

III B.Tech I Semester Regular Examinations, November 2006
MICROWAVE ENGINEERING
(Electronics & Telematics)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain clearly the different high frequency effects in electron tubes and show how these are eliminated in the design of a high frequency microwave tube.
(b) The bunching grids of a Klystron amplifier are 2 mm apart. The beam voltage is 2KV and the drift space is 2.8 cm. Long. What must be the value of the RF voltage at the bunching grid to produce maximum fundamental components of the current at the catcher. Assume the operating frequency 2.8 GHz. On what factors does the bunching parameter depend upon?. [8+8]
2. (a) With the aid of neat sketches, describe the construction and operation of TWT.
(b) Starting with the assumption that there are three forward traveling waves in TWT, derive an expression for power gain of the tube.. [6+10]
3. (a) Explain the growth of oscillations in a traveling wave magnetron.
(b) Compare the features of rising Sun magnetron with cavity magnetron. [8+8]
4. (a) What is a parametric amplifier? How is a varactor diode is made use of in building a parametric amplifier?
(b) Describe the operating principle of IMPATT diodes, giving their structure and characteristics. [8+8]
5. (a) Show that the TEM, TM₀₁ and TM₁₀ modes in a rectangular wave-guide do not exist.
(b) Discuss the merits and demerits of circular wave guide over rectangular wave guide. [10+6]
6. Write short notes on
 - (a) Wave guide Irises
 - (b) Rat Race hybrid.
 - (c) Dielectric phase shifters. [5+5+6]
7. (a) Obtain the S-Matrix of an ideal 3dB directional coupler.
(b) Write short notes on "Ferrite Devices". [8+8]
8. (a) Explain VSWR measurement procedure in microwave laboratory with a suitable microwave bench setup.

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Set No. 1

- (b) Calculate VSWR of a rectangular guide of 2.3cm x 1.0 cm operating at 8 GHz.
The distance between twice minimum power points is 0.09 cm. [8+8]

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1. (a) Write short notes on “Two cavity Klystron oscillator”.
 (b) Derive the expression for transadmittance of Reflex Klystron Oscillator and explain the condition of oscillation from admittance spiral.. [6+10]
2. (a) What is a w- β diagram? How is it significant for slow wave structures?
 (b) Explain the possibility of oscillations in a TWT amplifier. How are they prevented?
 (c) List out the gain relations of a TWT amplifier and comment on its bandwidth.. [5+5+6]
3. (a) A magnetron is operating in the Π mode and has the following specifications, $N=10$, $f= 3\text{MHz}$, $a = 0.4\text{cm}$, $b= 0.9 \text{ cm}$, $l = 2.5 \text{ cm}$, $V_0 = 18 \text{ KV}$, $B = 0.2 \text{ wb/m}^2$.
 Determine
 - i. the angular velocity of the electron.
 - ii. The radius at which radial forces due to electric and magnetic fields are equal and opposite.
 (b) What are Hatree harmonics? Explain in detail. [8+8]
4. (a) What is transferred electron effect? Explain cleanly how a GUNN diode is different from a tunnel diode both being a negative resistance devices.
 (b) What is parametric amplifier? Explain it as an amplifier and frequency converter. [8+8]
5. (a) A rectangular cavity of width ‘a’ height ‘b’ and length ‘d’ is to resonance with TE_{101} mode. Show that the frequency of resonance

$$f_{res} = \frac{c}{2d} \sqrt{1 + \frac{d^2}{a^2}}$$
 If $f_{res} = 10\text{GHz}$, $a= 2 \text{ cm}$., and $b = 1\text{cm}$, find ‘d’
 (b) Discuss how wave equations are useful in understanding the propagation of EM waves in wave guides. [8+8]
6. (a) What is a directional coupler? A 20dB coupler has a directivity of 30dB. Calculate the value of isolation, defining all the terms involved.
 (b) Explain the functioning of “rotary Vane attenuators”. [8+8]
7. (a) What is the necessity of S matrix representation of microwave components? Explain.

- (b) Derive the S matrix for H-plane Tee. [8+8]
8. (a) What are the precautions to be taken while setting up microwave bench for measurement of various parameters.
- (b) How do you measure microwave power using a Bolometer. [8+8]

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1. (a) Show that input admittance of triode circuit is given by $\omega^2 L_K C_{gk} g_m + j\omega C_{gk}$, considering the inter electrode capacitances, lead inductance.
(b) Describe the mechanism of velocity modulation in a two cavity Klystron and hence obtain an expression for the bunched beam current? [8+8]
2. (a) An O type TWT operates at 2 GHz. The slow wave structure has a pitch angle of 4.4° and attenuation constant of 2 Np/m. Determine the propagation constant of the traveling wave in the tube.
(b) Write short notes on "Helix traveling wave tube". [8+8]
3. (a) Explain the terms:
i. Strapping
ii. Frequency pushing
iii. Frequency Pulling [3x3=9]
(b) Derive a simple relation for frequency of oscillation for magnetron in terms of mode number of oscillation and angular velocity of electrons. [7]
4. (a) What is transferred electron effect? Discuss the differences between transferred electron devices and Avalanche transit time devices
(b) Write short notes on 'Ruby MASER'. [8+8]
5. (a) Show that the TEM, TM₀₁ and TM₁₀ modes in a rectangular wave-guide do not exist.
(b) Discuss the merits and demerits of circular wave guide over rectangular wave guide. [10+6]
6. (a) Discuss and compare the characteristics of E-plane Tee and H-Plane Tee.
(b) Write short notes on "Inductive and capacitive posts". [8+8]
7. Write short notes on
(a) Properties of S matrix.
(b) Gyrotator and its applications. [8+8]
8. (a) Explain the method to measure VSWR and reflection co-efficient.
(b) Describe the measurement of impedance using slotted line and Smith chart. [8+8]

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1. (a) List out the various advantages of using microwave frequencies for various applications.
(b) With the help of velocity diagram explain principle of two cavity Klystron Amplifier. [6+10]
2. (a) What are the desirable properties of slow wave structures to be used in TWT amplifiers.
(b) Draw a neat sketch of traveling wave tube and explain its principle of operation with bunching diagrams.. [8+8]
3. (a) A magnetron is operating in the Π mode and has the following specifications, $N=10$, $f= 3\text{MHz}$, $a = 0.4\text{cm}$, $b= 0.9 \text{ cm}$, $l = 2.5 \text{ cm}$, $V_0 = 18 \text{ KV}$, $B = 0.2 \text{ wb/m}^2$.
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5. (a) A rectangular cavity of width 'a' height 'b' and length 'd' is to resonance with TE_{101} mode. Show that the frequency of resonance
$$f_{res} = \frac{C}{2d} \sqrt{1 + \frac{d^2}{a^2}}$$
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(b) Discuss how wave equations are useful in understanding the propagation of EM waves in wave guides. [8+8]
6. (a) Explain the working of two hole directional coupler with a neat diagram.
(b) Explain about E plane Tee junction with a neat sketch. Why it is called a series Tee? [8+8]
7. Write short notes on

- (a) Properties of S matrix.
 - (b) Gyrator and its applications. [8+8]
8. (a) Explain the method to measure VSWR and reflection co-efficient.
- (b) Describe the measurement of impedance using slotted line and Smith chart. [8+8]
