

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 $f_r = 20$ 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/m², 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 $V_0 = 1$ kV, $I_0 = 22$ mA, $d = 1$ mm, $L = 3$ cm. If the dc beam conductance and catcher cavity total equivalent conductance are 0.25×10^{-4} mhos and 0.3×10^{-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)
