a linear array of two isotropic elements spaced $\lambda/2$ apart fed with signals of equal amplitude and opposite phase. Obtain the directions of maxima and minima and draw the field pattern. (9)
- (ii) An array of isotropic radiators is operated at a frequency of 4 GHz and is required to produce broadside beam. Find the Directivity if the array length is 10 m. (4)

Or

- (b) (i) Draw the pattern of 10-element binomial array with a spacing of $\lambda/2$ between the elements. Find HPBW in degrees and maximum directivity in dB. (9)
- (ii) What is Smart antenna? Briefly explain the types of Smart antenna. (4)

14. (a) (i) What are avalanche transit time devices? Explain the operation and construction of IMPATT diode. (9)
- (ii) Write short notes on attenuators. (4)

Or

- (b) (i) Explain the working principle of Reflex Klystron and derive the expression for velocity modulation process. (9)
- (ii) A reflex klystron is operated at 10 GHz with DC beam voltage 550 V. Calculate the velocity of electron in the tube. (4)
15. (a) (i) Deduce the expression for input stability circle equation and output stability equation. (9)
- (ii) A transistor has the following S parameters. Find the stability factor.

$$S_{11} = 0.61 \angle 152^\circ, S_{21} = 1.89 \angle 55^\circ, S_{12} = 0.1 \angle 79^\circ, S_{22} = 0.47 \angle -30^\circ. \quad (4)$$

Or

- (b) (i) A MESFET operated at 5.7 GHz has the following S-parameters.
- $$S_{11} = 0.5 \angle -60^\circ, S_{12} = 0.02 \angle 0^\circ, S_{21} = 6.5 \angle 115^\circ, S_{22} = 0.6 \angle -35^\circ.$$
- Draw the constant gain circle of 10dB. (9)
- (ii) Derive the expression for transducer power gain of the RF amplifier. (4)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Describe the cross sectional view of magnetron tube and explain how bunching occurs with equations of electron trajectory and derive the expression for Hull cut-off voltage. (10)
- (ii) A cylindrical Magnetron is operated with the following parameters. Anode voltage 25kV, Beam current 25A, Magnetic density 0.34 Wb/m², Radius of cathode cylinder 5 cm, Radius of anode cylinder 10 cm. Calculate cut-off voltage. (5)

Or

- (b) (i) Using impedance chart, Design any two possible configurations of discrete two element matching networks that match the source impedance $Z_s = (50 + j25)\Omega$ to the load $Z_L = (25 - j50)\Omega$, Assume a characteristic impedance $Z_0 = 50\Omega$ and an operating frequency of $f = 2\text{ GHz}$. (10)
- (ii) Describe the frequency response and Q of impedance matching network. (5)