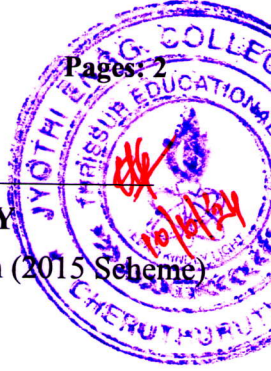Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
B.Tech Degree S7 (S, FE) May 2024/ S5 (PT) (S,FE) June 2024 Examination (2015 Scheme)

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 of re-entrant cavities?   (5)

     b)   What is velocity modulation? Explain how velocity modulation is utilized in klystron amplifier. Derive the expression for power output and efficiency.   (10)

2   a)   A cavity resonator with dimensions a= 2cm, b= 1cm is excited TE101 mode of 20 GHz. Calculate the length of the cavity.   (5)

     b)   Given the parameters of a two cavity klystron amplifier.   (10)

        Beam Voltage = 1000V, Beam current = 50 mA

        Operating frequency = 10 GHz, Gap spacing = 1 mm

        Spacing between two cavities = 5 cm, Ro = 40 KΩ, Rs = 30 KΩ

        Determine

        1. Input signal to generate maximum output voltage

        2. Voltage gain

        3. Efficiency

3   a)   Draw the structure of 8 cavity magnetron and explain its bunching process.   (10)

     b)   Illustrate that the coaxial re-entrant cavities can support infinite number of resonant frequencies.   (5)

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

4   a)   Define s-matrix and its properties?   (5)

     b)   What are slow wave structures? Explain how a helical TWT achieve amplification.   (10)

5   a)   Using the properties of scattering matrix of a lossless, reciprocal microwave junction, prove that for a four port network if all the four ports are matched, the device shall be a directional coupler.   (6)

b) Explain how impedances are measured using slotted line and reflectometer. (9)

6 a) With the help of a neat sketch explain the working of a Magic Tee and also derive (8)
its S matrix.

b) Explain how isolators can support only forward direction waves. (7)

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

7 a) What is transferred electron effect? (5)

b) Explain the tunnel diode characteristics with the aid of energy band diagram (10)

c) Derive the Radar range equation. (5)

8 a) Draw and explain block diagram of MTI radar system. (8)

b) What is blind speed of MTI radar? Obtain the expression for blind speed. (6)

c) Show that how the tunnel diode can be utilized as bistable, astable, monostable (6)
circuits.

9 a) A typical n-type GaAs Gunn diode has the following parameters. Threshold field (10)
Eth=2800V/cm, Applied field E=3200V/cm, Device Length L=10μm, Doping
concentration no=2x10^{14}cm-3
, operating frequency f=10GHz.

a) Compute electron drift velocity.

b) Calculate current density

c) Estimate negative electron mobility

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

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