DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SUBJECT CODE: EC 2403

MICROWAVE ENGINEERING

(FOR SEVENTH SEMESTER ECE)

TWO MARK QUESTIONS-ANSWERS

PREPARED BY

S. Amala Shanthi (AP/ECE)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC1403 MICROWAVE ENGINEERING

TWO MARK QUESTIONS AND ANSWERS

1. Define s-matrix

In a microwave junction there is intersection of three or more components.There will be an output port ,in addition there may be reflection from the junction of other ports.Totally there may be many combinations,these are represented easily using a matrix called S matrix.

2What are the .Properties of s-matrix?

1.It possess symmetric property sij =sji

2.It possess unitary property

[s][s]*=[i]

3.Why is s-matrix used in MW analysis?

S matrix is used in MW analysis to overcome the problems which occurs when H,Y,&Z parameters are used in high frequencies.

1.Equipment is not readily available to measure total voltage &total current at the ports of the network.

2.Short and open circuits are difficult to achieve over a broad band of frequencies.

3.Active devices,such as power transistor &tunnel diodes,frequently won't have stability for a short or open circuit.

4.Give ABCD matrix for a two port network

V1=A B V2

I1 C D -I2

5.What is ABCD matrix?

ABCD matrix is a transmission matrix.these parameters express voltage and current at output in terms of those at input port.

V1=AV2-BI2

I1=CV2-DI2

6.What are the advantages of ABCD matrix?

1.They are used in power transmission lines.

2.They are very helpful in the case of cascade networks.

7.What is the Scattering matrix for N port device?

[S]= S11 S12 S13…… S1n

S21 S22 ……S2n

S31 S32 ……S3n

. .

. .

. .

Sm1 Sm2 ……...Smm

8.Give the S matrix of uniform transmission line

$$S = \begin{matrix} 0 & e^{-jbl} \\ e^{-jbl} & 0 \end{matrix}$$

9.Give the properties of impedence [x]&admittance[y] matrix?

1.For a lossless junctionary y and z are symmetric .

2.$[y]=[z]^{-1}$

3.Elements of matix [Z] &matrix [Y] are Frequency dependent.

10.For a loss less junction all the elements in the impedence &admittance matrices are

Pure imaginary

11.What are the properties of scattering matrix for a lossless junctoion?

1.The product of any column of the S-matrix with conjugate of this column equals unity.

2.The product of any column of the scattering matrix with the complex conjugate of any other column is zero.

12.What is transmission matrix?

When a number of microwave devices are connected in cascade.Each junction is represented by a transmission matrix which gives the output quantities interms of input quantities.

13.Define one port circuit.Give two examples.

A one port circuit is a circuit for which power can enter or leave through a single wave Guide or transmission line.

Examples:

1.Short-circuited co-axial line

14.Write the voltage matrix for an N-port microwave circuits.

$$\begin{matrix} V1 \\ V2 \\ . \\ . \\ VN \end{matrix} = \begin{matrix} Z11 & Z12 & ….. & Z1N \\ Z12 & Z22 & …… & Z2N \\ . & . & …… & …. \\ ZN1 & ZN2 & . & ZNN \end{matrix} \begin{matrix} I1 \\ I2 \\ . \\ IN \end{matrix}$$

Where Zij=Elements of impedence matrix.

[Z]=Impedence martrix

15.For reciprocal media,the impedence and admittance matrices are

Symmetrical

16.For non-reciprocal media,the impedence and admittance matrices are

Ans: Asymmetrical

17.Give two examples for two port junctions.

1.The junction of two rectangular guides of unequal height

2.A symmetrical junction consisting of two similar rectangular guides joined by an Intermediate guide of greater width.

18.State the unique property of Scattering matrix?

Unitary Property: the row of a scattering matrix multiplied by the complex conjugate of the same row of the scattering matrix is one.

19. Write the scattering matrix for a ideal waveguide section?

$$[S]=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$$

20. What are the various reasons pertaining to the wide use of microwaves

Bandwidth,Improved directivity with an Aerial array ,Reliability, Power requirement.

21. What are the two types of terminations.

Matched load

Variable short circuit

22. What are ferrites and give its properties?

Ferrites are ceramic like materials. These are maby by sintering a mixture of metallic oxides

Properties

Specific resistivitieis may be used as much as 1014 greater than that of metals

Dielectric constants around 10to 15 or greater

Relative permeability is 1000

23.Give some examples of ferrite devices?

Isolator Circulator Phaseshifters, Modulators, Power limiters

24. List two microwave devices using faraday rotation principles

Isolator, Circulator

25.What are powere dividers?

Power dividers are used to divide the input power into a number of smaller amounts of power for exciting the radiating elements in an array antenna

26.What is the S-matrix of 3 port circulators?

Anticlockwise $[S]=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 1 & 0 & 0\end{bmatrix}$

Clockwise $[S]=\begin{bmatrix}0 & 0 & 1\\ 1 & 0 & 0\\ 0 & 1 & 0\end{bmatrix}$

27. Give the differences between Isolator and Circulator

Si.no	Isolator	Circulator
1	It is a 2 port device	It is a 3 port device
2	It cannot be used as circulator	It is used as isolator by terminating one port
3	If input is given in port 1,output is obtained at port 2 and vice versa	Each terminal is connected only to the next terminal

28.What is the S-matrix for 4 port circulators?

Clockwise

$$[S]= \begin{matrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{matrix}$$

Anticlockwise

$$[S] = \begin{matrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{matrix}$$

29.Give the S-matrix of E-plane Tee.

$$[S] = \begin{matrix} 0.5 & 0.5 & 0.707 \\ 0.5 & 0.5 & -0.707 \\ 0.5 & -0.707 & 0 \end{matrix}$$

30.Give the S-matrix of H-plane Tee

$$[S] = \begin{matrix} 0.5 & -0.5 & 0.707 \\ -0.5 & 0.5 & 0.707 \\ 0.707 & 0.707 & 0 \end{matrix}$$

31.Give the S-matrix of Magic Tee

$$[S] = \begin{matrix} 0 & 0 & 0.707 & 0.707 \\ 0 & 0 & 0.707 & -0.707 \\ 0.707 & 0.707 & 0 & 0 \\ 0.707 & -0.707 & 0 & 0 \end{matrix}$$

32.Give the Smatrix of directional coupler

$$[S] = \begin{matrix} 0 & P & 0 & jq \\ P & 0 & jq & 0 \\ 0 & jq & 0 & P \\ Jq & 0 & P & 0 \end{matrix}$$

33.Give an example for a two port MW device

Isolator is an example for a 2 port MW device

34.Give the applications of directional coupler

1.Unidirectional power measurement
2.SWR measurement
3.Unidirectional wave launching
4.Reflectometer
5.Balanced duplexer

35.What is Faraday's rotation law?

If a circulary polarised wave is made to pass through a ferrite rod which has been influenced by an axial magnetic field B ,then the axis of polarization gets tilted in clockwise direction and amount of tilt depends upon the strength of magnetic field and geometry of the ferrite.

36.Define VSWR

Voltage standing wave ratio is defined as the ratio of maximum voltage to the minimum vottage

$$VSWR=\frac{V_{max}}{V_{min}}$$

37.What is Gyrator?

Gyrator is a two port device which provides a relative phase shift of 180 degree for transmission from port 1 to port 2 as compared to the phase for transmission from Port2 to port 1.

38.What is the principle of Microwave phase shifter?

When a wave propagates on a line,a phase difference prevails between any two arbitary points along its paths.The phase difference between two points,

39.what are junctions?Give some examples

A microwave circuit consists of several microwave devices connected in some way to achieve the desired transmission of MW signal.The interconnection of two or more microwave may be regarded as MW junction.

Eg:Magic Tee,Hybrid Ring

40.What is Tee junction?Give two examples

In MW circuits a wave guide or coaxial junction with three independent ports is referred to as tee junction.

Eg: E- Plane Tee,H-plane Tee

41.What is the other name for magic TEE?

Hybrid Tee

42.What is hybrid ring?

Hybrid ring consists of an annular line of proper electrical length to sustain standing waves,to which four arms are connected at proper intervals by means of series or parallel junctions.

43.What is the other name for Hybrid ring?

Rat-race circuit.

44.Name some wave guide components used to change the direction of the guide through an arbitrary angle

Wave guide corner,Bend and twist

45.What are the different types of Directional coupler?

1.Two hole directional coupler
2.Be the hole directional coupler
3.Four hole directional coupler

46.What are hybrid couplers?

Hybrid couplers are interdigitated microstrip couplers consisting of four parallel striplines with alternate lines tied together,It has four ports.This type of coupler is called Lange hybrid coupler.

47. What are nonreciprocal devices? Give two examples

The devices which are having the property that the forward characteristics are not equal to the reverse characteristics are called non reciprocal devices.

48.Why isolators are called uniline?

An ideal isolator completely absorbs the power for propagation in one direction and provides lossless transmission in the opposite direction. Thus isolators are called uniline

49. Give some coupling parameters of directional coupler?

Coupling coefficient, Directivity, Insertion loss, Isolation

50. What are the high frequency effects in conventional tubes?

The high frequency effects in conventional tubes are

i) Circuit reactance

a)Inter electrode capacitance

b) Lead inductance

ii) Transit time effect

iii)Cathode emission

iv) Plate heat dissipation area

v) Power loss due to skin effect, radiation and dielectric loss.

51. What are the assumptions for calculation of RF power in Reflex Klystron?

i) Cavity grids and repeller are plane parallel and very large in extent.

ii) No RF field is excited in repeller space

iii) Electrons are not intercepted by the cavity anode grid.

iv) No debunching takes place in repeller space.

v) The cavity RF gap voltage amplitude V, is small compared to the dc beam voltage V_O

52. What is the condition for oscillation in Reflex klystron ?

The necessary condition for oscillation is that the magnitude of the negative real part of the electronic admittance should not be less than the total conductance of the cavity circuit i.e. $|-Ge| \geq G$.

Where

$$G = G_c + G_b + G_1 = \frac{1}{R_{sh}}$$

R_{sh} → effective shunt resistance

G_c → copper losses of cavity

G_b → beam loading conductance

G_1 → load conductance

53. Give the drawbacks of klystron amplifiers.

1. As the oscillator frequency changes then resonator frequency also changes and the feedback path phase shift must be readjusted for a positive feedback.

2. The multicavity klystron amplifiers suffer from the noise caused because bunching is never complete and electrons arrive at random at catcher cavity. Hence it is not used in receivers.

54. What is the effect of transit time?

There are two effects.

1) At low frequencies, the grid and anode signals are no longer 180^{O} out of phase, thus causing design problems with feedback in oscillators.
2) The grid begins to take power from the driving source and the power is absorbed even when the grid is negatively biased.

55. What are the applications of reflex klystron ?

1) Signal source in MW generator
2) Local oscillators in receivers
3) It is used in FM oscillator in low power MW links.
4) In parametric amplifier as pump source.

56. What is the purpose of slow wave structures used in TWT amplifiers?

Slow wave structures are special circuits that are used in microwave tubes to reduce wave velocity in a certain direction so that the electron beam and the signal wave can interact. In TWT, since the beam can be accelerated only to velocities that are about a fraction of the velocity of light, slow wave structures are used.

57. How are spurious oscillations generated in TWT amplifier? State the method to suppress it.

In a TWT, adjacent turns of the helix are so close to each other and hence oscillations are likely to occur. To prevent these spurious signals some form of attenuator is placed near the input end of the tube which absorb the oscillations.

58. State the applications of TWT.

1) Low power, low noise TWT's used in radar and microwave receivers
2) Laboratory instruments
3) Drivers for more powerful tubes
4) Medium and high power CWTWT'S are used for communication and radar.

59.How the klystron amplifier can act as klystron oscillator? What are the applications of klystron amplifier?

When the klystron amplifier is given a positive feedback such that the overall phase shift becomes zero 360° and $|\beta Av| = I$ then klystron amplifier acts as an oscillator.

Applications:

(1) UHF TV Transmitters
(2) Long ranger radar
(3) Linear particle accelerator
(4) Troposcatter links
(5) Earth station transmitter.

60.Define phase focusing effect.

The bunching of electrons in known as " Phase focusing effect" This effect is important because without it, favoured electrons will fall behind the phase change of electric field across the gaps. Such electrons are retarded at each interaction with the R.F field in magnetron.

61.What do you mean by O-type tubes? Name some O-type tubes.

In O – type tube a magnetic field whose axis coincides with that electron beam is used to hold the beam together as it travels the length of the tube. It is also called as linear beam tube.

i) Helix Traveling wave tube
ii) Coupled cavity TWT

iii) Forward wave amplifier

iv) Backward wave amplifier

v) Backward wave oscillator

62. Define Transit time in Reflex klystron.

The time taken by the electron to travel into the repeller space and back to the gap.

$T = n + \frac{3}{4}$

63. Write the parameters on which bunching depend on?

vi) Drift space should be properly adjusted.

vii) D.C anode voltage

viii) Signal amplitude should be such that proper bunching takes place.

64. Compare TWTA Klystron amplifier

	Klystron amplifier	TWTA
1.	Linear beam or 'O' type device.	Linear beam or 'O' type device
2.	Uses cavities for input and Output circuits.	Use non resonant wave circuit.
3.	Narrow band device due to resonant cavities.	Wide band device because use of use of Non-resonant wave circuit.

65. Give the performance Specification of Reflex klystron?

Frequency range: 2- 200 GHz

Band width: $\pm$ 30 MHz for Δ VR $= \pm$ 10 V

Power output: 10 mw – 2.5W

Efficiency: 20 to 30%

66. What is CFA? State the applications of CFA.

CFA →Cross Field Amplifier

CFA is a microwave power amplifier. It is a cross between TWT and magnetron in its operation. i.e., it has a magnetron structure to provide an interaction between crossed dc electric and magnetic fields on one hand and an RF field on the other hand. It also uses a slow wave structure as in TWT to provide a continuous interaction between the electron beam and a moving RF field.

Applications:

(1) Radar system

(2) Electronic counter measure.

67. State the characteristics of magnetron and of 2-cavity klystron amplifier.

Magnetron:

Operating frequencies → 70 GH z

Output power → 40 MW

Efficiency → 40 to 70%

2-cavity klystron:

Efficiency → 40%

Power output → average power => 500 KW

Pulsed power => 30 MW

Power gain → about 30 db.

68. What are the advantages of TWT?

1. Bandwidth is large.
2. High reliability
3. High gain
4. Constant Performance in space
5. Higher duty cycle.

69. What is meant by strapping?

The magnetron has eight or more coupled cavity resonators and hence several modes of oscillation are possible. The oscillating frequency of different modes are not same and are quite close to each other which results in mode jumping. i.e., a 3 cm π mode oscillation which is normal for a particular magnetron

Could become a 3.05 cm------- $\frac{3\pi}{4}$ mode oscillation. This result in

oscillations of reduced power at wrong frequency. To prevent this. Strapping is used. It consists of two rings of heavy gauge wire connecting alternate anode poles. It provides a phase difference 0f 2 π radians for the modes other π-mode and thus preventing the occurrence of other modes, except the π-mode .

70. State the applications of magnetrons. why magnetron is called as cross filed device?

1) Pulse work in radar
2) Linear particle accelerators.

In cavity magnetron, there exists a radial electric field and an axial magnetic field perpendicular to each other and hence magnetron is called as a cross filed device.

71. What is BWO? State the applications of BWO.

A backward wave oscillator (BWO) is microwave cw oscillator with an enormous tuning and ever all frequency coverage range.

Applications:

(i) It can be used as signal source in instruments and transmitters.
(ii) It can be used as broad band noise sources which used to confuse enemy radar.

72. What is hull cutoff condition?

In a magnetron, the electron will just graze the anode and return towards the cathode depends on Vo and Bo . The hull cut of magnetic equation is

$$B_{oc} = \frac{(8V_o m / e)^{1/2}}{b(1 - a^2 / b^2)}$$

The hull cutoff voltage equation is

$$V_{oc} = \frac{e B_O^2 b^2 (1 - a^2 / b^2)}{8m}$$

If $B_{0>}B_{Oe}$ for given V_o.the electrons will not reach anode.

If $V_o < V_{oc}$ for a given B_o the electrons will not reach the anode.

73. What are the principal limitations of conventional negative grid electron tubes?

1) Electron transit time becomes a noticeable proportion at high frequencies.
2) Lumped electrical reactance and low Q resonant circuit.

74. What is frequency pulling and frequency pushing in magnetrons?

Frequency pulling is caused by changes in the load impedance reflected into the cavity resonators. Frequency pushing is due to the change in anode voltage which alters the orbital velocity of electron clouds.

75.What are the applications of High Q-oscillators and amplifier circuits?

They are used in

a)Low power transmitters

b)Parametric amplifier pumps
c)Police radars and intrusion alarms.

76.What are the Key phenomenon taking place in TRAPATT diode?

The Key phenomena are

a)Carrier generation by impact ionization producing a current pulse of phase delay of 90 degree.

b)An additional phase shift introduced by the drift of carriers.

77.What is the operating frequency of TRAPATT devices?

TRAPATT devices operate at frequencies from 400 MHz to about 12GHz.

78. What are the applications of TRAPATT devices?

The applications are

a)Phased-array Radar systems
b)Intermediate frequency transmitters.
c)Proxity fuse sources
d)Radio altimeters
e)Microwave landing systems.

79. What are the applications of Tunnel Diode?

a)used in self excited mixers
b)High speed switching and logic operations
c)Low power oscillators.

80.**What are the elements that exhibit Gunn effect?**

The elements are

a)Gallium arsenide
b)Indium phosphide
c)Cadmium telluride
d)Indium arsenide.

81. **What are the applications of Gunn Diode?**

The applications are

a) Low and medium power oscillators
b) Used in high pump frequencies
c) Burglar alarms and aircraft rate-of-climb indicators.

82.What is negative resistance?

Negative resistance is defined as that property of a device which causes the current through it to be 180 degree out of phase with the voltage across it.

83.What are the applications of Backward diode?

a) Video detection
b) Doppler radar

84. Why are FET's preferred to bipolar transistor at high frequencies?

FET's are preferred over Bipolar transistors at high frequencies as they easily lend themselves more readily to intrgration.

85.What is the main advantage of TRAPATT over IMPATT?

TRAPATT diode has much greater efficiency than IMPATT**.**

86.Draw the schematic diagram of PIN diode?

1. Metallic contact

ii. ----------

1. n-type Si

iii. ----------

iv. Intrinsic Si

v. (Slightly n-doped)

vi. ----------

1. p-type Si

vii. ----------

1. Mettalic contact

87. Define GUNN EFFECT.

Guneffect was first observed by GUNN in n_type GaAs bulk diode.according to GUNN,above some critical voltage corresponding to an electric field of 2000-4000v/cm,the current in every specimen became a fluctuating fuction of time.The frequency of oscillation was determined mainly by the specimen and not by the external circuit.

88. What is MESFET?

If the field effect transistor is constructed with metal semiconductor schottky barrier diode,the device is called metal-semiconductor field effect transistor.

89.Explain stable amplification mode.

When 'n0l'product of the device is less than about 10 ^(12)/cm^2 the device exhibits amplification at transit time frequency rather than

spontaneous oscillation. This is called stable amplification mode.Here n0 is the amount of doping and 'L' is the length.

90.What are the factors reducing efficiency of IMPATT diode?

1)Space charge effect
2)Reverse saturation current effect
3)High frequency skin effect
4)Ionization saturation effect.

91.Explain plasma formation in TRAPATT diode.

During the operation of the diode a high field avalanche zone propagates through the depletion region and fills the layer with a dense plasma of electrons and holes which get trapped in the low field region behind the zone.

92.What is negative resistance in gunn diode?

The carrier drift velocity increases linearly from 0 to maximum when the electric field is increased from 0 to threshold value in gunndiodes.When the electric field is beyond the threshold value of 3000v/cm the drift velocity is decreased and the diode exhibit negative resistance.

93.What are the applications of GaAsMESFET.?

a,Used in microwave integrated circuits for high power, low noise applications.
b.Used in broadband amplifier application.

94.What are the applications of TRAPATT?

a)Used in airborne
b)Marine radars.

95.What is Transferred electron effect?

Some materials like GaAs exhibit negative differential mobility,when biased above a threshold value of the electric field.This behaviour is called transferred electron effect.

96.What are time parameter for TED'S

a)Domain growth time constant
b)Dielectric relaxation time
c)transit time.

97.What are the various modes of transferred electron oscillators?

a)Transit time mode
b)Quenched and delayed domain modes
c)limited space charge accumulation mode.

98.List the type of circuit used for IMPATT diode circuits.

a)Broadly tunable circuits
b)Low 'Q'circuits
c)high 'Q'circuits

99.What are the applications of low Q-oscillators and amplifier circuits?

a)Final output stage of FM telecommunication transmitter
b)Up converter pump
c)CW Doppler radar transmitter.

100.List some of power detecting elements?

1.Schottky diode
2.baretter
3.thermistor
4.thermocouple

101.What are microwave detector?

Microwave detectors are the instruments used to detect the presence of microwave power is a microwave circuit.

102.Differentiate baretter and thermistor?

Baretter
1.baretter has positive
temperature coefficient.
2.it has thin wire.
3.less sensitive.
4.required less bias current

Thermistor
1.negative temp coefficient.
2.small bead of semi conductor material.
3.more sensitive.
4.require more sensitive.

103.What are tunable detector?

The tunable detectors are used to demodulate the signal and couple the required output to high frequency scope analyzer.The low frequency demodulated output is detected using non reciprocal detector diode monunted in the microwave transmission line.

104. What is slotted section with line carriage?

It is a microwave sectioned coaxial line connecting a coaxial E-field probe which penetrates inside a rectangular waveguide slotted section.The longitudinal slot is cut along the center of the waveguide broad walls.The probe is made to move along the slotted wall which samples the electric field propotional to probe voltage.

105. What is the main purpose of slotted section with line carriage?

1.For determination of location of voltage standing wave maxima and minima along the line.
2.Measure the VSWR and standing wave pattern.
3.Wavelength.
4.Impedence.
5.Reflection coeffient.
6.Return loss measurement.

106. What is a VSWR meter?

VSWR meter is a highly sensitive,high gain,high theta,low noise voltage amplifier tuned normally at fixed frequency of 1KHZ of which microwave signals modulated.This meter indicates calibrated VSWR reading fir any loads.

107. What is Bolometer?

It is a power sensor whose resistance change with changed temperature as it absorb the microwave power.It is ashort thin metallic wire sensor with positive temperature coefficient of resistance.

108. What is calorimeter?

It is convenient device setup for measuring the high power at microwave which involves conversion of microwave energy in to heat,absorbing the heat in a f luid and determine the temp.

109.Mention the disadvantages of single bridge circuit ?

1.change in resistance due to mismatch at the microwave input port results in incorrect reading
2.the thermistor is sensitive to change in the ambient temp resulting in false readings

110. Define insertion loss?

It is defined as difference in power arriving at the terminating load .with or witout The network in circuit

Insertion loss(db)=10 log(po/pi)

111.How will you determine the vswr and return loss in reflecto meter method?

The voltage ratio between port3 or port4 is known reflectin coefficient (T) determined we determine VSWR and return loss as

VSWR=(1+T)/(1-T)

Return loss=-20 log(T)

112.List the different types of Impedence measurement methods?

1.Slotted line method

2.Reflectometer method

3.Reactor discontructer method

113.How do you measure microwave frequency?

1.Wavemeter method

2.Slotted line method

3.Downconversion method

114.What is a wavemeter?

It is a device used for frequency measurement in microwave.It has cylindrical cavity with a variable short circuit termination .It changes the resonant frequency of cavity by changing cavitylength.

115.Define dielectric constant?

It is defined by the ratio of permittivity of medium to permittivity of freespace.

$\xi r=\xi/\xi o=((10^{-9})/36\pi)$

116.How the S-parameter of a microwave circuit measured?

S-parameters are conveniently measured using the deschamps method which utilizes the measured value of complex input reflection coefficient under a number of a reactive terminations.

117. List the methods for measuring dielectric constants?

1.Waveguide method

2.cavity pertubaration method

118.What is radiation pattern?

Radiation pattern is a representation of radiation characteristics of an antenna which is a function of elevation angle azimuth angle for a constant radial distance and frequency.

119. What is radiation efficiency?

Radiation efficiency is defined as the ratio of total power radiated to total power accepted at its input .

120. How do you measure the polarization?

The polarization of an antenna is measured using transmitting mode and probing the polarization by a dipole antenna in the which the dipole is rotated in the plane of polarization and the received voltage pattern is recorded.

121. What is spectrum analyzer?

Spectrum analyzer is a broad band super heterodyne receiver which is used to display a wave in frequency domain additionally, power measurements, side bands can also be observed.

122.List the types of spectrum analyzer

Real time spectrum analyzer
Swept tuned frequency spectrum analyzer

123. List some application of spectrum analyzer.

Identifying frequency terms and their power levels
Measuring harmonic distortion in a wave
Determine type of wave modulation
Signal to noise ratio
For identifying wave distortion

124. What is network analyzer

A Network analyzer measures both amplitude and phase of a signal over a wide frequency range. It requires accurate reference signal and a test signal

16 mark questions

1.Explain in detail about 2-cavity klystron amplifier.

-schematic circuit diagram
-mechanism of operation
-velocity modulation process
-bunching process
-calculation of efficiency, mutual conductance and voltage gain.

2. Explain about the reflex klystron.

-schematic diagram
-velocity modulation process
-power output &efficiency
-frequency characteristics.
-electronic admittance of reflex klystron.

3. Explain about TWT amplifiers.

-principle of operation
-calculation of gain
-applications

4. Explain about magnetron oscillator.

-schematic diagram
-equations of electron trajectory
-cut off magnetic field &voltage
-resonant modes&mode separation
-mechanism of oscillation.

5. Numerical problems.
-calculation of output voltage, power,efficiency for 2-cavity klystron amplifier, reflex klystron,magnetron,TWTamplifiers.

6.What are the properties of scattering matrix for a lossless junction?

1.The product of any column of the S-matrix with conjugate of this column equals unity.

2.The product of any column of the scattering matrix with the complex conjugate of any other column is zero.

7.What are ferrites devices.Explain in detail the different ferrite devices

Ferrites are ceramic like materials. These are maby by sintering a mixture of metallic oxides

Properties

Specific resistivitieis may be used as much as 1014 greater than that of metals

Dielectric constants around 10to 15 or greater

Relative permeability is 1000

some examples of ferrite devices are Isolator Circulator Phaseshifters, Modulators, Power limiters

Circulator

S-matrix of 3 port circulators

Anticlockwise $[S]=\begin{matrix}0&1&0\\0&0&1\\1&0&0\end{matrix}$

Clockwise $[S]=\begin{matrix}0&0&1\\1&0&0\\0&1&0\end{matrix}$

S-matrix for 4 port circulators

Clockwise

$[S]=\begin{matrix}0&0&0&1\\1&0&0&0\\0&1&0&0\\0&0&1&0\end{matrix}$

Anticlockwise

$[S]=\begin{matrix}0&1&0&0\\0&0&1&0\\0&0&0&1\\0&0&1&0\end{matrix}$

8. Dicuss the high frequency effects in conventional tubes?

The high frequency effects in conventional tubes are

i) Circuit reactance

a)Inter electrode capacitance

b) Lead inductance

ii) Transit time effect

iii)Cathode emission

iv) Plate heat dissipation area

v) Power loss due to skin effect, radiation and dielectric loss.

9.Explain in detail about spectrum analyzer?

Spectrum analyzer is a broad band super heterodyne receiver which is used to display a wave in frequency domain additionally, power measurements, side bands can also be observed.

Types of spectrum analyzer

Real time spectrum analyzer

Swept tuned frequency spectrum analyzer

Application of spectrum analyzer.

Identifying frequency terms and their power levels

Measuring harmonic distortion in a wave

Determine type of wave modulation

Signal to noise ratio

For identifying wave distortion

10.Explain in detail about network analyzer

A Network analyzer measures both amplitude and phase of a signal over a wide frequency range. It requires accurate reference signal and a test signal

-Applications

-Types

11.Explain the different types of Impedence measurement methods?

1.Slotted line method

2.Reflectometer method

3.Reactor discontructer method

12. How do you measure microwave frequency?

1.Wavemeter method

2.Slotted line method

3.Downconversion method

Wavemeter is a device used for frequency measurement in microwave.It has cylindrical cavity with a variable short circuit termination .It changes the resonant frequency of cavity by changing cavitylength

13. Explain the power measuring devices baretter and thermistor?

Baretter

1.baretter has positive
temperature coefficient.

2.it has thin wire.

3.less sensitive.

4.required less bias current

Thermistor

1.negative temp coefficient.

2.small bead of semi conductor material.

3.more sensitive.

4.require more sensitive.

14.Explain in detail power detecting elements?

1.Schottky diode
2.baretter
3.thermistor
4.thermocouple

15.Explain in detail about microwave detector?

Microwave detectors are the instruments used to detect the presence of microwave power is a microwave circuit.

Types

Crystal detector
Tunable detector

16.What is Transferred electron effect?Explian some of the TED's?

Some materials like GaAs exhibit negative differential mobility,when biased above a threshold value of the electric field.This behaviour is called transferred electron effect.

a)Domain growth time constant
b)Dielectric relaxation time
c)transit time.

17.What is negative resistance in gunn diode?Desribe the operation of GUNN diode

Guneffect was first observed by GUNN in n_type GaAs bulk diode.according to GUNN,above some critical voltage corresponding to an electric field of 2000-4000v/cm,the current in every specimen became a fluctuating fuction of time.The frequency of oscillation was determined mainly by the specimen and not by the external circuit.

The carrier drift velocity increases linearly from 0 to maximum when the electric field is increased from 0 to threshold value in gunndiodes.When the electric field is beyond the threshold value of 3000v/cm the drift velocity is decreased and the diode exhibit negative resistance.

18.Explain the operation of TRAPATT diode

The Key phenomena are

a)Carrier generation by impact ionization producing a current pulse of phase delay of 90 degree.

b)An additional phase shift introduced by the drift of carriers.

TRAPATT devices operate at frequencies from 400 MHz to about 12GHz.
The applications are

a)Phased-array Radar systems
b)Intermediate frequency transmitters.
c)Proxity fuse sources
d)Radio altimeters
e)Microwave landing systems.