

B.Tech III Year II Semester (R13) Supplementary Examinations December 2016

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- In the notation TEM_n and TM_m what do 'm' and 'n' represent?
 - If the broader dimension of a rectangular waveguide is 2.2 cms, what is the cutoff frequency and wavelength for dominant mode?
 - List the properties of scattering matrix for a lossless junction.
 - What is Faraday's rotation law?
 - How are spurious oscillations generated in TWT amplifier? State the method to suppress.
 - Discuss the condition for oscillation in Reflex klystron.
 - What is meant by strapping?
 - Mention the Key phenomenon taking place in TRAPATT diode.
 - Differentiate between barettor and thermistor.
 - What is the main purpose of slotted section with line carriage?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 (a) Derive the wave equation for a TM wave and obtain all the field components in a rectangular wave guide.
- (b) A rectangular wave guide with dimension of 3 × 2 cm operates in the TM₁₁ mode at 10 GHz. Determine the characteristic wave impedance.

OR

- 3 (a) Prove that a cavity resonator is nothing but an LC circuit.
- (b) Derive an expression for Q of a cavity supporting TE₁₀₁ mode.
- (c) What is the resonant frequency of the cavity if each side of the guide is 3 cm?

UNIT – II

- 4 Write short notes on:
- Waveguide Irises.
 - Rat Race hybrid.
 - Dielectric phase shifters.

OR

- 5 (a) Why are S - parameters used at microwave frequencies explain. Give the properties of S parameters and Derive S - matrix for series Tee using the properties of S parameters.
- (b) A Three port circulator has an insertion loss of 1dB, isolation 30 dB and VSWR = 1.5. Find the S – matrix.

UNIT – III

- 6 (a) Explain how the amplification takes place in TWT. Compare its bandwidth with Klystron amplifier.
- (b) A reflex klystron having an accelerated field of 300 V oscillates at a frequency of 10 GHz with a retarding field of 500 V. If its cavity is returned to 9 GHz. What must be the new value of retarding field for oscillations in the same mode to take place?

OR

- 7 (a) What is velocity modulation? Explain how amplification takes place in a two cavity Klystron amplifier.
- (b) A TWT operates with following parameters: $V_b = 2.5$ KV, $I_b = 25$ mA, $Z_o = 10$, circuit length, $L = 50$, $f = 9$ GHz. Find the gain parameter & power gain.

UNIT – IV

- 8 (a) Write short notes on “Hartree resonance conditions”.
(b) An n-type GaAs Gunn diode has following parameters:

Electron drift velocity: $V_d = 2.5 \times 10^5$ m/s

Negative Electron mobility: $\mu_n = 0.015$ m²/v s

Relative dielectric constant: $\epsilon_r = 13.1$

Determine the criterion for classifying the modes of operation.

OR

- 9 (a) How is bunching achieved in a cavity magnetron? Explain the phase focusing effect.
(b) Explain the physical structure and construction of IMPATT diodes.

UNIT – V

- 10 (a) Using slotted line, draw a typical microwave bench setup for measurement of unknown load and explain.
(b) Two identical 30dB directional couplers are used to sample incident and reflected power in a wave guide. VSWR = 2 and the output of the coupler sampling incident power = 4.5 mW. What is the value of reflected power?

OR

- 11 (a) Explain the method of microwave power measurement using Bolometer.
(b) Compare the power ratio and RF substitution methods of measuring attenuation provided by the microwave component.
