

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
Seventh semester B.Tech degree examinations (S), September 2020

**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) What are re-entrant cavities? Show that they support infinite number of resonant frequencies. (7)
- b) Derive power output and efficiency of a reflex klystron. (8)
- 2 a) A reflex klystron operates under the following conditions: (8)
- $V_0 = 600\text{V}$ ,  $R_{sh} = 15\text{K}\Omega$ ,  $f_r = 9\text{GHz}$ ,  $L = 1\text{mm}$ ,  $e/m = 1.759 \times 10^{11}$  (MKS system)
- The tube is oscillating at  $f_r$  at the peak of the  $n = 2$  or  $1\frac{3}{4}$  mode. Assume that the transit time through the gap and beam loading to be neglected. Determine:-
1. The value of the repeller voltage  $V_r$ .
  2. The direct current necessary to give a microwave gap voltage of 200 V.
  3. The electronic efficiency under this condition.
- b) Derive an expression for velocity modulation in two cavity Klystron with the help of a neat diagram. (7)
- 3 a) A two cavity klystron amplifier has the following parameters: (8)
- $V_0 = 700\text{V}$   $R_o = 100\text{k}\Omega$   $I_o = 30\text{mA}$   $f = 3\text{GHz}$
- Gap spacing in either cavity  $d = 1\text{mm}$ , spacing between the two cavities  $L = 5\text{cm}$  and shunt impedance  $R_{sh} = 30\text{k}\Omega$ .
- Determine:
1. Input gap voltage to give maximum voltage  $V_2$
  2. Voltage gain, neglecting the beam loading in the output cavity
  3. Efficiency of the amplifier, neglecting beam loading.
  4. Beam loading conductance and show that it can be neglected.
- b) With the help of neat sketches and sufficient equations explain the working of a cylindrical magnetron. (7)

**PART B**

*Answer any two full questions, each carries 15 marks.*

- 4 a) Show that the axial electric field of TWT varies with convection current (8)  
b) Explain the constructional features of two hole directional coupler and derive S matrix (7)
- 5 a) Explain the different methods used for measuring microwave frequency. (7)  
b) Explain how isolators can support only forward direction waves. (8)
- 6 a) What is the significance of slow wave structures used in microwave circuits? (8)  
Explain different slow wave structures with neat sketches.  
b) With a schematic describe the operation of a four port circulator. Obtain the simplified S matrix of a perfectly matched, lossless four port circulator. (7)

**PART C**

*Answer any two full questions, each carries 20 marks.*

- 7 a) Explain with block diagram an FM-CW Radar using sideband super heterodyne receiver (10)  
b) Draw the J-E characteristics of Gunn diode and explain its operation. (10)
- 8 a) What are the main assumptions made in power frequency limitations? (10)  
Explain the power frequency limitations of a microwave transistor.  
b) What are low noise front ends? Describe in detail the utility of low noise front ends. (10)
- 9 a) Explain with block diagram the working of MTI Radar with power amplifier and power oscillator (10)  
b) Draw the energy band diagrams of tunnel diode. Explain the operation of tunnel diode with the help of I-V characteristics. (10)

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