SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
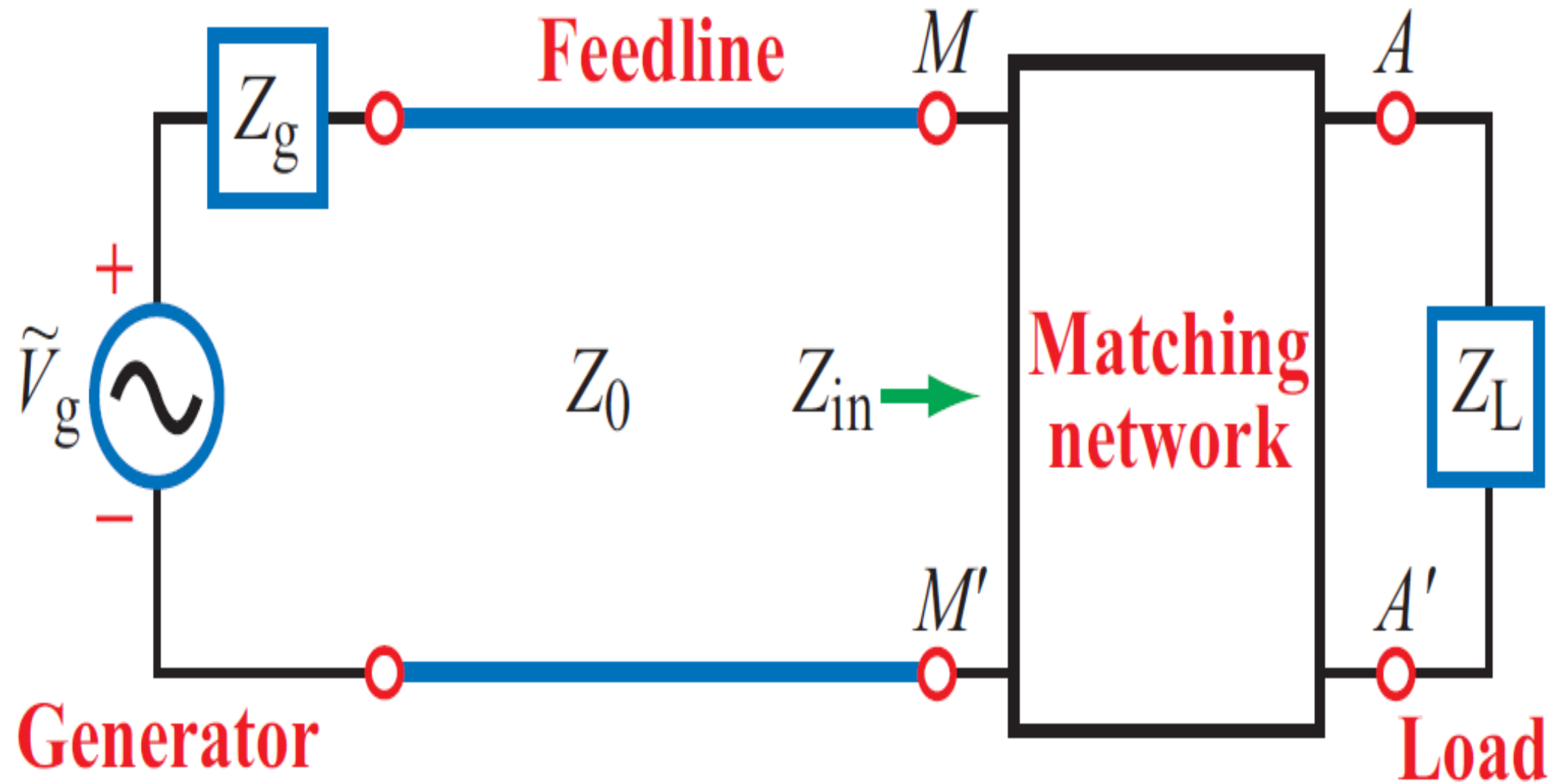
19ECT302 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

UNIT 1– THE LINE AT RADIO FREQUENCIES

TOPIC 9.1 – SINGLE STUB MATCHING

What is the purpose of matching networks of a transmission line?

MATCHING NETWORKS

- When a high frequency line is terminated in its characteristic impedance R_0 , it is operated as a smooth line
- Under such conditions,
  - there will be no reflections
  - maximum power delivered to the load
  - increased efficiency
- But in practice the loads such as antennas do not provide resistances equal to R_0 of the line
- So it is necessary to add some of the impedance matching networks between the line and load
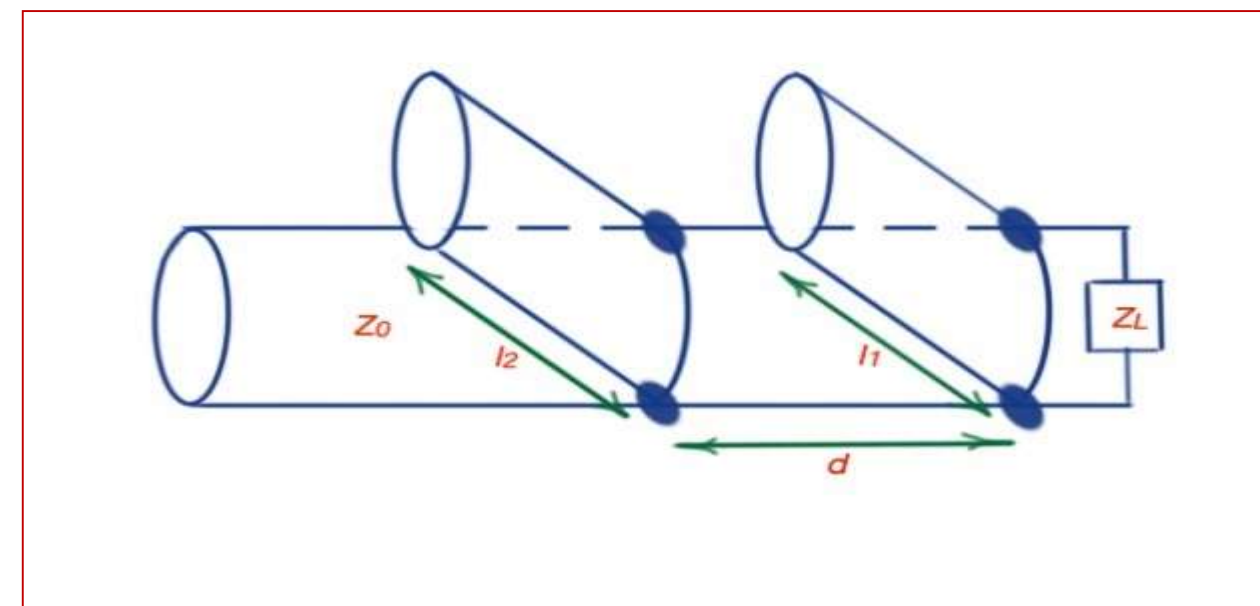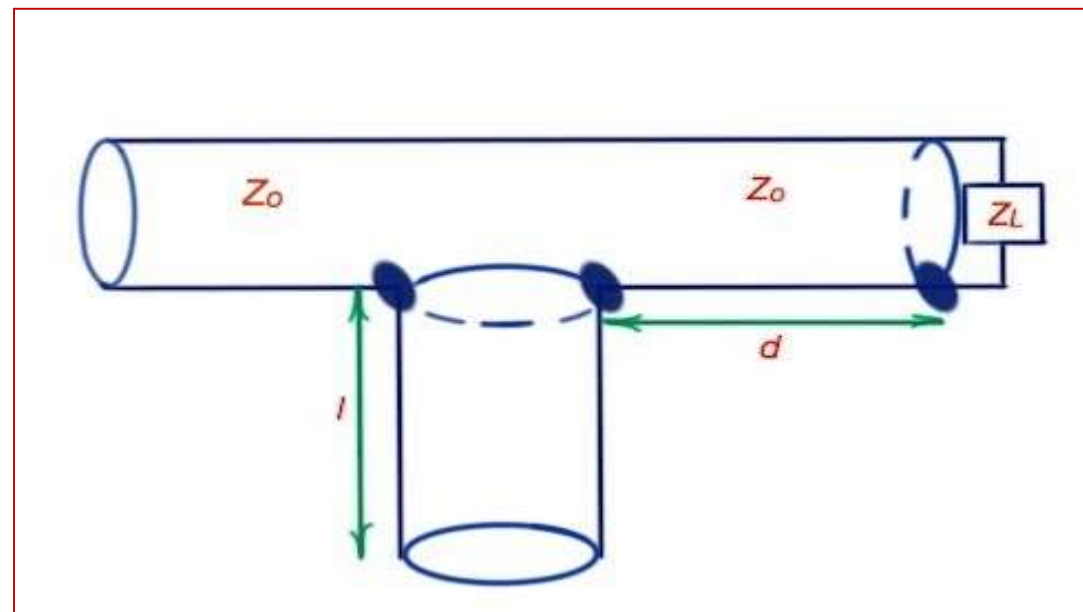
STUB MATCHING

- One of the impedance matching is to use open or short circuited stubs
- A stub of suitable length is connected in parallel with the line at a certain distance from the load
- Because of parallel connection of stub, it is convenient to work with admittances
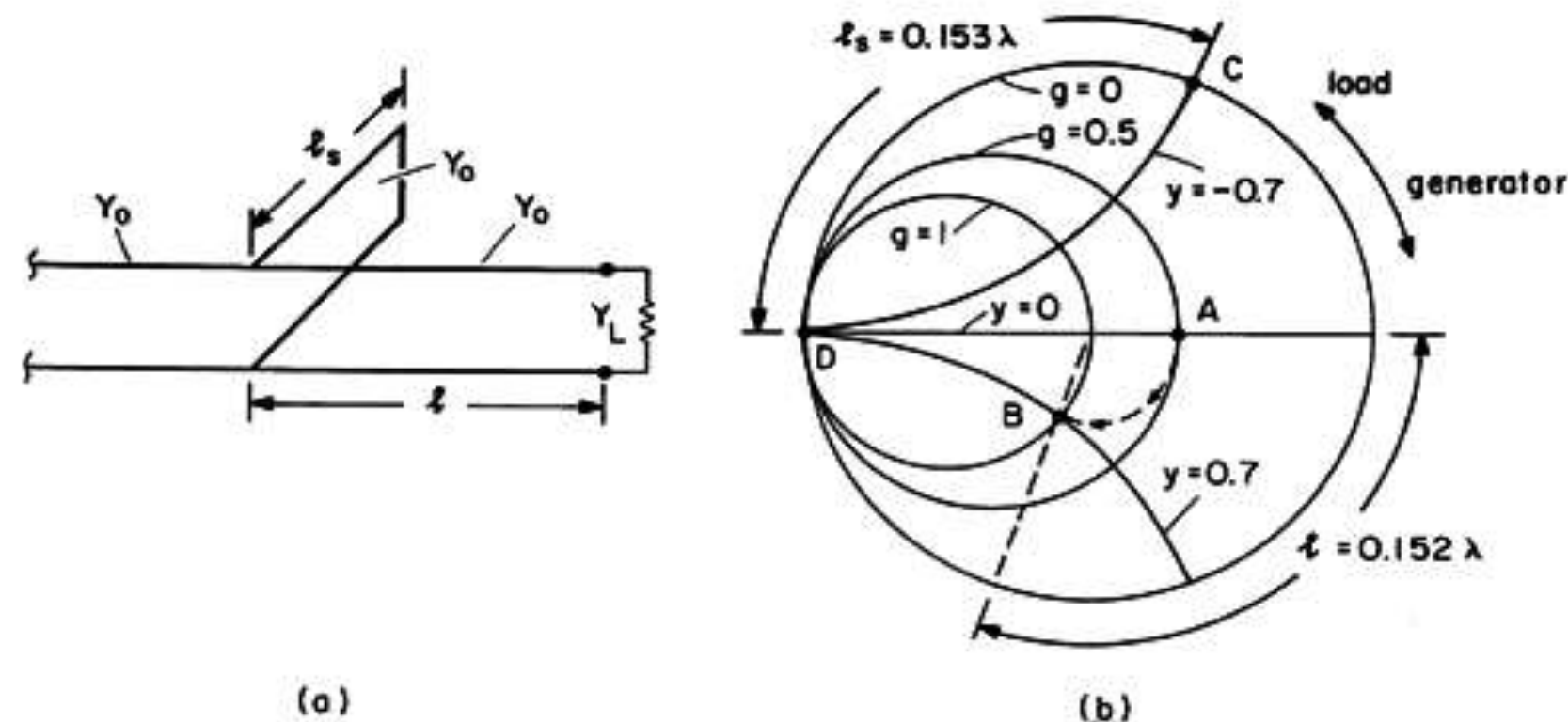
STUB MATCHING - TYPES

1. **Single stub matching** - A stub is connected in parallel to the transmission line at a fixed distance from load

2. **Double stub matching** - A type of matching where two stubs are shunted to main transmission line on a fixed distance

SINGLE STUB MATCHING - PRINCIPLE

- The input impedance at any point on a line is given by

$$Z_S = R_0 \pm jX$$

- The input admittance is

$$Y_S = G_0 \pm jB$$

- Then the short circuited stub of $\pm jB$ is connected at that point across the transmission line

- Then the total admittance is given by,
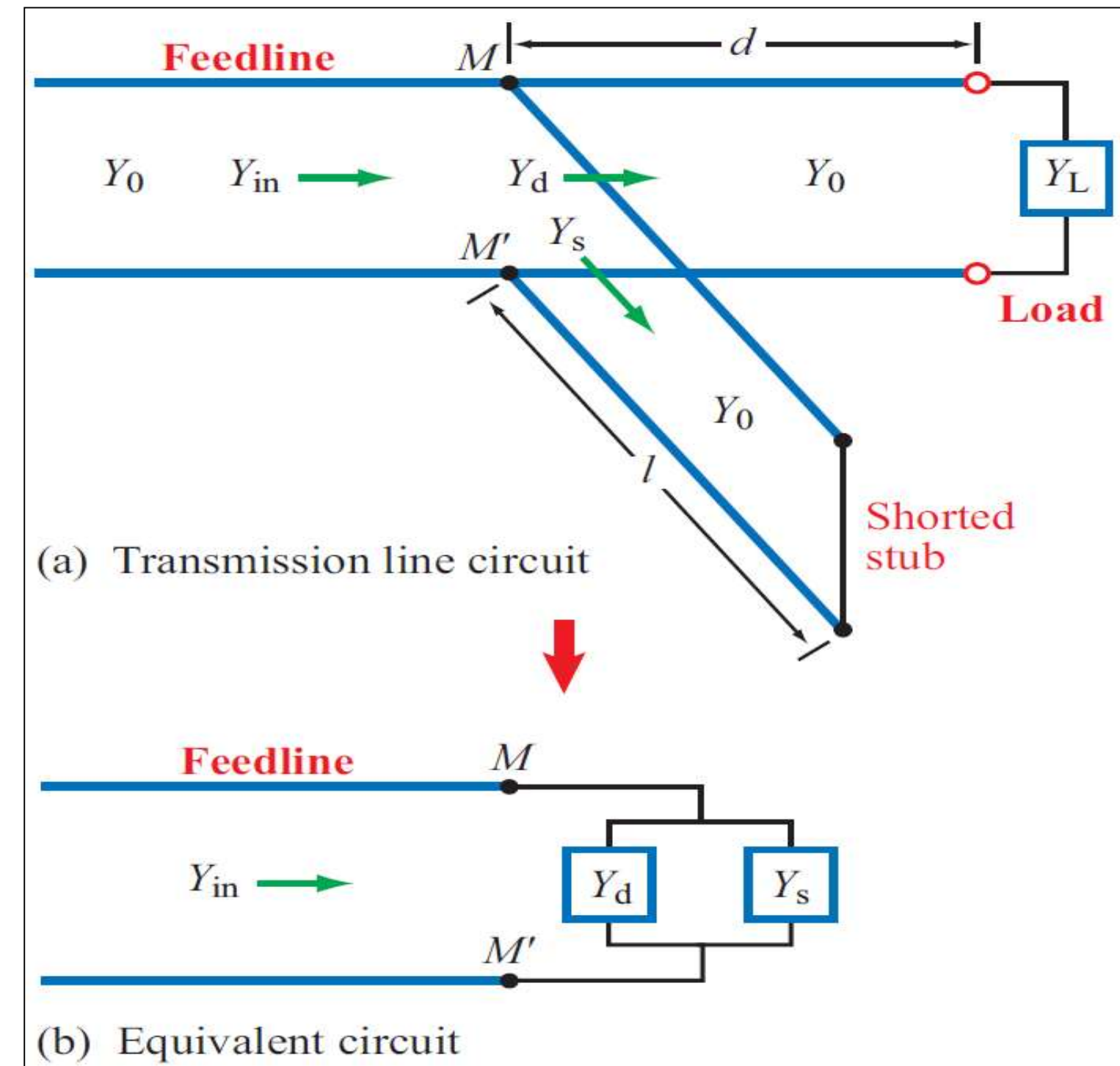
$$Y_S = G_0 \pm jB \mp jB = G_0$$
$$Z_S = R_0$$

- Thus the line from the source to the point is then terminated in R_0. It act as a smooth line

- **Design parameters**
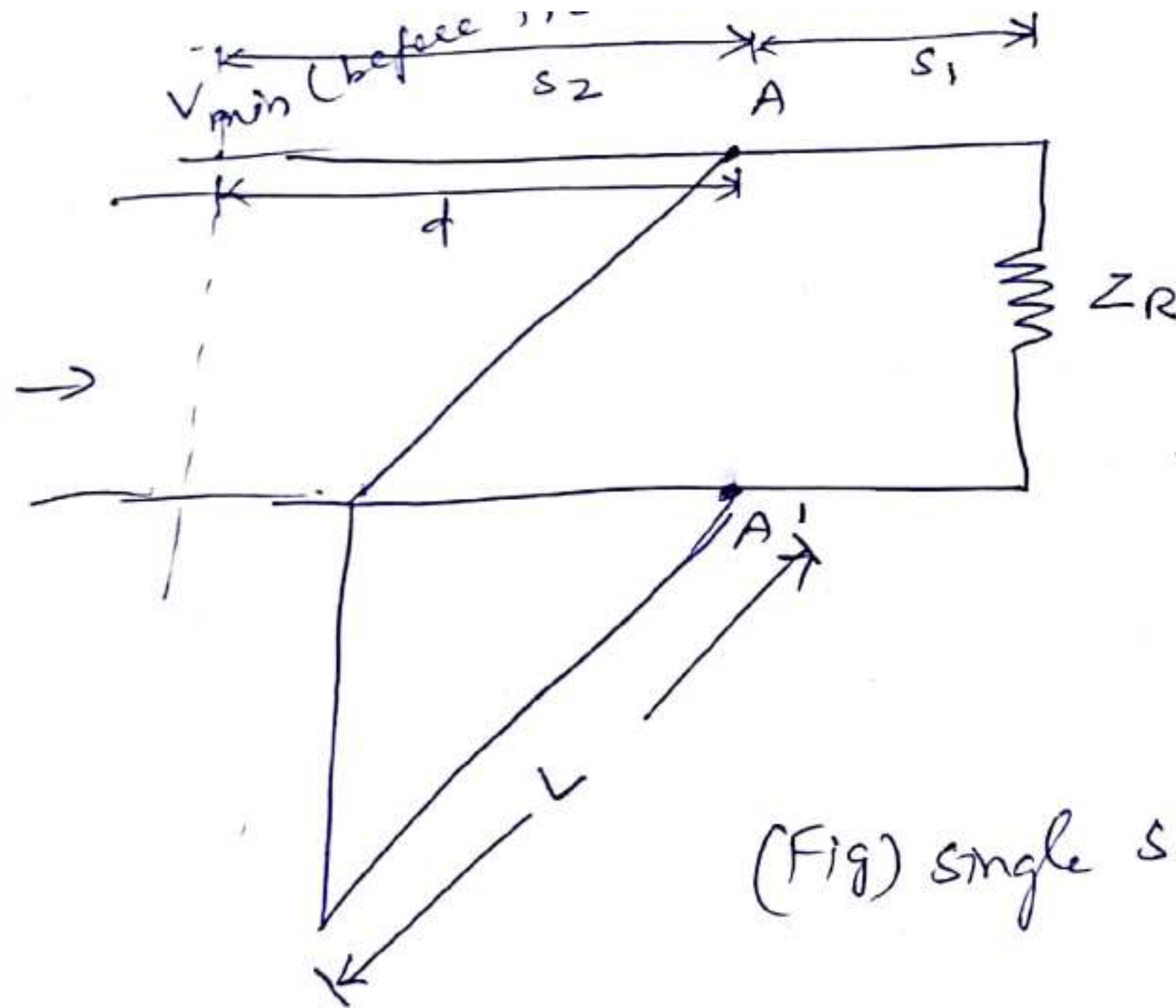 - The point of stub connection
  - Length of the stub

(a) Transmission line circuit

(b) Equivalent circuit

SINGLE STUB MATCHING - DIAGRAM

(Fig) single stub matching.

LENGTH OF THE STUB

$$L = \frac{\lambda}{2\pi} \tan^{-1}\left(\frac{\sqrt{1-|K|^2}}{2|K|} \right)$$

(or)

$$L = \frac{\lambda}{2\pi} \tan^{-1} \frac{\sqrt{S}}{S-1}$$

This is the length of the stub to be placed d meters towards the load from a point at which a Vmin existed before the attachment of the stub

DISTANCE OF THE STUB

$$d = \pm \frac{\cos^{-1}\left(\dfrac{s-1}{s+1}\right)\dfrac{\lambda}{4}}{\pi}$$

The stub should be connected at this distance from d measured from either direction from a Vmin nearest to the load

SINGLE STUB MATCHING - PROBLEM

A 75 Ohm lossless line is to be matched to a 100-j80 Ohms load with a shorted stub. Calculate the distance from the load, the stub length, and the necessary stub admittance.

Answer: Change z_L to admitance: Find d=distance to circle with real=1 as:

d=.4338- .3393=0.094l or

.0662-.1607 =0.094l (both yield same d)

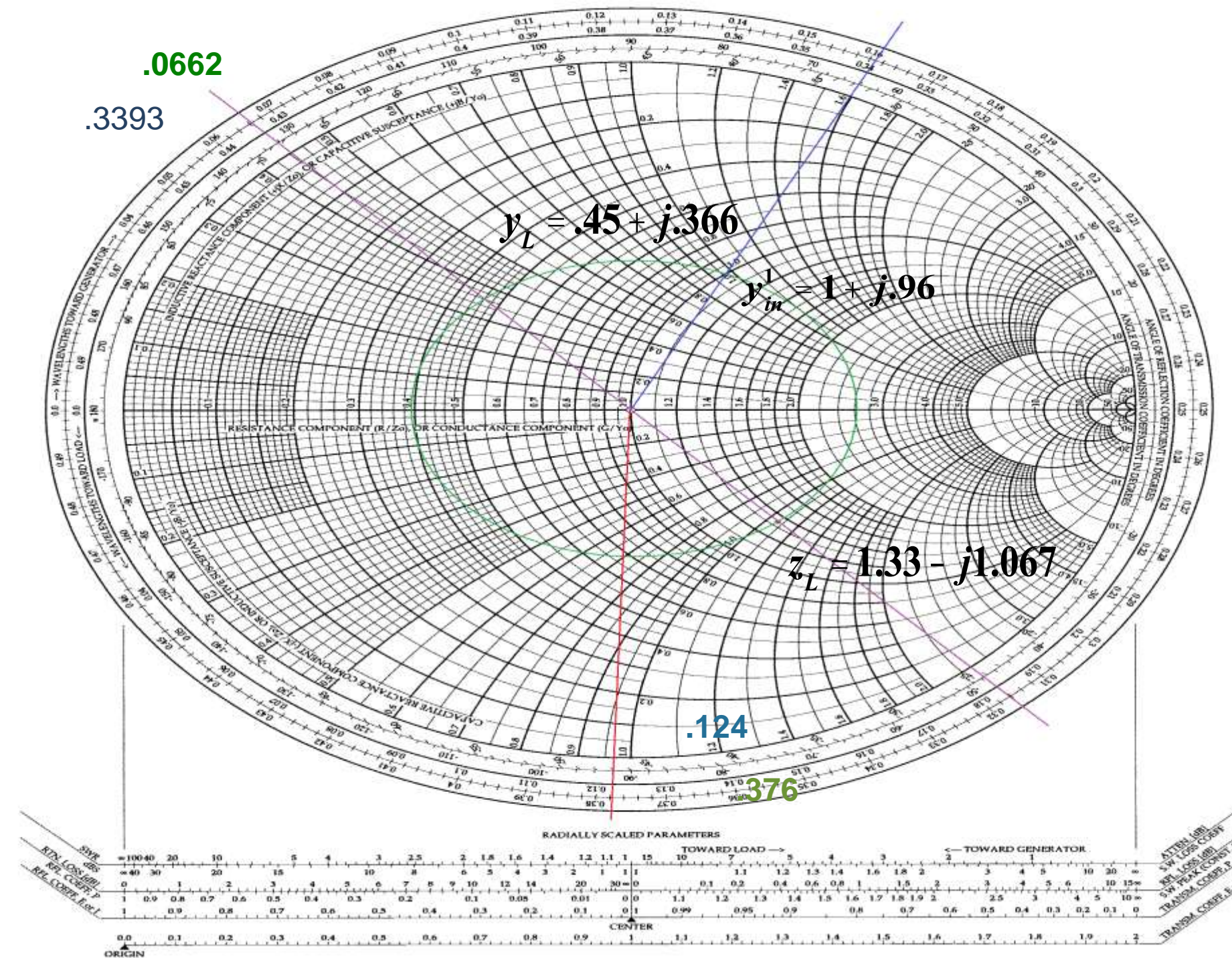[or next intersection i.e. 1-jb :d=0.272l,]

Short stub:.25l-.124l=0.126l

Or 0.376l-.25l= 0.126l (both yield same distance)

With y_{stub}= -j.96/75 *=-j.0128 mhos

SINGLE STUB MATCHING - STEPS

The Complete Smith Chart
Black Magic Design

.0662

.3393

$y_L = .45 + j.366$

$y_{in}^1 = 1 + j.96$

$z_L = 1.33 - j1.067$

.124

.376

RADIALLY SCALED PARAMETERS

A load impedance ZL= 25-j50 Ohms is connected to a 50 Ohm transmission line. Insert a shunt element to eliminate reflections towards the sending end of the line. Insert a shunt element to eliminate reflections towards the sending end of the line.

Specify the insert location d (in wavelengths), the type of element, and its value, given that f =100 MHz

ADVANTAGES OF SHORT CIRCUITED STUB OVER OPEN CIRCUITED STUB

- The length of short circuited stub can be easily changed but it is not easy in an open circuited stub
- Because of the shorting plate at the end mechanical rigidity of a short circuited stub is better than an open circuited stub
- The open circuit in the open circuited stubs do not behave like a true open circuit
- Poses fabrication problem

1. What is the purpose of matching networks?
2. Differentiate single and double stub matching.
3. What are the specific conditions to achieve matched condition at load?
4. Why short circuited stubs are preferred over open circuited stubs in stub matching?

THANK YOU