B. ETCE 4TH YEAR 1ST SEMESTER EXAMINATION, 2019

MICROWAVE ENGINEERING

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

Use separate Answer - Script for each Part

50 marks for each part

PART - I

Answer any **Five (5)** Questions from the followings: 10×5

1. Define the scattering matrix in terms of incident and reflected power. How a scattering matrix is related with impedance matrix? Proof that it is impossible to match a three port loss less microwave junction perfectly.
2. Discuss the construction and working of a magic- tee. Derive the scattering matrix for this junction. Mention the areas of application of magic tee.
3. Define the parameters which are related with the performance of a directional coupler. Obtain scattering matrix of a four port directional coupler.
4. How a magic–tee is used in a four port circulator. Write down the scattering matrix of a four port circulator.
5. What do you meant by Ferrites? Write down the some properties of Ferrites. Explain the operation of Faraday Rotation Isolator and give its application.
6. Define cavity resonator? What are their most desirable properties? A resonant cavity with dimensions w = 6 cm, l = 4 cm, and d = 9 cm is made of copper $\sigma_c = 5.8\times10^7$ mhos/m. It is filled with a lossless material μ_r =1 and ε_r =1.0. Find the resonant frequency f_r and the *quality factor* for TE_{101} mode.
7. What is the function of resonant Iris? Mention the advantages for the same? Draw the equivalent circuit of resonant Iris. How the resonant frequency is determined?.
8. Discuss the construction and working of a hybrid rings (Rare-Race circuit). Derive the scattering matrix for the same. Mention the areas of application for this microwave junction.
9. Write short notes (any two from the followings): 2×5
   a. Wave guide bend and twists
   b. Phase shifter
   c. Inductive and capacitive posts
   d. Equivalent transmission line circuit for TM and TE waves

[Turn over

Ref. No.: Ex/ET/T/414/2019

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FOURTH YEAR,
FIRST SEMESTER EXAM 2019

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.

1. Answer any two: [5x2=10]
   a) How will you measure frequency of microwave oscillator using slotted waveguide?

   b) Discuss on different microwave power detectors and compare their performances along with suitable applications.

   c) Using block diagram explain medium power measurement technique.

   d) Draw a neat diagram of a coaxial cavity and find its resonant frequency.

2. a) Explain the bunching process in a reflex klystron. Using curves explain its power output and frequency characteristics. [5+5]

   b) A two-cavity amplifier klystron has the following parameters:
   Beam Voltage: $V_o = 900$ V
   Beam Current: $I_o = 30$ mA
   Frequency: $f = 8$ GHz
   Gap spacing in either cavity: $d = 1$ mm
   Spacing between centers of cavities: $L = 4$ cm
   Effective shunt impedance: $R_{sh} = 40$ k Ohm

   Find:
   i) the electron velocity,
   ii) the dc electron transit time,
   iii) the input voltage for maximum output voltage and
   iv) the voltage gain (in dB). [10]

3. a) Write the differences between power gain G, available gain G_A, transducer power gain G_T and unilateral transducer power gain G_{TU}. [4]

   b) Explain the stability of an amplifier. What do you understand by conditional and unconditional stability? Show that the stability of a network is frequency dependent. Derive the equations for output stability circles. Draw and explain output stability circles for conditionally stable devices. [16]

4. An amplifier uses a transistor with the following s-parameters ($Z_0 = 50$ Ohm) : $S_{11} = 0.61\angle -170°$, $S_{21} = 2.3\angle 80°$, $S_{12} = 0.06\angle 70°$, $S_{22} = 0.72\angle -25°$. The input of the transistor is connected to a source with $V_s = 2V$ (peak) and $Z_s = 25$ Ohm, and the output of the transistor is connected to a load of $Z_L = 100$ Ohm.

   Calculate:
   a) The power gain, available gain, the transducer power gain, and the unilateral transducer power gain.
   b) The available power from the source and the power delivered to the load.

   Explain:
   c) How can the power gain and available gain be different.
   d) How can the available power from the source and the power delivered to the load be different. [10+6+2+2=20]

5. Write short notes on: [4x5 = 20]
   a) S-parameter measurement techniques
   b) Spectrum Analyzer
   c) Reentrant cavity
   d) Magnetron