b. A typical n type GaAs Gunn diode has the following parameters. 12 3 2 4

Threshold field $E_{th} = 2800V/cm$
Applied field $E = 3200$ V/cm
Device Length $L = 10\mu m$
Doping concentration $\eta_0 = 2 \times 10^{14}$ cm^{-3}
Operating Frequency $f = 10$ GHz
Compute the electron drift velocity, current density and the negative electron mobility.

30. a. Describe the principle of operation of GaAs MESFET with neat schematic diagram. 12 4 3 1

(OR)

b. A certain GaAs MESFET has the following parameters. 12 3 3 4

$R_g = 3\Omega$, $R_i = 2.5\Omega$
$g_m = 50m\upsilon$, $R_d = 450\Omega$
$R_s = 2.5\Omega$, $C_{gs} = 0.60PF$
Determine the cutoff frequency and the maximum operating frequency

31. a. Illustrate the structure of HEMT and write the fabrication process with neat schematics. 12 4 4 1

(OR)

b. i. Interpret the equivalent circuit of HEMT. 6 3 4 4

ii. A HEMT has the following parameters. 6 3 4 4
Gate width $W = 150\mu m$
Electron velocity $v(z) = 2 \times 10^5$m/s
Two dimensional electron gas density $n(z) = 5.21 \times 10^{15}$ m^{-2}
Determine the drain current of HEMT.

32. a. Examine the thermal aspects of the RF circuit/package design. 12 3 5 1

(OR)

b. Evaluate the temperature differences encountered in the flow of heat within electronic systems. 12 4 5 4

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Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2023
Fourth and Seventh Semester

18ECE321T – RF AND MICROWAVE SEMICONDUCTOR DEVICES
(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours Max. Marks: 100

PART – A (20 × 1 = 20 Marks)
Answer **ALL** Questions

	Marks	BL	CO	PO
1. A PN junction (A) Conducts in reverse direction only (B) Has high resistance in forward as well as reverse directions (C) Conducts in forward direction only (D) Has low resistance in forward as well as reverse directions	1	1	1	1
2. Varactor diodes are used in FM receivers to obtain (A) Automatic noise control (B) Automatic gain control (C) Automatic volume control (D) Automatic frequency control	1	1	1	1
3. Diodes formed by joining a doped semi-conductor region with a metal such as gold or silver or platinum is (A) Schottky diode (B) Zener diode (C) PIN diode (D) Current regulator diode	1	1	1	1
4. The PIN diode is most suited for _____ applications (A) Microwave switching (B) Microwave amplifying (C) Microwave oscillating (D) Microwave rectifying	1	1	2	1
5. The tunnel diode is also known as (A) High field diode (B) Channel diode (C) High frequency diode (D) Esaki diode	1	1	1	1
6. The gunn diode has (A) Three PN junction (B) No P-N junction (C) A single P-N junction (D) Two PN junction	1	1	2	1
7. When a reverse bias voltage exceeding the breakdown voltage is applied to an IMPATT diode, it results in? (A) Breakdown of depletion region (B) High reverse saturation current (C) Avalanche multiplication (D) Zener breakdown	1	1	2	1
8. Power diodes are made of (A) Aluminium (B) Silicon (C) Germanium (D) Se	1	1	2	1

9.	High power circuits generally use higher values of (A) Drain to source current (B) Drain current (C) Gate to source current (D) Gate to source voltage	1	1	3	1
10.	Advantage of using GaAs in MESFET as compared to use of silicon is (A) They have high resistance for flow of current in the reverse direction (B) They have lower mobility (C) GaAs are cost effective (D) They have higher mobility	1	1	3	1
11.	As the separation between metal semiconductor surface is reduced, induction charge (A) Decreases (B) Increases (C) Is not affected (D) Remains constant	1	1	3	1
12.	Advantage of HJT over BJT is that it has (A) Low frequency of Operation (B) Higher Gain (C) Sophisticated Construction (D) High Frequency of Operation	1	1	3	1
13.	The frequency at which a HEMT operates is limited by (A) The electron transit time from source to gate (B) The delay time from source to drain (C) The electron transit time from source to drain (D) The delay time from source to gate	1	1	4	1
14.	The reduction of gate length and the gate to channel separation in HEMT results in (A) An increase in the inductance of the device (B) A decrease in the transconductance of the device (C) An increase in the conductance of the device (D) An increase in the transconductance of the device	1	1	4	1
15.	Aspect ratio in HEMT is the ratio between (A) The gate length and the gate to source separation (B) The gate length and the gate to channel separation (C) The drain length and the gate to channel separation (D) The source length and the gate to channel separation	1	1	4	1
16.	In order to provide the best heat transfer path, engineers may inadvertently shortcut mechanical stress concerns, which en compromise package (A) Division (B) Addition (C) Multiplication (D) Integrity	1	1	5	1
17.	Intermodulation distortion is a measure of (A) How variable gain is in a device over a wide range of instantaneous drive conditions as induced by large RF signal (B) How constant gain is in a device over a wide range of instantaneous drive conditions as induced by a small RF signal (C) How constant gain is in a device over a wide range of instantaneous drive conditions as induced by a large RF signal (D) How variable gain is in a device over a wide range of instantaneous drive conditions as induced by a small RF signal.	1	1	4	1

18.	Since, overtime, it is the heat _____ mechanisms that eventually cause failure of semiconductor devices (A) Upgradation (B) Exaltation (C) Degradation (D) Dissipation	1	1	5	1
19.	_____ impedance can be achieved through properly dimensional microstrip input and output leads, through coaxial feeds, or through stripline to microstrip connections that feed in to the customer system. (A) 55Ω (B) 60Ω (C) 75Ω (D) 50Ω	1	1	5	1
20.	Particularly at higher frequencies, such as those in the RF or microwave arena, the electromagnetic propagation due to all circuit elements create _____. (A) Interactions (B) Circuit Oscillations (C) Interactions interference and circuit Oscillations (D) Interference	1	1	5	1

PART – B (5 × 4 = 20 Marks)

Answer **ANY FIVE** Questions

		Marks	BL	CO	PO
21.	Mention the applications of varactor diode.	4	2	1	1
22.	Categorize the combination of Hetero Junctions.	4	2	1	1
23.	An IMPATT diode has the following parameters. Carrier drift velocity $v_d = 2\times10^7$cm/s Drift region length $L = 6\mu m$ Maximum Operating current $I_{0max} = 100V$ Efficiency $\eta = 15\%$ Breakdown Voltage $V_{bd} = 90V$ Compute the maximum CW output power in Watts.	4	3	2	1
24.	Describe the V-I characteristics of MIS tunnel diode.	4	2	2	1
25.	Express the cut off frequency of MESFET.	4	2	3	1
26.	List out the Electronic applications of HEMT.	4	2	4	1
27.	Explore the elements of RF package design.	4	2	5	1

PART – C (5 × 12 = 60 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
28. a.	Illustrate the working principle of microwave PIN diode with neat sketch and mention the applications.	12	4	1	1
	(OR)				
b.	Determine the junction current from the energy band diagram for an n-Ge-P-GaAs junction.	12	3	1	4
29. a.	Examine the V-I characteristics of BARITT diode with the physical structure and determine the critical Voltage.	12	4	2	1
	(OR)				