**ME QUESTIONS**

**UNIT-1**

**CATEGORY 1**

**1) Define a waveguide, classify the waveguides and write the differences between waveguide and two wire transmission line. [12M]**

**2) a)Calculate the guide wavelength (in cm) at 7 and 12GHz for an air filledwaveguide with a=2.54 cm , b=1.5cm [6M]   
b)Write short notes on phase velocity and group velocity.[6M]**

**3) Explain power transmission and power losses in rectangular wave guides? [12M]**

**4) What are different types of transmission lines used at microwave regions explain with diagrams? [12M]**

**5) a) What are dominant and degenerate modes? What is the significance of dominant modes? [6M]  
b) Mention different band designations, regions and applications of microwaves. [6M]**

**6) Define and write the expressions for [12M]**

**i) Cut-off frequency ii) Cut-off wavelength iii) Phase constant**

**CATEGORY-2**

**1) Derive the field equations of rectangular waveguide in TM mode, starting from Maxwell’s equations. [12M]**

**2) a) Derive the dominate mode for TE mode of wave propagation in a rectangular waveguide? [6M]**

**b) Define TE, TM and TEM modes [6M]**

**3) (a) Sketch the field patterns for dominant modes in a rectangular wave guide. (4M)**

**(b) A rectangular waveguide is operated in dominant mode at 10GHz. If this operating frequency needs to be 15 percentage above the cut-off frequency of the only propagation mode and 20 percent below the cut-off frequency of the next higher order mode, compute the dimensions ot he guide. [8M]**

**4) a) Derive the dominate mode for TE mode of wave propagation in a rectangular waveguide? [6M]**

**b) For a dominant mode propagating at a frequency of 9GHz in TE mode , if the rectangular waveguide has a broader dimension of 31.14 mm, then the find cutoff wave length and guide wavelength. [6M]**

**5)What is a Dominant mode and derive the dominant mode for TE and TM modes in rectangular waveguide by using field equations? [12M]**

**6) Why a hollow rectangular waveguide cannot propagate TEM waves explain using field equations? [12M]**

**7) 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 TE10 and TM11 modes: [12M]**

**(a) Cutoff frequency**

**(b) Wavelength in the waveguide**

**(c) Phase constant and phase velocity in the waveguide**

**(d) Group velocity and wave impedance in the waveguide**

**8) a) Briefly explain the applications of microwave signal. [6M]**

**b) A hollow rectangular waveguide has dimensions a = 1.5 cm, calculate the amount of attenuation if the frequency of the signal is 6GHz.. [6M]**

**9) a) A rectangular waveguide has dimensions 2.5 x 5 cms. Determine the guide wavelength, phase constant and phase velocity at a wavelength of 4.5 cms for dominant mode. [6M]**

**b) What are different Microwave Bands. Explain briefly the applications of microwave waves at various frequency bands. [6M]**

**10) a) For TE10 and TM11 mode, if the waveguide is filled with air and the dimensions of the waveguide is 3x2cm, find the cutoff frequency ? [6M]**

**b) Define wave impedance of waveguide and write expressions for it in TE and TM modes[6M]**

**11) a) For TE10 mode, if the waveguide is filled with air and the broader dimension of the waveguide is 2 cm, then find the cutoff frequency and cutoff wave length? [6M]**

**b) Why TE00 and TM00 modes for a rectangular waveguide does not exist? [6M]**

**12) a) What are dominant and degenerate modes? What is the significance of dominant modes? Indicate the dominant mode in+C21 rectangular waveguide and derive the cut-off frequency for the same. [7M]**

**b) Write the differences between two wire transmission line and wave guide? [5M]**

**13) Derive the wave equation for a TM wave and obtain all the field components in a rectangular wave guides? [12M]**

**14)a) Design a rectangular waveguide so that the cut off frequency for the TE10 mode is 14GHz and the cut off frequency for TM11 mode is 3GHz. [6M]**

**b) What are different types of losses in wave guide explain it? [6M]**

**15)a) The cutoff frequency for the dominant mode in TM mode propagation for a rectangular waveguide of dimension of 30mm X 40mm is? [4M]**

**b) Derive phase velocity and group velocity of a rectangular wave guide? [8M]**

**CATEGORY 3**

**1)Explain the wave impedance of a rectangular waveguide and derive the expression for the wave impedance of TE and TM modes. [12M]**

**2)a) The dominant mode TE10 is propagating in a rectangular waveguide of dimensions a=6cm and b=4cm. The distance between a maximum and a minimum is 4.47cm. Determine the signal frequency of the dominant mode. [8M]**

**b) What is the significance of dominant modes and indicate the dominant modes for rectangular waveguides. [4M]**

**3)Derive the expression for wavelengths and impedance relation in rectangular wave guide for TE mode of propagation? [12M]**

**4) a) In TE01 mode of wave propagation in a rectangular waveguide, if the dimension of the waveguide are 3X2 cm, find the cutoff wavelength for that mode ? [4m]**

**b) Derive the expression for wave impedance for TE and TM mode in a waveguide? [8M]**

**5)a) Discuss the Power transmission in rectangular waveguides. [6M]**

**b) Derive the expression for guide wavelength of TEmn mode in rectangular waveguide. [6M]**

**6)Derive the wave equation for a TE wave and obtain all the field components in a rectangular waveguide. [12M]**

**CATEGORY-4**

**1)a) Explain different power losses in a waveguide and write the expression for break down power in rectangular waveguide. [8M]**

**b) Why phase velocity is greater than free space velocity? [4M]**

**2)A rectangular waveguide is filled by dielectric material of εr = 9 and has inside dimensions of 7 X 3.5 cm. It operates in the dominant TE10 mode. [12M]**

**(i)Determine the cut-off frequency.**

**(ii)Find the phase velocity in the guide at a frequency of 4GHz.**

**(iii)Find the guided wavelength λg at the same frequency.**

**3)a) Distinguish between the properties of TEM mode of propagation and that of TE and TM type of propagation. [8M]**

**b) An X-band rectangular waveguide filled with a dielectric medium of єr = 2.25 is operating at f = 9GHz. Calculate the phase and group velocities in the waveguide. (X-band WG has the dimensions of 2.286 x 1.016 cms). [4M]**

**UNIT-2**

**CATEGORY-1**

**1)Explain a circular wave guide and cavity resonator with diagrams and write their differences? [12M]**

**2)What are the types of strip lines? Write their merits and demerits and their applications.[12M]**

**3)Define Q-factor and derive the expression for rectangular cavity resonator? [12M]**

**4)a) Write the differences between cavity resonators and waveguides? [8M]**

**b) Draw the equivelent circuit of a cavity resonator and write the expression for resonant frequency? [4M]**

**5)Derive the expression for resonant frequency for a rectangular cavity resonator and write its uses? [12M]**

**CATEGORY-2**

**1)Derive the expression for resonant frequency of circular cavity resonators? [12M]**

**2)Derive the field expressions for rectangular cavity resonators? [12M]**

**3)Derive the field expressions for circular cavity resonators? [12M]**

**4)Why a hollow circular waveguide cannot propagate TEM waves, explain using field equations? [12M]**

**5)What are cavity resonators? Derive the equations for resonant frequencies for a rectangular cavity resonator and write the expression for Q factor? [12M]**

**6)Derive the expressions for field equations of TM modes in circular waveguide. [12M]**

**7)a)What is frienging effect in micro strip line explain? [6M]**

**8)b) Draw different types of strip lines and write their uses? [6M]**

**9)An air-filled circular waveguide of 2 cm inside radius is operated in the**

**TE01 mode.     [12M]**

**a) Compute the cutoff frequency.**

**b) If the guide is to be filled with a dielectric material of er = 2.25, to what value must its radius be changed in order to maintain the cutoff frequency at its original value?**

**10)a) Explaina bout unloaded quality factor and loaded qualityfactor. [6M]**

**b) Calculate the resonant frequency of rectangular cavity resonator of dimensions a = 3 cms, b = 2cms and d = 4cms, when it is operated in TE101 mode. [6M]**

**11)Derive the Q factor and Coupling Coefficients of the rectangular cavity resonator?**

**a) Derive expression for resonant frequency in a circular resonator. [6M]**

**b) Calculate the resonant frequency of circular resonator having diameter 12.5cms and length 5cms for TM012 mode. [6M]**

**12)a) Calculate the lowest resonant frequency of arectangular cavity resonator of**

**dimensions a = 2cms, b =1cm, and d =3cms. [6M]**

**b) Explain about different coupling methods to cavities. [6M]**

**13)An air filled circular waveguide is to be operated at a frequency of 6GHz and is to have dimensions such that fc= 0.8 GHz for TE11 mode. Determine the diameter of the waveguide and guide wave length. [12M]**

**14)a) For a circular waveguide in TM11 mode of propagation with inner radius of 30mm, and the phase constant being equal to 0.3, then the wave impedance is? [6M]**

**15)b) Write the parameters of microstrip lines and explain? [6M]**

**16)a) For the dominant mode of operation in an air filled circular waveguide of inner diameter is 4cm find cut-off wavelength and cut-off frequency. [6M]**

**b) Explain cylindrical cavity resonator with diagram. [6M]**

**CATEGORY-3**

**1) a) Explain how TEM wave does not exist in hallow circular waveguides [6M]**

**b) Justify that cavity resonator acts as an LC circuit. [6M]**

**2)Derive the field equation for rectangular cavity resonator in TEmnp mode,**

**starting from wave equation. [12M]**

**3)Derive the field expressions for a rectangular cavity resonator. Plot the field patterns for the dominant mode of propagation in such a resonator for TE and TM modes. [12M]**

**4)Derive the field expression for a circular cavity resonator. Plot the field pattern for TE and TM modes assuming dominant modes. [12M]**

**5)A TE11 mode is propagating through a circular waveguide, the diameter of the guide is 10cm and the guide is air-filled, relative di-electric constant is єr = 4.**

**6)Find : [12M]**

**a) cut-off frequency**

**b) wavelength in the guide for a frequency of 3 GHz**

**c) wave impedance of the guide**

**d) diameter for a di-electric filled guide**

**7)a) In TE mode of a circular waveguide, if Ez=0 derive the wave equation? [7M]**

**b) What is the cutoff frequency for TE11 mode in a circular waveguide of radius 2 cm with P11 (prime) = 1.841 [5M]**

**CATEGORY-4**

**1)Derive the expressions for field equations of TM modes in circular waveguide. [12M]**

**2)a) In a circular waveguide, if the propagation is in TE21 mode with P21=3.054, with a diameter of 60 mm, find the cutoff frequency for that mode? [6M]**

**b) What are different losses in a circular waveguide explain them? [6M]**

**3)A rectangular-cavity resonator has dimensions of a=5 cm, b=2 cm and d=15cm, compute [12M]**

**(i) the resonant frequency of the dominant mode for an air-filled cavity.**

**(ii) the resonant frequency of the dominant mode for a dielectric-filled cavity of er = 2.56**

**UNIT-3**

**CATEGORY-1**

**1)Define S-matrix and write the properties of S-matrix for multi port network? [12M]**

**2) a) Write Z-parameters, Y- parameters and S-parameters for a two port network? [6M]**

**b) Why S-parameters are mostly preferred at microwaves? [6M]**

**3)Explain in detail about waveguide irises, tuning screws and waveguide attenuators with neat diagram? [12M]**

**4)Explain about waveguide bends, corners and waveguide twists. [12M]**

**5)a) Write short notes on waveguide discontinuities and irises. [6M]**

**b) What is a T-junction, draw different types of T-junctions? [6M]**

**6)Explain the operation of a gyrator and isolator with diagrams? [12M]**

**CATEGORY-2**

**1)a) Write short notes on Properties of S – matrix? [8M]**

**b) Derive the S-matrix for Isolator? [4M]**

**2)Explain about H-plane tee junction and determine its S-matrix. [12M]**

**3)Explain with diagrams about [12M]**

**i) Aperture coupling mechanisms ii) Loop coupling mechanisms.**

**4)Explain the E-plane tee junction and determine its S-matrix. [12M]**

**5)What is an attenuator and explain different types of microwave attenuators with diagrams? [12M]**

**6)Write a short notes on waveguide irises, waveguide posts and screws with diagrams. [12M]**

**7)Define faraday rotation and explain about any two devices which uses pricipal of faraday rotation with diagrams. [12M]**

**8)Draw the structure of a multi hole directional coupler and explain its parameters? [12M]**

**9)Draw the Rat race juction and derive its S-matrix. [12M]**

**10)Explain about coupling probes and coupling loops with neat diagrams. [12M]**

**11)Write different waveguide multiport junctions, and differentiate E plane Tee & H plane**

**Tee junctions. [12M]**

**12)What is a coupler and explain different types of directional couplers with diagrams? [12M**

**13)Explain the applications of Magic Tee juction with a neat diagrams? [12M]**

**14)Explain the Gyrator and circulators with neat sketch. [12M]**

**15)What is meant by microwave Attenuator. Explain the functioning of flap and vane attenuator with diagrams. [12M]**

**CATEGORY-3**

**1)Draw and explain of 2-hole directional coupler and find the S-matrix. [12M]**

**2)What is Faraday rotation? Explain how it is utilized in the construction of 4 port circulator. [12M]**

**3)A) Derive S matrix for a 3-port circulator for given insertion loss of 0.5dB, isolation of 20dB and VSWR of 2. [6M]**

**b) Explain how circulator can be used as an isolator based on S-matrix. [6M]**

**4)Draw and explain the function of directional coupler and explain coupling factor and directivity of directional coupler. [12M]**

**5)Define a microwave junction. How can it be described by scattering matrix. Derive the scattering matrix relation between the input and output of a nxn junction starting with an analogy of a transmission line junction. [12M]**

**6)a) A 100 W power source is connected to the input of a directional coupler with coupling factor = 20 dB, Directivity = 60 dB and an insertion loss of 0.8 dB. Find output power at the through, coupled and isolated ports. Assume all ports to be matched. [7M]**

**b) Write the applications of directional coupler. [5M]**

**CATEGORY-4**

**1)a) Explain Coupling factor and Directivity for a Directional Coupler. [6M]**

**b) Describe in detail the operation of a 2-hole directional coupler. Calculate the coupling factor if the power in the primary waveguide is 72mW and the power delivered to the directional coupler is 8mW [6M]**

**2)a) A signal of power 32mW is fed into one of the collinear ports of a lossless H-plane Tee. Determine the powers in the remaining ports when other ports are terminated by means of matched loads. [6M]**

**b) How circulator can be used as a duplexer in RADAR applications? [6M]**

**3)Obtain the Scattering matrix for a 3-port circulator and also prove that it is impossible to construct a perfectly matched lossless , reciprocal 3-port junction.[12M]**

**Unit -4**

**Category-1**

**1.Explain the working of reflex klystron amplifier with neat apple gate diagram [12M]**

**2.Explain different types of microwave tubes and its classifications based on frequency?**

**[12M]**

**3.What is velocity modulation and derive expression for velocity modulation? [12M]**

**4.Discuss in detail about helix travelling wave tube with diagrams. [12M]**

**5.Draw and explain about multi cavity klystron amplifier with diagrams. [12M]**

**Category-2**

**1.What is magnetron? Explain the principle of operation with a neat sketch.[12M]**

**2.Derive Hull’s cut-off voltage equation for magnetron and explain its importance? [12M]**

**3.Write the different types of slow wave structures and explain the characteristics of slow wave structure and it’s applications. [12M]**

**4. a)Explain in brief about the limitations of conventional vacuum tubes. [6M]**

**b) Explain the classifications of Microwave tubes. [6M]**

**5.Explain the operation of a reflex klystron using neat sketches of construction details and an Apple gate diagram. [12M]**

**6. a)Draw the equivalent circuit of reflex klystron and derive its electronic admittance?[6M]**

**b) State the limitations of conventional tubes at microwave frequencies? [6M]**

**7. What is the purpose of Slow Wave Structures used in TWT amplifiers and explain its operation with diagrams. [12M]**

**8.Derive the output power of Two-cavity klystron amplifier. [12M]**

**9.Explain about electron trajectories in the presence of crossed field in magnetron**

**with neat diagrams.[12M]**

**10.Derive the Hull`s cut-off voltage equation for magnetron, and explain its operation. [12M]**

**11.Explain about reflex klystron oscillator with neat diagram and also explain about modes of oscillations? [12M]**

**12.Explain the concept of Mode jumping in magnetron and its types using diagrams. [12M]**

**13.Explain about sustained oscillations in magnetron and derive the condition for oscillations for N-cavity magnetron. [12M]**

**14.a) Write the performance characteristics and applications of magnetron. [6M]**

**b) What is a slow wave structure and explain with diagrams. [6M]**

**15 a) A two cavity klystron amplifier has the following specifications.**

**Beam voltage = 900V and gap spacing = 4cm. Find electron velocity and dc transit time of electron[6M]**

**b) Write the performance characteristics and applications of reflex klystron. [6M]**

**Category-3**

**1.What is strapping in magnetron .and explain its effect in operation with diagrams. [12M]**

**2.Explain the constructional details and working of TWT amplifier? [12M]**

**3.a) Why attenuators are used in helix structure for TWT and explain it. [6M]**

**b) Explain about strapping scheme for PI-mode operation in magnetron. [6M]**

**4. Explain the modes of resonance and PI mode operation in magnetron with diagrams. [12M]**

**5. a) A helical TWT has a diameter of 2mm with 50 turns per cm. Find its axial phase velocity and anode voltage. [6M]**

**b) Write about strapping and un-strapping in magnetron. [6M]**

**6. a)A two cavity klystron amplifier has the following characteristics [6M]**

**Voltage gain =15dB, Input = 5mW**

**Rsh of input cavity = 30Kohms and Rsh of output cavity = 40Kohms**

**Load Impedance = 40Kohms. Determine**

**i)Input RMS voltage ii) Output RMS voltage, iii) Power delivered to load.**

**b) Write short notes on multi cavity klystron amplifier. [6M]**

**Category-4**

**1.Derive the efficiency and maximum output power of a two cavity reflex klystron? [12M]**

**2. a) A reflex Klystron operates at the peak mode of n = 2 with beam voltage of 300V.Beam current is 20mA, and signal voltage V1 = 40V.**

**Determine I) The input power ii) Output power iii) Efficiency. [6M]**

**b) Draw and explain about power output and frequency characteristics of reflex klystron. [6M]**

**3. a) A reflex klystron operates at the peak of n=1 or 3/4 mode. The dc power input**

**is 40mW and ratio of V1 over Vo is 0.278.[8M]**

**(i)Determine the efficiency of the reflex klystron.**

**(ii)Find the total power output in mW**

**b) Explain about bunching.**

**Unit-5**

**Category-1**

**1.Explain the constructional details of a Gunn diode and draw the characteristics of Gunn diode? [12M]**

**2. a) Define Gunn Effect and draw its characteristics? [8M]**

**b) Write the applications of Gunn diode? [4M]**

**3. Define negative differential resistivity. Explain the J-E characteristics of Gunn diode [12M]**

**4. a) Explain about Transferred Electron Effect .[6M]**

**b) Draw the energy band diagram of gun diode and explain it. [6M]**

**5. Draw and explain constructional details of IMPATT diode. [12M]**

**6. a) Explain about avalanche transit time effect. [6M]**

**b) Write the applications and characteristics of IMPATT diode. [6M]**

**Category-2**

**1.Draw and explain constructional details of TRAPATT diode? [12M]**

**2. Explain the principle and operation of RWH theory with neat diagram? [12M]**

**3. Explain about all four frequency modes of gun oscillator with waveforms. [12M]**

**4. Explain about population inversion in gun diode and derive the condition for negative resistance effect. [12M]**

**5. a) Classify different IMPATT diodes and explain in detail. [6M]**

**b) Write the applications of microwave solid state devices [6M]**

**6. a) Draw the V-I characteristics of IMPATT diode and explain. [8M]**

**b) An IMPATT diode has a drift length of 2 micro meters. Determine the operating frequency of the diode if the drift velocity is 10 cms per second. [4M]**

**7. Explain the operation, basic modes of operation and oscillating modes in a GUNN diode. [12M]**

**8.What are Avalanche transit time devices? Explain the principle of operation and**

**characteristics of IMPATT diode with neat sketches. [12M]**

**9.Explain how Gunn diode is used as an oscillator using coaxial cavity and waveguide set-up? [12M]**

**10. Draw the V and I characteristics of TRAPAT diode and explain its operation.[12M]**

**11.Draw the energy band diagram of a gun diode and explain its operation based on band diagram. [12M]**

**12. a) Draw the characteristics of TRAPATT diode and show how its exhibits negative resistance. [7M]**

**b) Write the specifications of TRAPATT diode. [5M]**

**13.Explain the construction, fabrication and encapsulation of Gunn diodes. [12M]**

**14. Explain about qunched domain mode and LSA mode in Gunn diode. [12M]**

**15. Draw the V and I characteristics of IMPATT diode and explain its operation.[12M]**

**Category-3**

**1. Derive the condition for negative resistance effect in Gunn diode and explain each region in the characteristics curve. [12M]**

**2. a) Mention a device which exhibits negative resistance characteristics and explain its operation. [8M]**

**b) Write the specifications of TRAPATT diode. [4M]**

**3. Explain how Gunn diode is used as an oscillator with the help of circuit diagram.[12M]**

**4. a) Suggest a device which operates on Impact Ionization and explain its operation.[7M]**

**b) Write about domain formation in GUNN diode. [5M]**

**5. Explain how a Gunn diode can be developed using N-type GaAs specimen and explain its operation. [12M]**

**Category-4**

**1. a) A typical Gunn diode has the following specifications. [4M]**

**Operating frequency is10 GHz, device length is 75 micro meter and pulse amplified voltage is 25 V. Determine the threshold electric field.**

**b) Compare the features of IMPATT and TRAPATT diodes.[8M]**

**2.Explain 2-valley theory in GaAs material resulting in weak Gunn oscillations. [12M].**

**3. Prove that maximum power that can be given to mobile carriers decreases as inverse of square of frequency in IMPATT diode. [12M]**

**Unit-6**

**Category-1**

**1. Draw the block diagram of a typical microwave bench and explain the functionality of each component and their features? [12M]**

**2. Write about**

**i) Matched Load ii) Movable short iii) VSWR [12M]**

**3. Explain the measurement of microwave power using bolometer technique with neat sketch? [12M]**

**4.   a) What are the precautions to be taken in microwave measurements? [6M]**

**b) What is the use of slotted wave guide line in microwave measurements? [6M]**

**5.a) Explain the measurement of power using bolometer method. [8M]**

**b) Write about slotted waveguide. [4M]**

**6. a) Explain the power ratio method of attenuation. [8M]**

**b) Why microwave measurements different from low frequency measurements? [4M]**

**Category-2**

**1. a) Explain the self balancing bridge for measuring medium powers in the range of 10mW to 10W. [8M]**

**b) Write about wave meter. [4M]**

**2. a) Why isolator is used after source justify? [4M]**

**b) Describe how an ordinary voltmeter can be calibrated to read VSWR directly. What are the drawbacks involved for this method. [8M]**

**3. Describe the procedure for measurement of low VSWR and high VSWR using microwave bench? [12M]**

**4. Explain about Measurement of Q- factor of a cavity resonator using microwave bench? [12M]**

**5. Explain about measurement of impedance using bridge network method? [12M]**

**6.Explain about measurement of impedance using smith chart? [12M].**

**7. Explain about different microwave power measurement methods? [12M]**

**8. Draw and explain the measurement procedure to find out attenuation for fixed attenuator? [12M]**

**9.Explain how medium and high microwave power can be measured. [12M]**

**10. Explain how normalised unknown impedance can be measured using smith chart? [12M]**

**11.With the help of necessary experimental setup, describe the measurement of unknown load impedance using slotted line?**

**12. With the help of suitable measurement set up explain how measurement of the following microwave quantities can be done. [12M]**

**i. Power ii. Impedance**

**13. a) Explain the procedure for measuring VSWR greater than 10. [8M]**

**b) Explain about frequency drum.[4M]**

**14. Write short notes on reflection coefficient and insertion loss measurement at microwave frequencies. [12M]**

**15. a) Explain the RF substitution method of measurement of attenuation. [8M]**

**b) Write about VSWR meter[4M]**

**Category-3**

**1.Explain about Measurement of frequency using cavity resonator with diagram? [12M]**

**2. a) Determine the VSWR for a double minimum method, if the separation between two adjacent nulls is 3.5cm and that between twice minimum power points is 2.5mm. [6M]**

**b) Classify various methods used to measure attenuation of a microwave device. [6M]**

**3. Draw and explain measurement of impedance using reflectometer. [12M]**

**4. a) Two identical directional couplers are used to sample the incident and reflected powers. The output of the two couplers is found to be 2.5mW and 0.15mW. Find VSWR. [6M]**

**b) How are microwave measurements different from low frequency measurements? [6M]**

**5. Explain the double minimum method of measuring VSWR using microwave bench. [12M]**

**6. a) Determine the attenuation for the given attenuator, if the power meter reads 10mW with attenuator and 26mW after removing it. [6M]**

**b) Write the differences between matched termination and movable short. [6M]**

**Category-4**

**1. a) Describe how the power can be measured different methods. [8M]**

**b) A slotted line is used to measure the frequency and it was found that the distance between nulls is 1.85cm. Given the guide dimensions are 3X1.5cm, calculate the value of the operating frequency. [4M]**

**2. Explain any two methods of measuring impedance of a terminating load in a microwave**

**system? [12M].**

**3. a)Calculate the VSWR of a transmission system operating at 10GHz. Assume TE10 transmission inside a waveguide of dimension a=4cms, b=2.5cms. The distance between two minimum power points is 1mm on a slotted line. [6M]**

**b) What is a movable short and write its uses.[6M]**