



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (TELECOMMUNICATION & INFORMATION
TECHNOLOGY)

SPH 314 MICROWAVE AND DEVICES

DATE: 12/11/2020

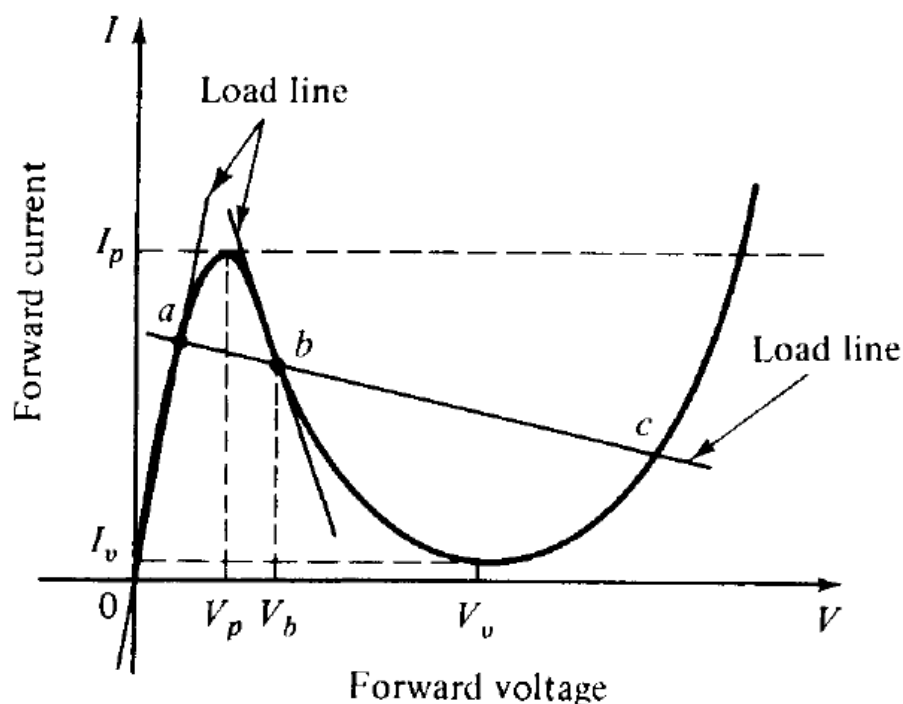
TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) With reference to the below IV characteristics, explain the operation of a tunnel diode at microwave frequencies (10 marks)



- a) Explain four basic parameters used to measure the performance of a directional coupler (4 marks)
- b) Using suitable illustration explain the Gunn Effect. (6 marks)
- c) A helix travelling wave tube operates at 4 GHz, under a beam voltage of 10 KV and beams current of 500mA. If the helix is 25Ω and interaction length is 20cm, find the gain parameter. (5 marks)
- d) Find the resonant frequency of TE₁₀₁ mode of an air-filled rectangular cavity of dimensions 5 cm * 4 cm * 2.5cm. (5 marks)

QUESTION TWO (20 MARKS)

- a) Explain 4 applications of reflex klystron (6 marks)
- b) A two cavity Klystron amplifier has the following parameters (14 marks)
 - $V_0 = 1000\text{V}$
 - $R_0 = 40\text{k}$
 - $I_0 = 25\text{mA}$
 - $F = 3\text{GHz}$
 - $D = 1\text{mm}$
 - $L = 4\text{cm}$
 - $R_{sh} = 30\text{k}$
 - i. Find the input gap voltage that gives the maximum voltage V_2
 - ii. Find the voltage gain, neglecting beam loading in the output cavity
 - iii. Find the efficiency of the amplifier, neglecting beam loading
 - iv. Calculate beam loading conductance and show that neglecting it was justified in the preceding calculations

QUESTION THREE (20 MARKS)

- a) Using suitable diagram explain the construction and operation of (10 marks)
 - i. H-Plane Tee
 - ii. E-Plane Tee
 - iii. Hybrid Tee
- b) An X-band pulsed conventional magnetron has the following operating parameters: (10 marks)

Determine

- i. The angular resonant frequency
- ii. The unloaded quality factor
- iii. The loaded quality factor
- iv. The external quality factor

QUESTION FOUR (20 MARKS)

- a) Draw the physical structure and doping profile of IMPATT diode oscillator and amplifier in detail. (8 marks)
- b) Give the comparison between gunn, IMPATT, TRAPATT and Baritt diode (12 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss impedance, wavelength and frequency measurement using slotted line method. (8 marks)
- b) Differentiate between Linear beam tubes (O-type and Crossed-field tubes (M-type) (4 marks)
- c) Use illustration to discuss the working principles of Parametric Amplifier and mention its application. (8 marks)