TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY IN TELECOMMUNICATION AND INFORMATION ENGINEERING

ETI 2305: MICROWAVE DEVICES AND COMPONENTS.

END OF SEMESTER EXAMINATION

SERIES: AUGUST, 2019

TIME: 2 HOURS

DATE: AUGUST, 2019

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 of the FIVE questions.

Do not write on the question paper.

Question ONE

(a) With a aid of a well labeled diagram, describe the microwave systems. **[5 marks]**

(b) With a suitable diagram describe its mode of operation of a two-cavity klystron

(c) The parameters of a two-cavity amplifier klystron are as follows:

Beam voltage	V_o=1200 V
Beam current	I_O= 28 mA.
Frequency	f= 8 GHz
Gap spacing in either cavity	d=1mm
Spacing between the two cavities	L= 4 cm
Effective shunt resistance :	R_{sh}=40 kΩ (excluding beam resistance).

(i) Electron velocity just leaving the cathode
(ii) Gap transit angle
(iii) Beam coupling efficiency
(iv) DC transit angle between cavities
(v) Maximum input voltage
(vi) Voltage gain
(vii) Efficiency of the amplifier **[15 marks]**

Question TWO

(a) State at least THREE losses in micro-stripe lines. **[3 marks]**

(b) A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a relative dielectric constant ε_{rd} of 6 (beryllia or beryllium oxide BeO) and a thickness d of 4mm.

Calculate:

(i) The required width w of the conducting strip in order to have a characteristic impedance of 50Ω.
(ii) The strip line capacitance
(iii) The strip line inductance
(iv) The phase velocity of the wave in the parallel strip line. **[9 marks]**

(c) (i) With the aid of a schematic diagram describe hybrid ring.

(ii) State its application. **[8 marks]**

Question THRE

(a) (i) Describe maser

(ii) Describe Ruby maser with the aid of energy band diagrams

(iii) State its application **(12 marks)**

(b) (i) Describe attenuation

(ii) Describe how attenuation can be measured by the power ratio method

(iii) State the limitation of this method. **(4 marks)**

(c) Calculate the SWR of a transmission system operating at 5 GHz, when the distance between the twice minimum power points is 1.1mm on a slotted line whose velocity factor is unity. **[4 marks]**

Question FOUR

(a) With the aid of a sketch describe principle of operation of a magnetron**.** **[7.5 marks]**

(b) An X-band pulsed cylindrical magnetron has the following operating parameters:

Anode voltage V_O= 26 kV.
Beam current I_O= 27 A
Magnetic flux density B_O= 0.336 Wb/m^2
Radius of cathode cylinder a= 5cm
Radius of vane edge to centre b=10 cm

Compute:

(i) The cyclotron angular frequency
(ii) The cut-off voltage for a fixed B_O
(iii) The cut-off magnetic flux density for a fixed V_O **[6.5 marks]**

(c) A certain transmission line has a characteristic impedance of 75+j0.01Ω and is terminated in a load impedance of 70+j50Ω. Calculate:

(i) The reflection coefficient
(ii) The transmission coefficient **[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 operation of ruby laser

(i) State its application. **[10 marks]**

(c) State THREE major differences between TWT and klystron. **[2 marks]**