Hall Ticket No | | | | | | | | | | | Question Paper Code: AEC015

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-I

B.Tech VII Semester End Examinations, November - 2019
Regulation: IARE-R16
MICROWAVE ENGINEERING
(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 70**

Answer any ONE question from each Unit
All questions carry equal marks
All parts of the question must be answered in one place only

UNIT – I

1 a) Describe the microwave frequency spectrum and list the advantages microwave communication. [7M]

b) When the dominant mode is propagated in an air-filled standard rectangular waveguide, the guide wavelength at a frequency of 9 GHz is 4 cm. Calculate width of the guide. [7M]

2 a) Derive the expression for phase velocity, group velocity and guide wavelength in rectangular waveguide. [7M]

b) An air-filled rectangular waveguide has dimensions of a = 6 cm and b = 4 cm. The signal frequency is 3 GHz. Compute the following for the TE10 and TM11 modes:
(a)Cut-off frequency
(b)Wavelength in the waveguide
(c)Phase constant and phase velocity
(d)Group velocity in the waveguide. [7M]

UNIT – II

3 a) Discuss in detail about the working principle of an E-plane Tee junction with neat schematics? [7M]

b) The collinear ports (1) and (2) of magic tee are terminated by impedances oreflection coefficients $\rho 1 = 0.5$ and $\rho 2 = 0.6$. The difference port (4) is terminated by an impedance with reflection coefficient of 0.8. If 1 watt power is fed at sum port (3), calculate the power reflected at port (3) and power divisions at the other ports. [7M]

4 a) Discuss about E-H plane Tee junction. Why a hybrid E-H plane Tee referred to as Magic Tee. Derive the scattering matrix for E-H plane Tee junction. [7M]

b) An isolator has an insertion loss of 0.5 dB and an isolation of 30 dB. Determine the scattering matrix of the isolator if the isolated ports are perfectly matched to junction [7M]

UNIT – III

5	a)	Explain in detail bunching process & obtain expression for bunching parameter in a two cavity klystron amplifier?	[7M]
	b)	The operating frequency of reflex klystron is 2 GHz. Calculate the change in frequency for a 2% change in the repeller voltage given that; Repeller voltage = 2000 V Accelerating voltage= 500 V Space between exit of the gap and repeller electrode = 2 cm (Assume that the operation is for n = 1).	[7M]
6	a)	With the aid of a schematic diagram, describe the travelling wave tube amplifier and How is continuous interaction between the electron beam and RF field ensured in the TWT?	[7M]
	b)	An X-band pulsed cylindrical magnetron has V0 = 30 kV, I0 = 80 A, B0 = 0.01 wb/m2 , a =4 cm, b = 8 cm. Calculate: (i) Cyclotron angular frequency (ii) Cut-off voltage (iii) Cut-off magnetic flux density	[7M]

UNIT – IV

7	a)	Derive the criterion for classifying the modes of operation for Gunn effect diodes..	[7M]
	b)	The drift velocity of electron is 2 * 107 cm/s, through the active region of length 10 *10−4 cm. Calculate the natural frequency of the Gunn diode and the critical voltage.	[7M]
8	a)	What is meant by Avalanche Transit Time Devices? Explain the operation, construction and Applications of IMPATT.	[7M]
	b)	An IMPATT DIODE has the following parameters: Carrier drift velocity = 105 m/s, Length of the drift space = 5 μm. Calculate the frequency of oscillation produced. .	[7M]

UNIT – V

9	a)	Draw a neat diagram of microwave test bench and explain about each block along with its features.	[7M]
	b)	The input power given to an attenuator is 1000 W. The output power produced by the attenuator is 1W. Calculate the value of the attenuator	[7M]
10	a)	Explain the measurement of attenuation using power ratio method with neat block diagram.	[7M]
	b)	A slotted line is used to measure VSWR of the load at 8 GHz by double minima method. If the distance between the positions of twice minimum power is 0.5 cm. Find the value of VSWR on the line and magnitude of the voltage reflection coefficient	[7M]

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I COURSE OBJECTIVES

The course should enable the students to:

S.No	Description
I	Develop the knowledge on transmission lines for microwaves, cavity resonators and Wave guide components and applications.
II	Enable the students to understand and analyze the operation of microwave tubes like klystron, magnetron, travelling wave tube, etc.,
III	Familiarize with microwave solid state devices.
IV	Introduce the student the microwave test bench for measure different parameters like attenuation, VSWR, impedance etc.

II COURSE OUTCOMES (COs):

CO 1	Describe the types of waveguides, rectangular waveguides and field equations.
CO 2	Understand the coupling mechanisms in waveguides and analyze the waveguide multiport junctions.
CO 3	Explore the microwave linear tubes and analyze with microwave cross field tubes.
CO 4	Understand the microwave solid state devices and avalanche transit time devices.
CO 5	Demonstrate the microwave bench set up and conducting measurements of different parameters.

III COURSE LEARNING OUTCOMES

Students who complete the course will have demonstrated the ability to do the following.

AEC015.01	Understand the microwave spectrum and applications of microwaves
AEC015.02	Analyze the types of waveguides, rectangular waveguides and field equations in rectangular waveguide.
AEC015.03	Determine the wave impedance for a TM and TE wave in rectangular waveguide
AEC015.04	Understand the types of cavity resonators and determine the dominant mode.
AEC015.05	Explore the coupling mechanisms for a cavity resonator.
AEC015.06	Understand the waveguide discontinuities: waveguide irises, tuning screws, posts and matched loads
AEC015.07	Understand the operation of multiport junctions and its applications
AEC015.08	Understand the Faraday rotation principle and analyze the different ferrite devices.
AEC015.09	Understand the limitations of conventional vacuum tubes at microwave frequencies and Understand the velocity modulation process and bunching process in microwave linear beam tubes
AEC015.10	Determine the beam current density in Multi cavity Klystron amplifiers
AEC015.11	Understand the velocity modulation process and power output in Reflex Klystron

AEC015.12	Determine the amplification process in helix Traveling wave tube (TWT)
AEC015.13	Describe the 8-cavity cylindrical travelling wave Magnetron
AEC015.14	Analyze the Hull cut-off and Hartree conditions in Magnetron.
AEC015.15	Illustrate the microwave solid-state devices: microwave tunnel diode and transferred electron devices
AEC015.16	Determine the RWH theory and modes of operations in Gunn diodes
AEC015.17	Understand the Avalanche transit time devices: IMPATT diode, TRAPATT diode and BARITT diode
AEC015.18	Describe the microwave bench set-up with different blocks and their features
AEC015.19	Determine the measurements of microwave power, attenuation, frequency, VSWR and impedance

IV MAPPING OF SEMESTER END EXAMINATION TO COURSE LEARNING OUTCOMES:

SEE Question No.		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AEC015.01	Understand the microwave spectrum and applications of microwaves	CO 1	Understand
	b	AEC015.02	Analyze the types of waveguides, rectangular waveguides and field equations in rectangular waveguide.	CO 1	Understand
2	a	AEC015.03	Determine the wave impedance for a TM and TE wave inrectangular waveguide	CO 1	Understand
	b	AEC015.03	Determine the wave impedance for a TM and TE wave inrectangular waveguide	CO 1	Understand
3	a	AEC015.07	Understand the operation of multiport junctions and itsapplications	CO 2	Understand
	b	AEC015.07	Understand the operation of multiport junctions and its applications	CO 2	Understand
4	a	AEC015.07	Understand the Faraday rotation principle and analyze thedifferent ferrite devices.	CO 2	Understand
	b	AEC015.08	Understand the Faraday rotation principle and analyze thedifferent ferrite devices.	CO 2	Remember
5	a	AEC015.08	Understand the limitations of conventional vacuum tubes at micro wave frequencies and Understand the velocity modulation process and bunc hing process in microwavelinear beam tubes	CO 3	Understand
	b	AEC015.11	Understand the velocity modulation process and power outputin Reflex Klystron	CO 3	Remember

6	a	AEC015.11	Understand the velocity modulation process and power outputin Reflex Klystron	CO 3	Understand
	b	AEC015.12	Determine the amplification process in helix Traveling wave tube (TWT)	CO 3	Understand
7	a	AEC015.17	Understand the Avalanche transit time devices: IMPATTdiode, TRAPATT diode and BARITT diode	CO 4	Understand
	b	AEC015.17	Understand the Avalanche transit time devices: IMPATTdiode, TRAPATT diode and BARITT diode	CO 4	Understand
8	a	AEC015.16	Determine the RWH theory and modes of operations in Gunn diodes	CO 4	Understand
	b	AEC015.16	Determine the RWH theory and modes of operations in Gunn diodes	CO 4	Understand
9	a	AEC015.18	Describe the microwave bench set-up with different blocksand their features attenuation, frequency, VSWR and impedance	CO5	Understand
	b	AEC015.18	Describe the microwave bench set-up with different blocksand their features attenuation, frequency, VSWR and impedance	CO5	Remember
10	a	AEC015.19	Determine the measurements of microwave power,attenuation, frequency, VSWR and impedance	CO5	Understand
	b	AEC015.19	Determine the measurements of microwave power,attenuation, frequency, VSWR and impedance	CO5	Remember

Signature of Course Coordinator **HOD, ECE**