

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), May 2019

B. Tech. in Electronics & Communication Engineering, Semester VI

Roll No.....

ECE509: Microwave Engineering

Time: 3 hours

Max. Marks: 40

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Use of Programmable Calculator is not allowed.

Q.1A A typical n type GaAs Gunn Diode has the following parameters:

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Threshold Field $E_{th} = 2800$ V/cm

Applied Field $E = 3000$ V/cm

Device Length $L = 12 \mu m$

Doping Concentration $n_0 = 3 \times 10^{14} \text{ cm}^{-3}$

Operating Frequency $f = 11$ GHz

- a) Compute the Electron Drift Velocity.
- b) Calculate the current density.
- c) Estimate the negative electron mobility.

Q.1B Design a microwave component which can allow to transmit the wave only in one direction. Also explain the construction, working and S matrix for the component.

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Q.2A Draw the Block diagram of Microwave oven used for domestic purpose. Also explain the technical specification, working to cook food and operating safety measures.

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Q.2B A reflex klystron operates under the following conditions:

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$V_0 = 700$ V, $R_{sh} = 18k \text{ ohm}$, $f_r = 10$ GHz, $L = 1$ mm, $e/m = 1.759 \times 10^{11}$ (MKS system)

The tube is oscillating at f_r at the peak of the $n = 2$ mode or $1 \frac{3}{4}$ mode. Assume that the transit time through the gap and beam loading can be neglected.

- a) Find the value of the repeller voltage V_r .
- b) Find the direct current necessary to give a microwave gap voltage of 200 V.
- c) What is the electronic efficiency under this condition?

Q.3A An X-band pulsed cylindrical magnetron has the following operating parameters:

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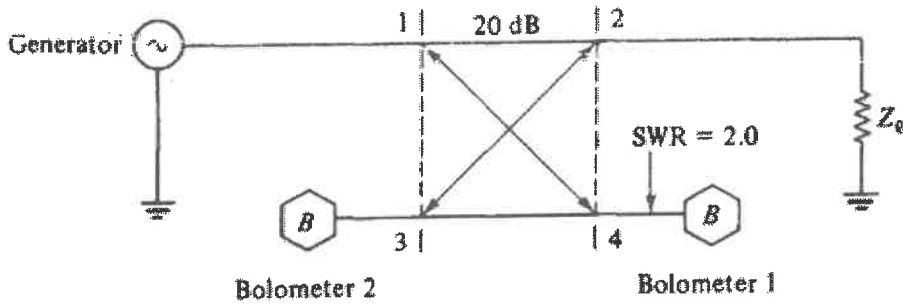
Anode voltage: $V_0 = 26$ kV Beam current: $I_0 = 27$ Amp, Magnetic flux density: $B_0 = 0.336$ Wb/m² Radius of cathode cylinder: $a = 5$ cm Radius of vane edge to center: $b = 10$ cm

Compute:

- The cyclotron angular frequency.
- The cutoff voltage for a fixed B_0 .
- The cutoff magnetic flux density for a fixed V_0 .

Q.3B

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A symmetric directional coupler with infinite directivity and a forward attenuation of 20 dB is used to monitor the power delivered to a load Z_L (see Fig.) Bolometer 1 introduces a VSWR of 2.0 on arm 4; bolometer 2 is matched to arm 3. If bolometer 1 reads 8 mW and bolometer 2 reads 2 mW, find:

- the amount of power dissipated in the load Z_L .
- the VSWR on arm 2.