JNTUA UNIVERSITY
PREVIOUS QUESTION PAPERS

Code: R7320405

R07

B.Tech III Year II Semester (R07) Supplementary Examinations December/January 2015/2016

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

(For 2008 regular admitted batch only)

Time: 3 hours Max Marks: 80

Answer any FIVE questions

All questions carry equal marks

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1 (a) Draw the field patterns of the dominant mode in a rectangular waveguide.
(b) Derive the expression for the cutoff frequency of the same mode.

2 Derive the field expressions of a circular waveguide for the dominant mode

3 (a) What are the different types of waveguide discontinuities available? Explain them with suitable sketches.
(b) How do you achieve inductive and capacitive effects using tuning screw microwave component?

4 What are the properties of scattering matrix? Explain them with suitable expressions.

5 (a) State term *"Reflex Klystron saturation factor"* and discuss about the electronic admittance of the reflex Klystron tube.
(b) A reflex Klystron operates at the peak of n = 2 mode with beam voltage V_0 = 300 V, beam current I_0 = 20 mA, and signal voltage V_1 = 40 V. Determine the input power, output power and efficiency.

6 (a) How amplification is achieved in helix TWT amplifier? Describe the process with sketches.
(b) A traveling wave tube is operated under the following parameters: Beam voltage V_0 = 3 kV, beam current I_0 = 30 mA, characteristic impedance of the helix Z_0 = 10 ohms, Circuit length N = 50, frequency f = 10 GHz. Determine the output power gain in dBs and all possible propagation constants.

7 Explain the Gunn Effect. Mention various modes of GUNN diode and explain them in detail.

8 Write short notes on:
(a) Impedance measurement.
(b) VSWR measurement.
(c) Frequency measurement using wave-meter.

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Code: 9A04606

AS

B.Tech IV Year II Semester (R09) Supplementary Examinations July 2018

MICROWAVE ENGINEERING

(Electronics & Communication Engineering)

(For 2009 (LC), 2010, 2011, 2012 regular & 2011 (LC), 2012, 2013 lateral admitted batches only)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Draw the field patterns of TE_{11}, TE_{21}, TM_{11} and TM_{21} modes in rectangular waveguide.
(b) Justify why TE_{10} is dominant mode in rectangular waveguide.

2 (a) State the factors up on which the attenuations constant of a parallel strip line are dependent.
(b) Derive an expression for the attenuation factor of a micro strip line.

3 (a) Explain the construction and working of two choke type movable short circuit used in microwave circuits.
(b) Write short note on tuning screws and ports.

4 (a) Write the properties of scattering matrix.
(b) Obtain scattering matrix of E-plane Tee junction.

5 (a) What do you mean by O-type tubes? Explain difference between O-type and M-type tubes.
(b) Derive the expression for the distance between cavities of klystron for maximum bunching.

6 (a) What is BWO? Explain its operation with a neat sketch.
(b) Discuss about the performance characteristics and applications of BWO.

7 (a) Draw the schematic diagram of an n-type GaAs diode and explain its operation.
(b) Derive the criterion for classifying the modes of operation for Gunn effect diodes.

8 (a) What is spectrum analyzer? List the types of spectrum analyzer. List some application of spectrum analyzer.
(b) Describe a microwave bench.

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Code: 9A04606 **R09**

B.Tech III Year II Semester (R09) Supplementary Examinations May/June 2017

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 An air filled rectangular waveguide has dimensions of a = 6 cm and b = 4 cm. The signal frequency is 3 GHZ. Compute the following for the TE_{10}, TE_{01} and TE_{11} modes.
   (i) Cut off frequency.
   (ii) Wavelength in the waveguide.
   (iii) Phase constant and phase velocity in the waveguide.
   (iv) Group velocity and wave impedance in the waveguide.

2 Derive the expressions for the field components due to TM wave in circular waveguide.

3 (a) What is the need of phase shifter? Name different types of phase shifter.
   (b) Draw the diagram of dielectric phase shifter and explain the operation.

4 (a) Explain the operation of circulator.
   (b) What is Faraday rotation?

5 (a) Explain the following with a neat diagram:
      (i) Transit-angle effect.
      (ii) Gain-Bandwidth product limitation.
   (b) Discuss about reentrant cavities.

6 (a) What is Hull-voltage in a magnetron? Explain its significance.
   (b) Explain about the magnetron oscillator with neat diagrams.

7 (a) What is Gunn effect? Explain this phenomenon using two-valley theory.
   (b) What is time parameter for TED'S?
   (c) List some of the power detecting elements.

8 (a) Write short notes on the measurement of noise factor.
   (b) Calculate the SWR of a transmission system operating at 10 GHz. Assume TE_{10} wave transmission inside a waveguide of dimensions a = 4 cm, b = 2.5 cm. The distance measured between twice minimum power points=1 on a slotted line.

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Code: 9A04606

R09

B.Tech III Year II Semester (R09) Supplementary Examinations December/January 2015/2016

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Derive the expressions for cut off frequency, phase constant, group velocity, phase velocity and wave impedance in a rectangular wave guide.

(b) An rectangular wave guide is filled by dielectric material of Єr = 9 and has dimensions of 7× 3.5 cm. It operates in the dominant TE mode. (i) Determine the cut off frequency. (ii) Find the phase velocity in the guide at a frequency of 2 GHz. (iii) Find the guided wave length at 2 GHz.

2 A air-filled circular waveguide has a radius of 3 cm and is used as a resonator for TE_{01} mode at 10 GHz by placing two perfectly conducting plates at its two ends. Determine the minimum distance between the two end plates.

3 (a) Draw a typical magic Tee junction and explain its operation to obtain sum and difference signal.

(b) Differentiate between isolators and circulators.

4 (a) Discuss the important parameters of ferrite devices.

(b) State and prove unitary property of S-matrix.

5 (a) Derive the relation between Repeller voltage and Accelerating voltage of a Reflex Klystron.

(b) Draw the equivalent circuit of a Reflex Klystron and explain.

6 (a) Explain the terms:
(i) Strapping.
(ii) Frequency pushing.
(iii) Frequency pulling.

(b) Discuss about the superposition of oscillations in a TWT.

7 (a) Distinguish between ATD's and TED's.

(b) Write short notes on negative-resistance parametric amplifier.

8 (a) Describe with neat diagram and mathematical formulation, the measurement of dielectric constant of a solid using rectangular waveguide method.

(b) What is slotted section with line carriage? What is the main purpose of slotted section with line carriage? Explain.

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Code: 9A04606 **R09**

B.Tech III Year II Semester (R09) Supplementary Examinations December 2017

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 An air-filled rectangular waveguide with cross-section of 4 cm X 2 cm transports energy in the dominant mode (TE_{10}) at a rate of 2mW. If the frequency of operation is 10 GHz, determine the peak value of the electric field in the waveguide.

2 A TE_{11} wave is propagated through air filled circular waveguide of diameter 10 cm. Determine (i) Cut off frequency. (ii) Guide wavelength for 3 GHz. (iii) Wave guide impedance.

3 With the help of diagrams, clearly explain the principle and operation of rotary phase shifter.

4 (a) What is reciprocal effect?

(b) Explain the construction and working of a rotation isolator using reciprocal effect.

5 (a) Draw the electronic admittance diagram of reflex klystron and explain.

(b) What is meant by frequency pushing and frequency pulling? Explain.

6 (a) Write short notes on slow wave structure.

(b) In a O-type traveling wave tube, the acceleration voltage (beam voltage) is 3000 V. The characteristic impedance is 10 Ω. The operating frequency is 10 GHz and the beam current is 20mA. Determine the propagation constants of the four modes of the traveling waves.

7 (a) Explain various modes of operation of Gunn diode with the neat sketches.

(b) Explain the two-valley model theory and give the data for two-valleys in GaAs.

8 (a) Define the following: (i) VSWR meter. (ii) Bolometer. (iii) Calorimeter. (iv) Wave meter.

(b) Draw the block diagram of network analyzer and explain the function of each block.

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Code: 9A04606

R09

B.Tech III Year II Semester (R09) Supplementary Examinations December 2016

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1 A rectangular waveguide with dimensions a = 2.5 cm, b = 1 cm is to operate below 15.2 GHz. How many TE and TM modes can be propagated in the waveguide? Calculate the cut off frequencies of these modes.

2 (a) What are cavity resonators? Explain the desirable properties of resonators.
(b) Draw the field pattern of TM_{110} and TE_{123} modes.

3 (a) Draw different types of corners and give the design procedure criterion.
(b) Explain the construction and working of waveguide phase shifters.

4 With the help of appropriate diagram, explain the working of an isolator. What is the S-matrix of the isolator?

5 Explain in detail about multicavity klystron amplifiers.

6 (a) Write short notes on M-type tubes.
(b) Explain the principle of working of Travelling Wave Tube with neat sketches.

7 (a) Draw the equivalent circuit of varactor diode and explain its operation. What are the applications of varactor diode?
(b) Give the typical characteristics of Gunn diode.

8 (a) Explain the impedance measurement by reflectometer.
(b) Explain the measurement of ‘Q’ by Reflectometer method.

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Code: 13A04603 **R13**

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)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) In the notation TEmn and TMmn what do 'm' and 'n' represent?

(b) If the broader dimension of a rectangular waveguide is 2.2 cms, what is the cutoff frequency and wavelength for dominant mode?

(c) List the properties of scattering matrix for a lossless junction.

(d) What is Faraday's rotation law?

(e) How are spurious oscillations generated in TWT amplifier? State the method to suppress.

(f) Discuss the condition for oscillation in Reflex klystron.

(g) What is meant by strapping?

(h) Mention the Key phenomenon taking place in TRAPATT diode.

(i) Differentiate between baretter and thermistor.

(j) 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 TM_{11} 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:

(a) Waveguide Irises.

(b) Rat Race hybrid.

(c) 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.

Contd. in page 2

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: $\mu_n = 0.015$ m^2/ v s

Relative dielectric constant: $\varepsilon_r = 13.1$

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 simple 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.

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Code: 13A04603

R13

B.Tech III Year II Semester (R13) Regular & Supplementary Examinations May/June 2017

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What is a dominant mode?

(b) For a cavity of dimensions 3 cm x 2 cm x 7 cm filled with air and made of copper, find the resonant frequency.

(c) Why H-plane T junction called as current junction?

(d) What is the coupling factor of a directional coupler?

(e) What is bunching process?

(f) What is a slow wave structure? Write two examples.

(g) What is a cross field tube?

(h) What is population inversion in Gunn diode?

(i) What are different methods used for power calculation.

(j) What is a double minimum method?

PART – B

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

UNIT – I

2 (a) Enumerate the basic advantages of microwaves.

(b) Draw the EM spectrum and list all the frequency ranges involved in microwave bands.

(c) Briefly explain the applications of microwaves.

OR

3 Deduce the electromagnetic field relations for the dominant mode in a rectangular waveguide from the Maxwell's equations.

UNIT – II

4 What is a magic Tee junction. Derive the S matrix of a magic Tee.

OR

5 (a) Explain the operation of circulator with a neat diagram.

(b) A signal power 32mW is fed into one of the collinear ports of loss less H-Plane Tee. Determine the powers in the remaining ports when other ports are terminated by means of matched load.

UNIT – III

6 Explain the construction, operation, operating characteristics of reflex klystron oscillator with a neat diagram.

OR

7 With a neat sketch, explain the structure and principle of operation of TWT Amplifier.

UNIT – IV

8 What are the bulk properties of GUNN diode that give rise to negative resistance?

OR

9 Why pi-mode operation is preferred in cylindrical type magnetron? Give its working principle with neat sketches.

UNIT – V

10 Give the measurement procedure for Q factor of a resonant cavity and attenuation constant at microwave frequencies.

OR

11 (a) Draw a neat sketch of a MW test bench for impedance measurements using reflectometer.

(b) Two identical directional are used in a waveguide to sample the incident and reflected powers. The output of the two coupler is found to be 2.5mW and 0.15mW. Find the values of VSWR in the wave guide.

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Code: 13A04603 **R13**

B.Tech III Year II Semester (R13) Supplementary Examinations December 2017

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Define dominant mode.
(b) Why TEM waves are not propagated through the waveguide?
(c) Write the scattering matrix for an ideal waveguide section.
(d) State Faradays rotation in non-reciprocal devices.
(e) List the applications of reflex Klystron.
(f) How does the convection current can be expressed in TWT?
(g) Name the elements that exhibit Gunn effect.
(h) Define Hull cut off.
(i) What are the different blocks that frame the microwave test bench?
(j) Express the characteristics of VSWR meter.

PART – B

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

UNIT – I

2 (a) Express the three cases which determines the propagation constant γ_g in the rectangular waveguide.

(b) A TE_{11} mode is propagating through circular waveguide, the radius of the guide is 5 cm, a guide contains an air dielectric.

(i) Determine cutoff frequency.
(ii) Determine the wavelength λ_g in the guide for an operating frequency of 3 GHZ.
(iii) Determine the wave impedance Z_g in the guide.

OR

3 Elucidate in detail about Q factor of a cavity resonator with equivalent circuit.

UNIT – II

4 Explain the function of four port circulator and derive its scattering matrix.

OR

5 Illustrate the working principle of resistive card variable attenuator with neat sketch.

UNIT – III

6 Describe the mechanism of operation of two cavity klystron amplifier with Applegate diagram.

OR

7 Draw the schematic diagram of travelling wave tube with its simplified circuit and explain about the amplification process.

UNIT – IV

8 With neat sketch, illustrate the concept of Hartree condition in magnetron.

OR

9 (a) The drift velocity of electron is 3 x 10^7 cm/s through the active region of length 15μm. Calculate the natural frequency of the Gunn diode and the critical voltage.

(b) Using Manley-Rowe power relation, demonstrate the concepts of parametric amplifier and state its applications.

UNIT – V

10 Explain in detail about the microwave power measurement using power meter with neat sketch.

OR

11 Draw the block diagram and describe the principle of measurement of impedance of a unknown load using slotted section waveguide method.

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Code: 15A04703 **R15**

B.Tech IV Year I Semester (R15) Regular Examinations November/December 2018

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Differentiate waveguide and resonator.

(b) For a frequency of 6 GHz and plane separation of 3 cm, find the group velocity for dominant mode in a rectangular waveguide.

(c) What is the need of matching networks?

(d) Mention the purpose of isolator.

(e) Compare two cavity klystron and travelling wave tube.

(f) Name any four examples for slow wave structures.

(g) Draw V-I characteristics of Gunn diode.

(h) What is the PI-mode of operation in magnetron?

(i) State any three properties of S-matrix.

(j) What are the precautions follow to do experiment using microwave bench setup?

PART – B

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

UNIT – I

2 Derive the field expressions for TE_{mnp} mode in a rectangular cavity resonator.

OR

3 A rectangular wave guide is filled by dielectric material of $\varepsilon_r = 9$ and has dimensions of 7 x 3.5 cm, it operates in the dominant TE mode. Find cut off frequency, phase velocity in guide at 2 GHz.

UNIT – II

4 What is Faraday rotation? Explain how a 4 port circulator operates with the use of 2 magic tees and one Gyrator.

OR

5 What is phase shifter? Describe its principle of operation with a neat sketch. Give its applications.

UNIT – III

6 Describe the necessary theory and working of reflex klystron.

OR

7 A TWT operates under the following parameters: Beam voltage $V_0 = 3$kV, beam current $I_0 = 30$mA, characteristic impedance of helix $Z_0 = 10\Omega$, circuit length N = 50, frequency f = 10 GHz. Determine: (i) The gain parameter. (ii) The output power gain A_p in decides (iii) Four propagation constants.

UNIT – IV

8 With the use of two valley theory, explain how negative resistance is created in Gunn diodes?

OR

9 Explain the principle of operation of TRAPATT diode with suitable diagram.

UNIT – V

10 How to measure attenuation of given microwave signal using microwave bench setup? Explain.

OR

11 Obtain the S-matrix for series Tee.

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Code: 13A04603 **R13**

B.Tech III Year II Semester (R13) Supplementary Examinations December 2018

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)

(a) What is dominant mode? Write the dominant modes in rectangular waveguide.
(b) Define phase and group velocities.
(c) What is meant by Faraday rotation?
(d) Write applications of isolator.
(e) Define efficiency.
(f) What is electron bunching in klystron tube?
(g) Define Hartee condition.
(h) Write the applications of varactor diode.
(i) Define double minima method.
(j) What is slotted section, why it is used?

PART – B

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

UNIT – I

2 (a) Write the applications of microwaves in detail and the EM spectrum and list the frequency ranges in microwave bands.
(b) Discuss about TM waves propagation in rectangular wave guide with field components.

OR

3 (a) Write the differences between rectangular and cylindrical cavity resonators.
(b) Explain about resonant frequencies and coupling coefficients of resonators.

UNIT – II

4 (a) Write the principle and operation of magic tee and derive its scattering matrix.
(b) Explain the construction details of isolator and write its applications.

OR

5 (a) Derive the scattering matrix of H-plane tee and write its operation.
(b) Write different types of attenuators explain each type.

UNIT – III

6 (a) Draw and explain about two-cavity klystron amplifier and write its applications.
(b) Draw and explain about TWT tube in detail.

OR

7 (a) Explain the operations of reflex klystron with neat diagram.
(b) Derive output power and efficiency in reflex klystron.

Contd. in page 2

UNIT – IV

8 (a) Write the different types of magnetron and explain cylindrical travelling wave magnetron.
(b) Explain about 'Hartree resonance conditions'.

OR

9 (a) Explain the construction details of varactor diode and draw its equivalent circuit.
(b) Explain about avalanche transists time devices in briefly.

UNIT – V

10 (a) Explain the measurement of attenuator by using microwave bench set-up.
(b) Write measurement of law and medium VSWR.

OR

11 (a) Explain the measurement procedure of impedance by using microwave bench setup.
(b) Explain measurement procedure of microwave frequency by using MW bench set-up.

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Code: 9A04606

R09

B.Tech III Year II Semester (R09) Supplementary Examinations December 2018

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

(For 2010 (LC), 2011, 2012 regular & 2012 (LC), 2013 lateral entry)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 A rectangular waveguide 4.5 X 3 cm is operating at 9 GHz. Calculate the cut off frequencies for the modes TE_{11}, TE_{10}, TE_{01}, TM_{01}, TM_{10} and TM_{11}.

2 With reference to microstrip line discuss the following characteristics:
(a) Effective dielectric constant.
(b) Characteristic impedance.

3 (a) Draw waveguide different types movable short circuit terminations and explain the conditions for satisfactory performance.
(b) Explain the loop coupling mechanism of power to waveguide.

4 (a) A reciprocal tow port microwave device has a VSWR of 1.5 and insertion loss of 2dB. Find the magnitudes of S-parameters for the device.
(b) Explain the scattering matrix for a n-port network.

5 (a) Draw the electronic admittance diagram of reflex klystron and explain.
(b) What is meant by frequency pushing and frequency pulling? Explain.

6 (a) Describe the structure of an O-type traveling wave tube and its characteristics. Also explain its working.
(b) Derive the expression for the amplification factor of a TWT amplifier.

7 (a) Draw the equivalent circuit of a parametric amplifier and explain its operation.
(b) Discuss about the advantages and disadvantages of the parametric amplifier.

8 Describe the different blocks of microwave bench setup used in microwave measurements and explain their features.

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