

Code No: RT32044

R13

SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April -2018

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

PART -A

- | | | | |
|---|----|---|------|
| 1 | a) | List out the various IEEE Microwave frequency bands. | [3M] |
| | b) | What are the applications of Micro strip lines? | [4M] |
| | c) | Write the properties of S-parameters. | [4M] |
| | d) | What is meant by velocity modulation? | [3M] |
| | e) | Draw the ω - β diagram for a helical structure and explain its significance. | [4M] |
| | f) | Write short notes on two-valley theory. | [4M] |

PART -B

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|---|----|--|------|
| 2 | a) | Derive the TE_{mn} field equations in rectangular waveguide. | [8M] |
| | b) | Write short notes on phase velocity and group velocity. | [8M] |
| 3 | a) | Derive the expressions for field equations of TM modes in circular waveguide. | [8M] |
| | b) | With necessary equations, explain about rectangular cavity resonator. | [8M] |
| 4 | a) | What is magic tee? Derive the S matrix of a Magic Tee. | [8M] |
| | b) | Explain the various construction methods and applications of circulator. | [8M] |
| 5 | a) | What are the limitations of conventional tubes at microwave frequencies? Explain. | [8M] |
| | b) | A reflex klystron operates under the following conditions:
$V_0 = 600$ V, $L = 1$ mm, $R_{sh} = 15$ k Ω , $e/m = 1.759 \times 10^{11}$, $f_r = 9$ GHz. The Tube is oscillating at f_r at the peak of the $n = 2$ mode or $1\frac{3}{4}$ mode. Assume that the transit time through the gap and beam loading can be neglected.
i) Find the value of the repeller voltage V_r .
ii) Find the direct current necessary to give a microwave gap voltage of 200 V.
iii) What is the electronic efficiency under this condition? | [8M] |
| 6 | a) | Derive the expression for Axial Electric field in helix type travelling wave tube. | [8M] |
| | b) | Explain the operation of Magnetron and write its applications. | [8M] |
| 7 | a) | Discuss about construction and operation of TRAPATT diode. | [8M] |
| | b) | Draw the general set-up of microwave bench and explain the purpose of each block. | [8M] |

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SET - 2

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2. Answering the question in **Part-A** is compulsory

3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) List out the applications of microwaves. [3M]
- b) Sketch the schematic diagram of strip lines. [3M]
- c) Write short notes on tuning screws. [4M]
- d) Draw the Applegate diagram with gap voltage for a reflex klystron and explain it. [4M]
- e) Write the advantages of travelling wave tubes. [4M]
- f) Write the differences between transferred electron devices and avalanche transit time devices. [4M]

PART -B

- 2 a) Derive the equation for the solution to the Helmholtz equation in rectangular coordinates. [8M]
- b) Discuss about the impossibility of TEM mode in Waveguides. [8M]
- 3 a) Explain about quality factor of Micro strip lines. [8M]
- b) With necessary expressions, explain about circular cavity resonator. [8M]
- 4 a) What are the various applications of Magic Tee? Explain. [8M]
- b) What are ferrites? How they are useful in microwaves? Explain faradays rotation? [8M]
- 5 a) With necessary equations, explain the velocity modulation process in two cavity klystron amplifier. [8M]
- b) Define Electronic Admittance of a reflex klystron and explain it with necessary equations. [8M]
- 6 a) Discuss about Helical slow-wave structure in microwave tubes. [8M]
- b) Derive the Hull cutoff magnetic equation and Hull cutoff voltage equation. [8M]
- 7 a) Explain the operation of IMPATT diode. [8M]
- b) Define VSWR and explain the procedure for measurement of VSWR. [8M]

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R13**SET - 3****III B. Tech II Semester Regular/Supplementary Examinations, April -2018****MICROWAVE ENGINEERING**

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Time: 3 hours

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) What is meant by mode of a electromagnetic wave in waveguide? [3M]
b) Write the applications of circular waveguide. [4M]
c) Define Coupling Factor and Directivity of a Directional Coupler. [3M]
d) List out the characteristics of two-cavity klystron amplifier. [4M]
e) What is the purpose of slow-wave structures in microwave tubes? Explain. [4M]
f) Write short notes on Low Frequency Measurement versus Microwave Measurements. [4M]

PART -B

- 2 a) Derive the wave equation for a TM wave and obtain all the field components in a rectangular waveguide. [8M]
b) An air filled rectangular waveguide of inside dimensions 7 x 3.5 cm operates in the dominant TE_{10} mode. [8M]
(i) Find the cut off frequency.
(ii) Determine the phase velocity of the wave in the guide at a frequency of 3.5 GHz.
- 3 a) Discuss about ohmic losses in Micro strip lines. [8M]
b) Explain about Q factor of a Cavity Resonator. [8M]
- 4 a) Derive the S-Matrix of H-Plane Tee. [8M]
b) Explain the different types of Microwave attenuators. [8M]
- 5 a) What is meant by Reentrant Cavities? How they are useful in microwaves? Explain. [8M]
b) Explain the operation of reflex klystron and write its performance characteristics. [8M]
- 6 a) Explain the nature of four propagation constants in helix travelling-wave tube. [8M]
b) Discuss about power output and efficiency of magnetron. [8M]
- 7 a) Explain about Gunn Oscillation modes. [8M]
b) Explain the procedure for measurement of Attenuation. [8M]

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SET - 4

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) Define cutoff frequency and write its significance. [3M]
- b) Write the expressions for resonant frequencies in rectangular and circular cavity resonators. [3M]
- c) Write short notes on Microwave Isolator. [4M]
- d) What are the applications of reflex klystrons? [4M]
- e) Write the major differences between the TWT and the Klystron. [4M]
- f) List out the performance characteristics of IMPATT diode. [4M]

PART -B

- 2 a) Derive the expressions for the characteristic impedance and wavelength in the guide for TE and TM modes. [8M]
- b) Discuss about the power losses in rectangular waveguide. [8M]
- 3 a) Derive the expression for the solution of Helmholtz equation in cylindrical coordinates. [8M]
- b) Explain about Dielectric losses in Micro strip lines. [8M]
- 4 a) Define a Microwave junction. Explain how it is described by using S-Parameters. [8M]
- b) Derive the S-Matrix of a Directional Coupler. [8M]
- 5 a) With necessary equations, explain the bunching process in 2 – cavity klystron amplifiers. [8M]
- b) Derive the expression for power output and efficiency of reflex klystron. [8M]
- 6 a) Draw the diagram of helix travelling-wave tube and explain its operation. [8M]
- b) An X-band pulsed cylindrical magnetron has the following operating parameters: [8M]
Anode voltage = 26 kV, Beam current = 27 A, magnetic flux density = 0.336 Wb/m², radius of cathode cylinder = 5 cm, Radius of vane edge to center b = 10 cm. compute
i) The cyclotron angular frequency
ii) The cutoff voltage for a fixed B₀
iii) The cutoff magnetic flux density for a fixed V₀.
- 7 a) Explain the concept of Gunn effect with necessary figures. [8M]
- b) Explain the procedure for impedance measurement. [8M]