

**III B. Tech II Semester Regular Examinations April - 2016**  
**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**

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**PART -A**

- 1 a) What are the various applications of Microwaves? [4M]
- b) How to find Q of resonant rectangular cavity? [4M]
- c) How to use matched load in microwaves? [3M]
- d) What are the limitations of conventional tubes? [4M]
- e) How separate the  $\pi$  mode in Magnetron? [4M]
- f) Why isolator is used in microwave bench set up? [3M]

**PART -B**

- 2 a) Derive the field equations of rectangular waveguide in TM mode, starting from Maxwell's equations. [10M]
- b) Calculate the guide wavelength (in cm) at 7 and 12GHz for an air filled waveguide with  $a=2.54$  cm,  $b=1.5$ cm. [6M]
- 3 a) Explain how TEM propagate in circular waveguides. [8M]
- b) A cubic shaped cavity is required to resonate at 7500MHz in the  $TE_{101}$  mode. Calculate its dimensions and unloaded Q if the cavity is air filled. [4M]
- c) Determine the strip width of a Teflon filled balanced strip line for  $Z_0 = 50\Omega$  if the ground plane spacing is 0.25 inch and the strip thickness is 4 mils. [4M]
- 4 a) What are the different types of attenuators? Explain them with neat diagrams [8M]
- b) Derive S-matrix of Magic Tree and also draw its structure. [8M]
- 5 a) Explain the bunching process of two cavity klystron and how to convert velocity modulation into current modulation and also derive the equation for efficiency? [12M]
- b) How to change the frequency of oscillations in reflex klystron? [4M]
- 6 a) What are the different propagation constants TWT? How to calculate them? [8M]
- b) What is Hartree condition in Magnetron? Derive the equation for Hartree voltage of it. [8M]
- 7 a) Draw the characteristics of Gunndiode and explain how negative region is obtained in it? [8M]
- b) What is bolometer? How it is used for microwave measurements? [8M]

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**PART -A**

- 1 a) What are the advantages waveguides have compared to coaxial transmission lines? [3M]
- b) What are the applications of Microstrip line? [4M]
- c) How to use tuning screws and posts in microwaves? [4M]
- d) How to tune the reflex klystron oscillator? [3M]
- e) What the effects are of cross field in Magnetron? [4M]
- f) What is mean by transferred electron devices? Give some examples [4M]

**PART -B**

- 2 a) Derive the field equations of rectangular waveguide in TE mode, starting from Maxwell's equations. [10M]
- b) Prove that the cutoff frequency is same for both TE and TM modes. [6M]
- 3 a) Calculate the cutoff frequency of the dominant mode in a 1 inch diameter, Teflon filled circular waveguide. What is its maximum operating frequency if the possibility of higher mode propagation is to be avoided? Include a 5 percent safety factor, what would be the value of  $f_{\max}$  if the possibility of  $TM_{01}$  propagation was excluded? [10M]
- b) Compare rectangular and circular waveguides [6M]
- 4 a) Explain the working of Rotary Vane type phase shifter with neat diagram. [8M]
- b) What are the properties of S-matrix? Derive the S-matrix of Circulator. [8M]
- 5 a) Derive the equation of optimum output power of two cavity Klystron amplifier. [8M]
- b) Draw and explain the mode characteristics of Reflex Klystron. [8M]
- 6 a) Draw the structure of TWT and explain its amplification process. [8M]
- b) What is Hull cut off condition? Derive the equation for Hull cut off voltage. [8M]
- 7 a) Explain how Gunn diode is used as an oscillator? Explain with the help of circuit diagram. [8M]
- b) Explain the method of measurement of low and high VSWR with neat diagrams. [8M]

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**PART -A**

- 1 a) Draw the field patterns of rectangular waveguide in  $TE_{10}$  and  $TM_{11}$  modes. [4M]
- b) Define effective dielectric constant of micro strip line and derive its equation. [4M]
- c) What is waveguide Iris? Where it is used? [4M]
- d) What are reentrant cavities? How these are used? [3M]
- e) Draw the different types of slow wave structures. [4M]
- f) Explain the function of slotted section in microwave measurements? [3M]

**PART -B**

- 2 a) Why the TEM wave is not possible in rectangular waveguide? [6M]
- b) A rectangular waveguide has the following characteristics: [10M]  
 $b=1.5\text{cm}$ ,  $a=3.0\text{cm}$ ,  $\mu_g = 1$ , and  $\epsilon_g=2.25$   
 Calculate cutoff wavelength, frequency,  $\lambda_g$ ,  $Z_0$  and attenuation constant at 3.0 GHz.
- 3 a) What is meant by degenerative modes? [4M]
- b) Derive the field equation for rectangular cavity resonator in  $TM_{mnp}$  mode, starting from wave equation. [12M]
- 4 a) What are the different types of Directional couplers? Explain the working of two hole directional coupler. [8M]
- b) Derive the S-matrix of E plane Tee and also write its characteristics. [8M]
- 5 a) Explain the bunching process of reflex klystron and also derive the equation for efficiency? [10M]
- b) Why multi cavities are used in Klystron amplifiers? [6M]
- 6 a) Derive the equation for gain of TWT amplifier. [8M]
- b) Draw the structure of 8 cavity magnetron and explain its bunching process [8M]
- 7 a) Explain the principle of working of IMPATT diode with suitable structure and characteristics. [8M]
- b) What are the different precautions have to be made while measuring parameters at Microwave range? [8M]

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**PART -A**

- 1 a) Define and derive the equation for guide wave length of rectangular waveguide. [4M]
- b) How to find the  $Z_0$  of Micro strip line? [4M]
- c) Compare coupling mechanisms using loop and probe in all aspects. [4M]
- d) Classify the microwave tubes. [3M]
- e) Why slow wave structures are used in TWT? [3M]
- f) What are different methods of measurement of microwave frequency? [4M]

**PART -B**

- 2 a) Calculate the cutoff frequencies of air-filled wave guide with  $a=3.24\text{cm}$  and  $b=2.2\text{cm}$ , for the  $TE_{10}$ ,  $TE_{20}$ ,  $TE_{01}$ , and  $TM_{11}$  modes. [8M]
- b) Determine the power loss in rectangular waveguide. [8M]
- 3 a) Derive the characteristic equation of circular waveguide. [6M]
- b) Derive the field equation for rectangular cavity resonator in  $TE_{mnp}$  mode, starting from wave equation. [10M]
- 4 a) What is the principle of Faraday's rotation? How this is used in isolator? [8M]
- b) Derive the s-matrix of Hybrid ring. [8M]
- 5 a) Explain the bunching process in two cavity klystron amplifier with Apple gate diagram. [6M]
- b) Explain how oscillations are generated in reflex klystron? How to calculate its electronic admittance? [10M]
- 6 a) Explain how gain of TWT amplifier is more compared to Klystron amplifiers? [8M]
- b) Explain how cross field is used to generate oscillations in Magnetron? [8M]
- 7 a) Explain the principle of working of TRAPATT diode with suitable characteristics. [8M]
- b) Explain the method of measurement of impedance at microwave frequencies with suitable block diagram. [8M]

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