



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION (SUPPLEMENTARY)FOR:

DIPLOMA IN TECHNOLOGY IN TELECOMMUNICATION AND INFORMATION ENGINEERING

ETI 2305: MICROWAVE DEVICES AND COMPONENTS.

END OF SEMESTER EXAMINATION

SERIES: NOVEMBER, 2024

TIME: 2 HOURS

DATE: NOVEMBER, 2024

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt any THREE out the FIVE questions.

Do not write on the question paper.

Question ONE

(a) Consider a two-cavity klystron. With a suitable diagram explain its principle of operation.

[10 marks]

(b) A travelling wave tube operates under the following parameters:

Beam voltage $V_0 = 2 \text{ kV}$

Beam current $I_0 = 4 \text{ mA}$.

Circuit length $N = 50$

Characteristic impedance of helix, $Z_0 = 20 \Omega$

Calculate:

(i) Gain parameter

(ii) Output power gain.

[6 marks]

(c) State FOUR characteristic of S- matrix.

[4 marks]

Question TWO

- (a) (a) State at least THREE losses in micro-stripe lines. [3 marks]
- (b) Discuss FOUR factors that are considered in selecting the type of couplers to use. [9 marks]
- (c) Microwave transistor has the following S-parameters at 10 GHz with 50Ω reference impedance:

$$S_{11} = 0.33 - j0.16$$

$$S_{12} = S_{21} = 0.56$$

$$S_{22} = 0.44 - j0.62$$

The source impedance $Z_s = 2Z_0$ and load impedance $Z_L = 30\Omega$. Determine

- (i) Reflection coefficient at source
- (ii) Reflection coefficient at load
- (iii) Reflection coefficient looking at the input
- (iv) Reflection coefficient looking at the output. [8 marks]

Question THREE

- (a) A symmetric π -attenuator pad has a series arm of resistance 1000Ω and shunt arms of each of 500Ω . Determine:
- (i) Its characteristic impedance
 - (ii) The insertion loss (in decibels) when feeding a matched load. (15 marks)
- (b) Briefly explain microwave linear operation and state THREE examples of such tubes. [5 marks]

Question FOUR

- (a) Differentiate between spontaneous and stimulated emission. [4 marks]
- (b) (i) Discuss the operation of ruby laser
- (ii) State its application [10 marks]
- (c) (i) Calculate the SWR of a transmission system operating at 5 GHz, when the distance between the twice-minimum power points is 1.1 mm on a slotted line whose velocity factor is unity.
- (ii) The measured turn loss for a load is 18.2 dB. Calculate the SWR in the system with the load connected. [6 marks]

Question FIVE

- (a) (i) Describe a varactor multiplier
- (ii) With the aid of I-V characteristics explain its principle of operation. [8 marks]
- (b) (i) Discuss the concept of microwave power and the basic methods of measuring.
- (ii) State the reasons why these methods are divided on the basis of the power level. [10 marks]
- (c) A magnetron produces 0.5μ sec pulses with a PRF of 4000. If the power measured with a thermistor is 2.5 W, calculate the magnetron's peak power output. [2 marks]

