2 marks

1) Lumped parameters cannot be used at high frequencies because,
* Short circuit & open circuit are difficult to achieve in high frequencies
* Pre

8 marks

1) Lumped parameters cannot be used at high frequencies because, Inductors and capacitors have significant loss and all of the elements store energy in both electric and magnetic forms

2) Limitations of low freq parameters:
* Equipment is not available to measure current and voltage at ports
* Short circuit & open circuit are difficult to achieve in high frequencies
* Presence of active devices make system unstable

3) Characteristics of MW
* They are reflected by metals (conductors)
* They pass through glass, paper, plastic
* ~~Absorbed~~ Easily attenuated with shorter distances
* Radiate electromagnetic energy with shorter wavelength

4) Scattering matrix:
* Scattering matrix is a square matrix which describes all combinations of power relationships btwn various i/p and o/p ports of microwave junction
* Elements of scattering matrix are called Scattering parameters

10) Differentiate Low Freq & High freq MW circuits

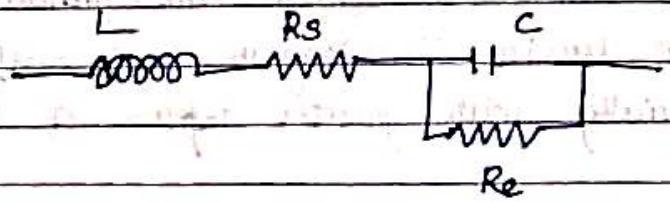
Low frequency	High frequency
→ Large wavelength	→ Short wavelength
→ Circuit theory	→ transmission line theory
→ Lumped elements R, L, C	→ Distributed elements

11) Applications of Inductors:
- → Impedance matching
- → Creating tank circuits
- → Storing and transferring energy in power circuits

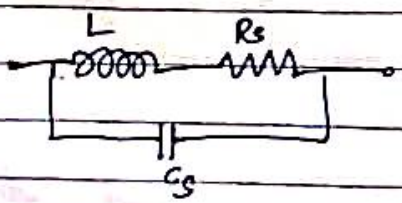
12) Condition for lossless: nw:
The sum of products of all the elements of a row or a column of a [S] multiplied with its complex conjugate is unity.

13) Types of high freq resistors:
- * Carbon - composition resistors
- * Wire - wound "
- * Metal film "
- * Thin - film chip "

14) Equivalent Circuit of ~~inductor~~ capacitor at radio freq



15) Equivalent Circuit of inductor



23) Condition for lossless bend & corners

Length of corners, bends & twists will be equal to odd multiple of quarter wavelength.

$$L = (2n+1)\,\lambda/4.$$

24) Circulators:

* Passive, non-reciprocal & multiport device (usually 3 or 4)
* In circular, wave will travel from one port to the next immediate port in only one direction

25) Principle of operation of isolator

Qs: 21

26) S-matrix of a port circulators

Clockwise:

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

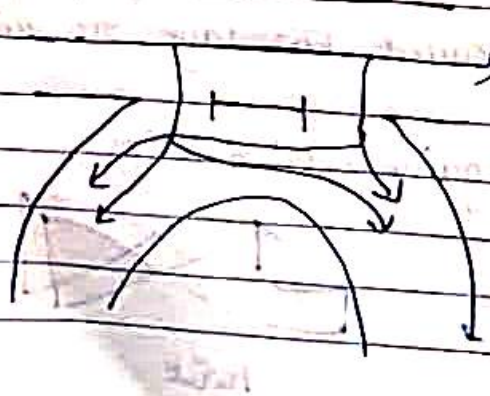
Anticlockwise

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

27) two devices using Faraday rotation

* Isolator
* Circulator

28) Two hole direction coupler:



Find insertion loss for $S_{21} = 4$

Insertion loss in dB $= -20\log(4)$

$= -12.04$ dB.

18) Subbands of microwave freq spectrum

* HF band	* L band	* C band	* Ku band
* VHF "	* S "	* X "	* mm "
* UHF "	* X "	* V "	

8) Applications of microwaves

* Medical application
* Navigation
* Domestic & industrial
* Communication

19) Different types of tee junctions

* E-plane
* H-plane
* Hybrid (Magic tee)

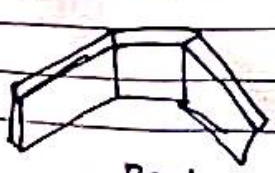
20) Applications of magic tee

* Isolators
* Duplexer
* Mixer
* Matching device
* Phase shifter

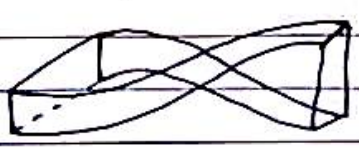
21) Faraday's rotation law

When an electromagnetic wave passes through ferrites, plane of polarization continuous to rotate to angle θ in one particular direction (clockwise / anticlockwise). The plane of polarization changes in the same direction whatever may be the direction of propagation of wave. This is called Faradays rotation law

22) Diagram of waveguide bend & twist



Bend



twist

5) properties of S-parameters

* Zero diagonal elements for perfectly matched network
* Symmetric [S] for reciprocal network, $S_{ij} = S_{ji}$ where $i \neq j$
* Unitary property for lossless ntwk, $[S][S^*] = I$
* Phase shift property

6) S-matrix of 2 port network

$$\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$$

S_{11}, S_{22} → Reflection coefficients of port 1 and port 2
S_{12} → Reverse transmission coefficient
S_{21} → Forward "

7) Reflection coefficient

The ratio of amplitude of reflected wave to that of incident wave is called reflection coefficient
Transmission coefficient

The ratio of amplitude of transmitted wave to that of incident wave is called tc

8) Skin effect:

Skin effect is the tendency of AC current to become distributed within the conductor such that the current density is largest near surface and decreases exponentially with greater depths of the conductor

9) Need for S-parameters

Qs. no: ②

10)