

Hall Ticket Number:

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Code No. : 17436 S

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) VII-Semester Supplementary Examinations, July-2022**Microwave Engineering**

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B****Part-A (10 × 2 = 20 Marks)**

| Q. No. | Stem of the question | M | L | CO | PO |
|----------------------------------|--|---|---|----|----|
| 1. | What are microwaves? List out the typical applications of microwaves. | 2 | 1 | 1 | 1 |
| 2. | Sketch the field distribution inside a parallel plane guide for dominant mode. | 2 | 2 | 1 | 1 |
| 3. | Find the cut-off frequency of an air filled rectangular cavity resonator when $a = 6\text{cm}$, $b = 2\text{cm}$ and $d = 10\text{cm}$ for TE_{101} mode? | 2 | 2 | 2 | 2 |
| 4. | Differentiate between dominant and degenerate modes in waveguides. | 2 | 2 | 1 | 2 |
| 5. | What is scattering matrix and mention its properties? | 2 | 2 | 3 | 1 |
| 6. | How the circulator can be used as an isolator? Outline their functionality. | 2 | 2 | 3 | 1 |
| 7. | List out the limitations of conventional tubes at microwave frequencies. | 2 | 1 | 4 | 1 |
| 8. | Compute the velocity of the electron when the applied beam voltage $V_0 = 300$ volts of a Reflex Klystron Oscillator. | 2 | 3 | 4 | 2 |
| 9. | Outline the structure of microstrip line and mention the importance of effective dielectric constant. | 2 | 2 | 3 | 1 |
| 10. | Find the operating frequency of an IMPATT diode with carrier drift velocity of $v_d = 2 \times 10^7 \text{cm/s}$ and drift space charge length of $L = 6\mu\text{m}$. | 2 | 3 | 5 | 2 |
| Part-B (5 × 8 = 40 Marks) | | | | | |
| 11. a) | Explain attenuation with planes of finite conductivity for TE, TM wave propagating through a parallel plane waveguide and sketch their variation as a function of frequency. | 4 | 4 | 1 | 3 |
| b) | Consider a parallel plane wave guide with plate separation of 20cm with the TE_1 mode excited at 1GHz. Find the propagation constant, the cut off frequency and wavelength in the guide. | 4 | 3 | 1 | 2 |
| 12. a) | Starting from the Maxwell's equations, Illustrate the TE field equations propagating inside the rectangular waveguide. | 4 | 1 | 1 | 1 |
| b) | A Rectangular waveguide has a cross section of 1.5cm X 0.8cm, $\sigma = 0, \mu = \mu_0$, and $\epsilon = 4 \epsilon_0$. The electric field component is along the direction of propagation and the magnetic field component is given as $H_x = 2 \sin\left(\frac{\pi x}{a}\right) \cos\left(\frac{3\pi y}{b}\right) \sin(\pi \times 10^{11} t - \beta z)$ A/m, Determine a. The mode of operation b. Cut off frequency c. Phase Constant d. Wave Impedance | 4 | 3 | 1 | 2 |

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|--------|---|---|---|---|---|
| 13. a) | Explain the construction and operation of E-Plane Tee? Formulate the Scattering matrix for E-Plane Tee. | 4 | 3 | 3 | 1 |
| b) | A 10mW signal is fed into one of collinear port of a lossless Magic - Tee junction. Calculate the power delivered through each port when other ports are terminated with matched load. | 4 | 4 | 3 | 3 |
| 14. a) | Derive the expression for bunching distance of a two cavity klystron Amplifier. | 4 | 3 | 4 | 1 |
| b) | Explain the operation of Reflex klystron tube with the help of Applegate diagram. | 4 | 2 | 4 | 1 |
| 15. a) | Explain the construction and working principle of a Gunn diode using two valley model? | 4 | 2 | 5 | 1 |
| b) | Explain the geometrical structure and operation of IMPATT diode. | 4 | 1 | 5 | 1 |
| 16. a) | Explain the significance of TEM mode in parallel plane waveguides using corresponding field equations? | 4 | 2 | 1 | 1 |
| b) | Design an air filled rectangular wave guide at the signal frequency 1 GHz for a. TE ₁₀ mode b. TE ₂₀ mode | 4 | 3 | 1 | 3 |
| 17. | Answer any <i>two</i> of the following: | | | | |
| a) | A signal of 25W is fed at one port of a symmetric directional coupler with directivity D= 40 dB and coupling factor C=13 dB. Find the power outputs at i. Coupled port ii. Isolated port iii. Output port | 4 | 4 | 3 | 2 |
| b) | A 400kW cylindrical magnetron is operating at X-Band has the following set of parameters anode voltage V _{dc} =32KV beam current I _{dc} =84A radius of cathode (a) = 6cm radius of anode (b)= 12 cm magnetic flux density (B)= 0.01 wb/m ² Calculate (a) Cyclotron angular frequency (b) Cut off magnetic flux density for a fixed V _{dc} (c) The cut off voltage for a fixed B ₀ | 4 | 3 | 4 | 2 |
| c) | Explain different modes of operation of a GUNN diode with neat sketches. | 4 | 1 | 5 | 1 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

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| i) | Blooms Taxonomy Level - 1 | 20% |
| ii) | Blooms Taxonomy Level - 2 | 30% |
| iii) | Blooms Taxonomy Level - 3 & 4 | 50% |
