Ref No. Ex/ ET/PC/B/T/412/2025

B. ETCE 4TH YEAR 1ST SEMESTER EXAMINATION, 2025

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. Explain why the measurement of *Z*, *Y*, and *h* parameters are not suitable at microwave frequencies? Define the scattering matrix for a two port network. Draw the signal flow graph for a three port network.

   3+3+4

2. Discuss the construction and working of H plane- tee. Proof that if two input waves are fed into port 1 and port 2 of the collinear arm the output wave at port 3 will be in phase and additive for H plane tee.

   5+5

3. Discuss the working principle of 4- port directional coupler with suitable circuit diagram. How we can measure the directivity and coupling factor of a four port directional coupler? Write down the scattering matrix of a four port loss less symmetrical directional coupler.

   4+4+2

4. Discuss the construction and working of a four port circulator using two magic tees and a phase shifter. Write down the scattering matrix of a four port circulator.

   7+3

5. What are Ferrites? What properties do they have? Consider an infinite lossless ferrite medium with a static magnetic field is applied along *Z* direction. Let a plane of TEM wave that is linearly polarized along *X* axis at $Z = 0$ be propagating in the *Z* direction. Proof that the plane of polarization of this wave is rotated as it propagates through the ferrite medium.

   2+2+6

6. Describe how a waveguide cavity resonator is constructed? Mention the areas of application for waveguide cavity resonator. Derive the expression for resonant frequency of a rectangular waveguide cavity resonator for TE mode.

   3+2+5

7. Discuss the construction and working of a hybrid rings (Rare-Race circuit). Mention the areas of application for this microwave junction. Derive the scattering matrix for the same.

   4+2+4

8. How the effect of discontinuity on the propagating dominant mode is determined? Describe the construction and working of three symmetrical inductive discontinuities.

   3+7

9. Write short notes (any two from the followings): 2×5
   a. Reciprocal phase shifter
   b. Inductive and capacitive posts
   c. Wave guide bend
   d. Wave guide bend and twists

[Turn over

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B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING FOURTH YEAR FIRST SEMESTER - 2025

MICROWAVE ENGINEERING

Time (Full Paper): Three hours Full Marks : 100

Use separate answer scripts for each half.

PART II (50 Marks)

Answer **Q.1** and ***any three*** questions from the rest.

1. a) How will you measure gain of an antenna? [5]

   b) Draw single pole PIN diode switch with shunt configuration and explain it. [5]

   c) Explain double minimum method for VSWR measurement. [5]

   d) Draw and explain the biasing/decoupling circuit for radio frequency NPN BJT. [5]

2. Draw a neat diagram of two cavity klystron amplifier and explain its operation. [10]

3. Derive the equations for output stability circles. Draw and explain output stability circles for conditionally stable devices. [6+4]

4. A two-cavity amplifier klystron has the following parameters:
   Beam Voltage: $V_0 = 900$ V
   Beam Current: $I_0 = 30$ 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: the electron velocity, the dc electron transit time, the input voltage for maximum output voltage and the voltage gain (in dB). [10]

5. The BFP640F transistor has the following scattering parameters at 1.0 GHz ($Z_0 = 50$ Ohm): $S_{11} = 0.91\angle -44^\circ$, $S_{12} = 0.06\angle 68^\circ$, $S_{21} = 3.92\angle 149^\circ$, and $S_{22} = 0.93\angle -17^\circ$. For the transistor with no matching networks compute the power gain, available power gain, and transducer gain for $Z_S = Z_L = 50$ Ohm. [10]

6. Write short notes on: [2x5]
   a) GUNN diode and its use in microwave generation
   b) Reflex klystron