Q2 (a) List out the different types of transmission lines used at low frequency and at RF frequency with neat figures. Why wave guides are used at microwave frequencies.

Answer
List transmission lines:-

(i) Single wire
(ii) Two wire
(iii) Coaxial
(iv) Gaussian lines, Single conductor coated with dielectric figures of all these transmission lines.

Q2 (b) Explain Smith Chart; explain how VSWR can be obtained from it. Give example.

Answer Page Number 82 of Textbook

Q3 (a) Starting from Maxwell's equations device wave equation for rectangular wave guide.

Answer Page Number 104 of Text Book

Case I, II, III in page 105 to 106 to be written completely. All mathematical steps: to be written

$$\left.\begin{aligned}\nabla^2 E &= (\sqrt{\ })^2 E \\ \nabla^2 H &= (\sqrt{\ })^2 H\end{aligned}\right\}$$

$4-1-3$ To behavived

$4-1-3$ To behavived

equ^n $4-1-22., 4-1-21, 4-1-20, 1-4-19.$

all to be devived and designed.

Q3 (b) Calculate the voltage attenuation provided by a 25cm length of wave guide having a = 1 cm and b = 0.5 cm in which 1 GHz signal is propagated in dominant mode, {symbols have usual meaning}

Answer

$$\lambda_a = \frac{2a}{m} = 1 \times \frac{2}{1} = 2ems, \lambda = \frac{3 \times 10^{10}}{109} = 30$$

The wave guide is well below cut off therefore $A_{dB} = 54$

For a wave guide operated below cut off it can be shown that $A = e^{\alpha\varepsilon} \alpha = 2\pi / \lambda c$
Where e is base of natural logarithms in.

$\alpha \rightarrow$ off "foetew, $\lambda_c \rightarrow$ cut off wave length of wave guide

under these conditions the off " is completely independendent of frequency and reduces to

$$A_{dB} = 20 \log e^{\alpha} = \tfrac{40\pi}{\alpha\lambda} \log e$$

$$= 40\pi \times 0'434 \times \varepsilon / \lambda_0 = \frac{54.5}{\lambda} \varepsilon dB$$

Where A_{dB} is the ratio, expressed decibels of the inputs voltage to the output voltage turn a wave guide operated substantially below cut off

$$A_{dB} = 54.3\varepsilon / \lambda = 54.5 \times \frac{25}{2} = 68 / dB$$

Q4 (a) Explain the performance of a directional coupler with a neat diagram. Derive an expression for [S] matrix of directional coupler.

Answer
Page Number 149- 152 of Textbook
[s] Matrix of g directional couple 'Deviation

$$s = \begin{bmatrix} 0 & p & 0 & jq \\ p & 0 & jq & 0 \\ jq & jq & 0 & p \\ jq & 0 & p & 0 \end{bmatrix}$$

Q5 (b) Write a note on principle of operation of microwave Tunnel diode.

Answer Page Number 198- 199 of Text Book

Q6 (a) A Reflex klystron operates under the following conditions:

$V_o = 600\text{volts}, \alpha = 1\text{mm}, R_{sh} = 15K\Omega, \; e/m = 1.759 \times 10^{11}, f_r = 9GHz$

The tube is operating at $f_v f_r$ at the peak of the n = 2 mode or 1 $\frac{3}{4}$ mode. The transit time through the gap and beam loading can be neglected. Find the value of repeller voltage V_r.

Answer

$equ^n (9-4-22) we\ \ obtain$

$$\frac{v_0}{(v_r+v_0)^2} = (e/m)\frac{(2\pi n - \frac{\pi}{2})^2}{8w^2\angle 2} = (1.759\times 10^{11})\frac{(2\pi 2 - \pi/2)^2}{(8(2\pi\times 9\times 10^{92})\times(10^{-3})2}$$

$$= 0.832\times 10^{-3}$$

$(Vr + Vo)^2 = 600/0.832 \text{ X } 10^{-3} = 0.721 \text{ X } 10^6$

$V_r = 25$ Volts

Q7 (a) Describe the principle of operation for a normal cylindrical magnetron and derive equation for cyclotron angular frequency.

Answer Page Number 467 of Textbook

Q7 (b) A circular carcinotron has the operating parameters

Anode voltage	$V_o = 20kV$
Anode Current	$I_o = 3.5A$
Magnetic flux density	$B_o = 0.3\,Wb/m^3$
Operating frequency	**f = 4 GHz**
Characteristic impedance	$Z_o = 50\Omega$
D factor	**D = 0.8**
b factor	**b = 0.5**

Compute:

(i) The dc electron velocity
(ii) The electron-beam phase constant
(iii) The delta differentials
(iv) The propagation constants

Answer Page Number 465 of Textbook

Q8 (a) Derive an expression for quality factor Q of Micro-strip lines.

Answer Page Number 484 of Textbook

Q8 (b) Certain microstrip line has the following parameters

$\in_r = 5.23, h = 7mils, t = 2.8mils, \omega = 10mils$

Calculate the characteristic impedance Z_{10} **of the line.**

Answer

$$z_0 = \frac{87}{\sqrt{E_r + 1.41}} \ln\left\{\frac{5.98h}{0.8w + t}\right\} = \frac{87}{\sqrt{5.23 + 1.41}} \ln\left[\frac{5.98 \times 7}{0.8 \times 10 + 2.8}\right]$$

$= 45.78\Omega$

Q9 (a) What are the advantages offered by MMIC over the discrete circuits? Discuss in detail the MMIC technique.

Answer Page Number 496 of Textbook

Q9 (b) Explain the types of planar capacitors commonly used in MMICs.

Answer Page Number 518 of Textbook

<u>Text Book</u>

Microwave Devices and Circuits, Samuel Y. Liao, 3rd Edition, Prentice-Hall of India, New Delhi, 2006.