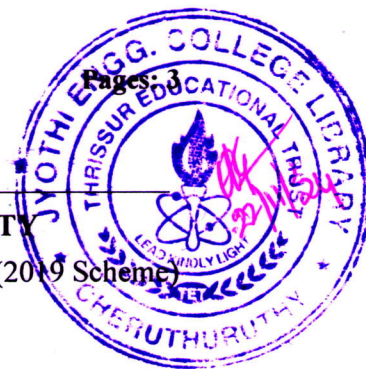


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Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R, S) / S7 (PT) (R,S) Examination November 2024 (2019 Scheme)

Course Code: ECT401

Course Name: MICROWAVES AND ANTENNAS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

Marks

- | | | |
|----|--|-----|
| 1 | What is aperture efficiency of an antenna? Find the effective aperture of a hypothetical, idealized isotropic antenna with Directivity $D = 1$. | (3) |
| 2 | Explain about the antenna field zones. | (3) |
| 3 | Derive the expression for apex angle of a log periodic antenna. | (3) |
| 4 | With a neat diagram explain the Cassegrain feed method for a parabolic antenna. | (3) |
| 5 | Explain the principle of pattern multiplication with an example of resultant pattern of four isotropic elements spaced at $\lambda/2$. | (3) |
| 6 | What is the concept of phased arrays? Give any two types of phased arrays. | (3) |
| 7 | Calculate the lowest resonant frequency of a rectangular cavity resonator with dimensions $a = 2$ cm, $b = 1$ cm and $d = 3$ cm. | (3) |
| 8 | What is a re-entrant cavity in microwave engineering, and what are the different types. | (3) |
| 9 | What are the different modes in Gunn diode? | (3) |
| 10 | Derive the S matrix of a two- port network. | (3) |

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

- | | | |
|----|--|-----|
| 11 | a) Explain and derive the mathematical relationship between gain and directivity for an ideal, lossless antenna, and interpret what this relationship implies about the antenna's radiation characteristics. | (7) |
| | b) State and prove Reciprocity theorem. | (7) |

OR

- | | | |
|----|---|-----|
| 12 | a) Derive Helmholtz theorem of a vector field. | (6) |
| | b) Derive the Radiation Resistance of a half wave dipole antenna. | (8) |

Module II

- 13 a) Differentiate between axial mode and normal mode of a helical antenna and write down the design equations. (7)
- b) With necessary diagrams explain the working and feed techniques of a microstrip antenna. (7)

OR

- 14 a) Explain the working principle of a horn antenna and discuss how the shape of the horn affects its performance. Mention the types of horn antennas commonly used in communication systems. (7)
- b) Why Log Periodic antenna is called as Frequency Independent antenna? Draw the structural geometry of a log periodic antenna array and explain its design steps. (7)

Module III

- 15 a) Derive the expression for the array factor of a broad side array of N isotropic point sources and also the expression for major lobe, minor lobe and null of the array and plot the same for $N=4$ and $d=\lambda/2$. (9)
- b) Compare broadside and end fire arrays. (5)

OR

- 16 a) Using the Dolph-Chebyshev technique, determine the weights for a 4-element array with $\lambda/2$ spacing between elements. Ensure that the side lobe level is 19.1 dB below the main lobe. (8)
- b) What are grating lobes? How can it be minimised? (6)

Module IV

- 17 a) Using a structural diagram and an Applegate diagram, explain the working of a reflex klystron. (9)
- b) What are slow wave structures? Explain its types. (5)

OR

- 18 a) Show that magnitude of the velocity fluctuation of the electron beam in a TWT is directly proportional to the magnitude of the axial electric field. (9)
- b) An X-band pulsed cylindrical magnetron has a Magnetic flux density $B_0 = 0.336$ Wb/m², cathode cylinder radius $a = 5$ cm, vane edge to centre radius $b = 10$ cm, find i) The cyclotron angular frequency and ii) The cutoff voltage for a fixed B_0 . Given that the charge to mass ratio of electron = 1.759×10^{11} C/Kg. (5)

Module V

- 19 a) With the help of a structure explain the working of a two hole directional coupler. (4)
b) An input power of 10 mW is applied to the port 1 of a 20 dB directional coupler. (3)
Determine the coupled power at port 4.
c) Explain the working of a Ferrite isolator. What is its S matrix? (7)

OR

- 20 a) With neat sketches explain the working of magic Tee. Derive its S matrix (8)
b) Draw the J-E characteristics of a Gunn diode and explain the different regions. (6)
