B. ETCE 4TH YEAR 1ST SEMESTER EXAMINATION, 2018

MICROWAVE ENGINEERING

Time: 3 Hours **Full Marks: 100**

Use separate Answer - Script for each Part

50 marks for each part

B) A three port circulator has an insertion loss of 1 dB, isolation 30 dB and VSWR 1.5. Find the S-matrix.

[8]

C) Find the resonant frequencies of the five lowest modes of an air-filled cylindrical cavity of radius 1.905 cm and length 2.54 cm. list them in assending order.

[5]

D) Determine the length of a cavity which will resonate at 10 GHz. The cavity is made from WG 16 of the shortest length, calculate Q-factor.

[3+4]

4. A) What do you meant by waveguide discontinuity? How this discontinuity related with the change of height and width of waveguide?

[2+5]

B) Give the equivalent transmission line representation for TE mode.

[5]

C) Briefly explain the function of waveguide bends and twists.

[5]

E) Mention the areas of application of Magic-T.

[4]

F) Give the impedance versus frequency curve of a parallel resonant RLC circuit and define bandwidth.

[4]

Ref. No.: Ex/ET/T/414/2018

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FOURTH YEAR,
FIRST SEMESTER EXAM 2018

MICROWAVE ENGINEERING

Time (Full Paper): Three hours | Full Marks of (Part II): 50

Use separate answer scripts for each half.

PART II

Answer **Q.1** and ***any two*** questions from the rest. Use separate Smith charts for individual questions if required.

1. a) Explain TDR. What type of measurements can be carried out using TDR? [3+2]
   b) Discuss on different microwave power detectors and compare their performances along with suitable applications. [5]
   c) Explain high VSWR (>10) measurement technique. [4]

2. a) "Another limitation in application of conventional tubes at microwave frequencies is the electron transit angle between electrodes." - explain. Explain other limitations using proper arguments. [3+6]

   b) With examples explain "Reentrant Cavities". Draw a neat diagram of a coaxial cavity and find its resonant frequency. [3+6]

3. a) Draw a neat diagram of two cavity klystron amplifier. Explain velocity modulation and derive the equation for velocity modulation. Explain beam coupling coefficient and depth of modulation. [10]

   b) A two cavity klystron has Vo = 1000V. Find the electron velocity leaving the cathode. If the beam coupling coefficient is 0.95 then find the gap transit angle. You may state all assumptions required to obtain a solution. [8]

4. a) Why high frequency transistors are characterized by S-parameters? Why cannot S_{12} for a transistor be equal to S_{21}? [3+3]

   b) How will you represent a BJT amplifier as two port network? Draw a two-port transistor amplifier network with general source and load impedances and define source, load, input and output reflection coefficients (Γ_S, Γ_L, Γ_{in} and Γ_{out}). Calculate the power gain, available gain, the transducer power gain, and the unilateral transducer power gain of this amplifier in terms of transistor S-parameters and different reflection coefficients. [12]

5. a) Why do you need to test the stability of an amplifier? What are the differences between conditional and unconditional stability? Derive the equations for stability circles. [2+2+8]

   b) An amplifier uses a transistor with the following s-parameters at 2 GHz (Z_0 = 50 Ohm):

$S_{11} = 0.894\angle -60.6°$, $S_{21} = 3.122\angle 123.6°$, $S_{12} = 0.02\angle 62.4°$, $S_{22} = 0.781\angle -27.6°$. Determine its stability and plot stability circle on smith chart. Explain your plots. [6]

6. Write short notes on (Any three): [3 x 6 = 18]
   a) Microwave power measurement techniques
   b) Spectrum Analyzer
   c) Reflex klystron
   d) PIN diode based microwave switches