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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019
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) Derive the resonant frequency of a rectangular cavity resonator. (4)

   b) Determine the resonant frequency of an air filled rectangular cavity operating in the dominant mode with dimensions as a=4cm, b=5cm and d=6cm. (3)

   c) Assuming pi mode of oscillations explain how a magnetron can sustain its oscillations using the cross field. (8)

2 a) With the help of Applegate diagram describe the bunching process in a two cavity klystron amplifier and derive the bunching parameter. (8)

   b) A reflex klystron operates under the following conditions: (7)

     V_o=500V, R_{sh} =10KΩ, f_r= 8 GHz, L =1 mm, e/m = 1.759 x 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 Vr.
       2. The direct current necessary to give a microwave gap voltage of 200 V.
       3. The electronic efficiency under this condition.

3 a) Explain the electronic admittance of the gap in the case of reflex klystron. With admittance diagram explain the condition required for oscillation in a reflex Klystron. (7)

   b) Given the parameters of a two cavity klystron amplifier: (8)

       Beam Voltage = 1000V,

       Beam current = 50mA,

       Operating frequency = 10GHz

       Gap spacing=1mm,

       Spacing between two cavities = 5cm,

       Ro= 40KΩ, Rs = 30KΩ

   Determine:

       1. Input signal to generate maximum output voltage.
       2. Voltage gain.
       3. Efficiency.

PART B

Answer any two full questions, each carries 15 marks.

4 a) With neat diagrams explain any two methods to measure impedance at microwave frequencies. (8)

   b) Explain with figure a two hole directional coupler and derive its S matrix. (7)

5 a) With neat diagram explain the operation of a travelling wave tube. (7)

   b) Discuss the constructional features of magic tees and derive its S Matrix. Why are they called so? (8)

6 a) Derive the expression of axial electric field of Helix TWT. (8)

   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) What is tunnelling? Explain the operation of a tunnel diode with aid of energy band diagram. (10)

   b) Derive Radar range equation. (5)

   c) A simple MTI delay line canceller is an example of time domain filter. Explain Why? (5)

8 a) Discuss the various limitations of microwave transistors. (10)

   b) Explain the more commonly used radar displays. (5)

   c) Explain how the noise figure of a radar receiver is monitored. (5)

9 a) Explain with neat diagram, the working of CW radar with non zero IF. (10)

   b) Explain with the help of figures different modes of operation of Gunn diodes. (10)

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