Total number of printed pages: **Programme (UG) 7th Semester/UECE711A**
2023

Microwave Theory and Techniques

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1	(a)	Starting from the Helmholtz equation derive the electromagnetic field equations in rectangular waveguide for TE mode.	10
	(b)	Explain why a rectangular waveguide is preferred over a square waveguide for usual microwave transmission.	5
	(c)	Explain why TE_{10} is called dominant mode.	5
2	(a)	Derive the expressions of the electromagnetic field equations in cylindrical waveguide with circular cross section for TM mode.	10
	(b)	Derive the expression of the wave impedance	5
	(c)	Explain why TEM is not supported by a hollow metallic waveguide	5
3	(a)	Derive an expression for the resonant frequency of a rectangular cavity ($a \times b \times l$) with $a > b < l$ and hence obtain the dominant mode of resonance.	10
	(b)	Define 'Q-factor' of a cavity. Distinguish between 'loaded Q' and 'unloaded-Q' of the cavity.	5
	(c)	Derive the expressions of loaded Q for different types of coupling and draw the variation of standing wave ratio with coupling coefficient.	5
4	(a)	What is Scattering Matrix and Explain why 'scattering Matrix' representation of a microwave network is preferred over Z-matrix or Y-matrix representation	5
	(b)	Discuss briefly the different properties of S matrix	6
	(c)	Prove that for a reciprocal network the scattering matrix is a symmetrical matrix.	9

5	(a)	Obtain the scattering matrix equation of a 'Magic-T' by using the necessary properties of the scattering matrix	8
	(b)	Describe an ideal 'Directional coupler' and derive its 'Scattering Matrix'.	7
	(c)	Mention the principal shortcoming of two hole directional coupler and discuss how this shortcoming can be overcome.	5
6	(a)	Explain with neat sketch the oscillation mechanism of a magnetron	10
	(b)	Derived the expressions of Hull cut-off magnetic field and Hull cut-off voltage in Magnetron oscillator.	10
7	(a)	Explain the slotted line method for the measurement of unknown Impedance.	8
	(b)	Describe the procedure for measuring (i) VSWR (< 20) and (ii) VSWR (>20) using a VSWR meter in a microwave bench.	12