# $1 A R E$ <br> INSTITUTE OF AERONAUTICAL ENGINEERING <br> (Autonomous) <br> Dundigal-500043, Hyderabad <br> B.Tech VII SEMESTER END EXAMINATIONS (REGULAR) - FEBRUARY 2022 <br> Regulation: R18 <br> SATELLITE AND MICROWAVE ENGINEERING 

Time: 3 Hours
(ECE)
Max Marks: 70
Answer FIVE Questions choosing ONE question from each module
(NOTE: Provision is given to answer TWO questions from any ONE module) All Questions Carry Equal Marks
All parts of the question must be answered in one place only

## MODULE - I

1. (a) State the characteristics of a rectangular wave guide and discuss in brief about the TE mode of propagation.
[7M]
(b) A common air filled rectangular X band waveguide has the interior dimensions $\mathrm{a}=2.29 \mathrm{~cm}$ and $\mathrm{b}=1.0 \mathrm{~cm}$. Find the cut-off frequency of the lower order TM mode. If a source frequency which is twice the cut-off value found in (a), determine the propagating constant for the mode. Also obtain the wavelength in the guide, phase velocity and intrinsic wave impedance.
[7M]
2. (a) Discuss in detail about the principle and working of an H-plane Tee junction with neat schematics and derive the s-matrix of an H-plane Tee.
[7M]
(b) An air-filled rectangular wave guide of inside dimension $7 \times 3.5 \mathrm{~cm}$ operates in the dominant $T E_{10}$ mode. Find the cut off frequency, phase velocity and guided wavelength at a frequency of 3.5 GHz .
[7M]

## MODULE - II

3. (a) With a neat diagram, discuss the mechanism of oscillation and operation of magnetron.
(b) Illustrate two cavity klystron amplifier by indicating different blocks. Differentiate Klystrons and TWT.
4. (a) Discuss in brief about the slow wave structures used in microwave tubes.
[7M]
(b) A two cavity klystron amplifier has the following parameters beam voltage $V_{0}=900 \mathrm{~V}$ Beam current $I_{0}=30 \mathrm{~mA}$ Frequency $\mathrm{f}=8 \mathrm{GHz}$ gap spacing in either cavity $\mathrm{d}=1 \mathrm{~mm}$, Spacing between centers at cavity $\mathrm{L}=4 \mathrm{~cm}$, effective shunt impedance $R_{s h}=40 \mathrm{~kW}$ Determine:
i) The electron velocity
ii) The DC electron transit time
iii) The input voltage for maximum output voltage
iv) The voltage gain in decibels.
MODULE - III
5. (a) What is tunnel diode. Draw the VI characteristics, and symbol of tunnel diode.
[7M]
(b) Determine conductivity of an n-type GaAs Gunn diode if Electron density $n=10^{16} \mathrm{~cm}^{-3}$ Electron density at lower valley $n_{l}=10^{10} \mathrm{~cm}^{-3}$, Electron density at upper valley $n_{u}=10^{8} \mathrm{~cm}^{-3}$ at temperature $\mathrm{T}=400 \mathrm{~K}$
6. (a) With the help of block diagram, describe the features of different blocks of microwave bench set up.
[7M]
(b) Two identical 30 dB directional coupler are used to sample the reflected power in waveguide. If VSWR is 3 and the output of the coupler sampling the incident power is 5.2 mW . What will be the reflected power?
[7M]

## MODULE - IV

7. (a) With the help of block diagram, demonstrate the operation of satellite communication system.
[7M]
(b) A satellite is moving in a circular orbit at an altitude of 250 km . Assuming the mean radius of the earth as 6378 km , calculate the orbital period and orbital velocity of the satellite.
[7M]
8. (a) Discuss in detail about the tropospheric and ionospheric effects on radio wave propagation in satellite communication.
[7M]
(b) Calculate the eclipse time period and eclipse angle for a satellite at an altitude of $24,000 \mathrm{~km}$. Assume the earth's equatorial radius is 6378 km .
[7M]

## MODULE - V

9. (a) List different earth tracking systems used for satellite acquisition. Explain in detail automatic tracking systems commonly used for satellite tracking.
[7M]
(b) A satellite at a distance of 40000 km from a point on the earth's surface radiates a power of 10 W from an antenna with a gain of 17 dB in the direction of the observer and operates at a frequency of 11 GHz . The receiving antenna has a gain of 52.3 dB , find the received power.
[7M]
10. (a) With a neat sketch explain the frame structure of a time division multiple access (TDMA). List the advantages of TDMA.
[7M]
(b) In a TDMA network the reference burst and the preamble each requires 560 bits, and the nominal guard interval between bursts is equivalent to 120 bits. Given that there are eight traffic bursts and one reference burst per frame and the total frame length is equivalent to 40,800 bits, calculate the frame efficiency.
[7M]
