Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Seventh Semester B.Tech Degree Supplementary Examination August 2021

Course Code: EC403
Course Name: MICROWAVE & RADAR ENGINEERING

Max. Marks: 100   Duration: 3 Hours

PART A
Answer any two full questions, each carries 15 marks.   Marks

1 a) Explain the significance of re-entrant cavities in microwave tubes. What are the different types commonly used re-entrant cavities?   (4)

   b) Determine the length (d) of an air-filled rectangular cavity operating in TE_{101} mode with resonant frequency fr = 20 GHz. The height b = 2 cm and width a = 1 cm   (3)

   c) With the help of Applegate diagram describe the operation of a reflex klystron oscillator.   (8)

2 a) With the diagram of a two cavity Klystron amplifier deduce the expression for optimum distance at which the bunching occurs.   (8)

   b) A pulsed cylindrical magnetron is operated with the following parameters: (7)
      Anode voltage: V_o = 25 kV, Beam current: I_o = 25 A, Magnetic flux density: B_o = 0.34 Wb/m^2, Radius of cathode cylinder: a = 5 cm, Radius of anode cylinder: b = 10 cm

      Compute:

      a. The cyclotron angular frequency

      b. The cut-off voltage for a fixed B_o

      c. The cut-off magnetic flux density for a fixed V_o

3 a) Explain with figure the power output and frequency characteristics of reflex klystron.   (7)

   b) 2-cavity klystron operates at 4 GHz with V0 = 1 kV, I_0 = 22 mA, d = 1mm, L = 3 cm. If the dc beam conductance and catcher cavity total equivalent conductance are 0.25 x 10^{-4} mhos and 0.3x 10^{-4} mhos respectively.   (8)

      Find out

          (a) Beam coupling coefficient

(b) Dc transit angle in the drift space

(c) Input cavity voltage V_1 for max V_2

(d) Voltage gain and efficiency (neglecting beam loading)

PART B
Answer any two full questions, each carries 15 marks.

4 a) Explain the different techniques used for measuring frequency at microwave range. (8)

   b) Discuss the constructional features of magic tees and derive its S Matrix (7)

5 a) With neat diagram describe the constructional features and working principle of a Travelling Wave Tube (TWT) (7)

   b) With a schematic diagram describe the operation of a four-port circulator. Obtain the simplified S matrix of a perfectly matched, lossless four port circulator. (8)

6 a) Explain the wave modes of Helix TWT. Prove that there are four waves existing in a TWT (8)

   b) Explain the operation of hybrid rings. Derive its S matrix. How it differs from magic tee? (7)

PART C
Answer any two full questions, each carries 20 marks.

7 a) With necessary figures explain the physical structures of microwave bipolar junction transistors. (10)

   b) Draw the block diagram of non-coherent MTI radar and explain the function of each block in detail. (10)

8 a) Explain the tunnel diode characteristics with aid of energy band diagram. (10)

   b) Explain the basic principles of radar system. Derive the Radar range equation. Explain the factors that affects the maximum range of a radar. (10)

9 a) Explain Ridley–Watkins–Hilsum theory with the help of two valley model. (10)

   b) Explain FM-CW Radar using sideband super heterodyne receiver. (10)

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