b. A typical n type GaAs Gunn diode has the following paramete Threshold field $E_{th} = 2800 \text{V/cm}$ Applied field $E = 3200 \text{ V/cm}$ Device Length $L = 10 \mu \text{m}$ Doping concentration $\eta_0 = 2 \times 10^{14} \text{ cm}^{-3}$ Operating Frequency $f = 10 \text{ GHz}$ Compute the electron drift velocity, current density and the negation mobility.		12	3	2	4
 a. Describe the principle of operation of GaAs MESFET with nea diagram. 	ut schematic	12	4	3	I
b. A certain GaAs MESFET has the following parameters. $R_g = 3\Omega$, $R_i = 2.5\Omega$ $g_m = 50 \text{mu}$, $R_d = 450\Omega$ $R_s = 2.5\Omega$, $C_{gs} = 0.60 \text{PF}$ Determine the cutoff frequency and the maximum operating free		12	3	3	4
31. a. Illustrate the structure of HEMT and write the fabrication proce schematics.	ss with neat	2	4	4	1
(OR)					
b. i. Interpret the equivalent circuit of HEMT.	6	5	3	4	4
ii. A HEMT has the following parameters. Gate width $W = 150 \mu m$ Electron velocity $v(z) = 2 \times 10^5 m/s$ Two dimensional electron gas density $n(z) = 5.21 \times 10^{15} m^{-2}$	6		3	4	4
Determine the drain current of HEMT.					
32. a. Examine the thermal aspects of the RF circuit/package design.	12	2 3	3	5	1
b. Evaluate the temperature differences encountered in the flow of electronic systems.	heat within = 12	! 4	4	5	4

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

18ECE321T - RF AND MICROWAVE SEMICONDUCTOR DEVICES (For the candidates admitted from the good anis year 2019, 2019, 2019)

Note: (i)	Port A should be seen the 2018-2019 to 2021-2022	•			
(1)	Part - A should be answered in OMR sheet within first 40 minutes and OMR sheet over to hall invigilator at the end of 40 th minute.	t shou	ıld b	e ha	nded
(ii)	Part - B & Part - C should be answered in answer booklet.				
Time: 3	hours	Max.	Maı	ks:	100
	$PART - A (20 \times 1 = 20 Marks)$	Marks	BL	CO	PO
	Answer ALL Questions			CO	10
1.	A PN junction	1	1	1	,
	(A) Conducts in reverse direction (B) Has high resistance in forward only		1	1	1
	(C) Conducts in forward direction (D) as well as reverse directions only as well as reverse directions well as reverse directions				
2	Variable 1° 1				
2.	Varactor diodes are used in FM receivers to obtain	1	1	1	1
	(A) Automatic noise control (B) Automatic gain control				
	(C) Automatic volume control (D) Automatic frequency control				
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 DDI 4:-1.		×		
	The PIN diode is most suited for applications (A) Microwave switching (B) Microwave amplifying	1	1	2	1
	(A) Microwave switching (B) Microwave amplifying (C) Microwave oscillating (D) Microwave rectifying				
5.	The tunnel diode is also known as	1			
	(A) High field diode (B) Channel diode	1	1	1	1
	(C) High frequency diode (D) Esaki diode				
6.	The gunn diode has	1	1	2	
	(A) Three PN junction (B) No P-N junction	1	1	2	1
	(C) A single P-N junction (D) Two PN junction				
	When a reverse bias voltage exceeding the breakdown voltage is applied to an IMPATT diode, it results in?	1	1	2	1
	(A) Breakdown of depletion region (B) High reverse saturation current (C) Avalanche multiplication (D) Zener breakdown				

(B) Silicon

(D) Se

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8. Power diodes are made of

(A) Aluminium

(C) Germanium

(A)		(B)	Drain current					
Δdvs	antage of using GaAs in MESFE They have high resistance for flow of current in the reverse	Г as с (В)	compared to use of silicon is They have lower mobility	1	1	3	1	
(C)		(D)	They have higher mobility					
indu (A)	ction charge Decreases	(B)	Increases	i	1	3	1	
		` /		1	1	3	1	
(A)	Low frequency of Operation	(B)	Higher Gain High Frequency of Operation					
The (A)	frequency at which a HEMT open The electron transit time from source to gate.	(B)	drain	I	1	4	1	
resu (A)	Its in An increase in the inductance of the device	e (B)	A decrease in the transconductance of the device	1	1	4	1	
(A)	The gate length and the gate to source separation The drain length and the gate to	o (B)) The gate length and the gate to channel separation		1	4	· 1	
sho (A	ortcut mechanical stress concerns) Division	s, whi (B) Addition	1	1	5	5 1	
(A	 How variable gain is in a device over a wide range of instantaneous drive condition as induced by large RF signal. How constant gain is in device over a wide range instantaneous drive condition. 	ce (Bof of a (I of ns	over a wide range of instantaneous drive conditions as induced by a small RF signal over a wide range or over a wide range or instantaneous drive conditions	f s e f s	1		4	l
	(A) (C) Adva (A) (C) As indu (A) (C) Adv (A) (C) The (A) (C) (C) Asj (A) (C) (C) Asj (A) (C) (A) (C) (A) (C) (A) (C) (A) (C) (A) (C) (A) (A) (C) (A) (A) (C) (A) (A) (A) (A) (A) (A) (A) (A) (A) (A	(A) Drain to source current (C) Gate to source current (A) They have high resistance for flow of current in the reverse direction (C) GaAs are cost effective As the separation between metal induction charge (A) Decreases (C) Is not affected Advantage of HJT over BJT is that it (A) Low frequency of Operation (C) Sophisticated Construction The frequency at which a HEMT ope (A) The electron transit time from source to gate (C) The electron transit time from source to drain The reduction of gate length and the results in (A) An increase in the inductance of the device (C) An increase in the conductance of the device (A) The gate length and the gate to source separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) Multiplication 7. Intermodulation distortion is a mea (A) How variable gain is in a device over a wide range instantaneous drive condition as induced by large RF signal (C) How constant gain is in device over a wide range instantaneous drive condition distortion drive condition as induced by large RF signal (C) How constant gain is in device over a wide range instantaneous drive condition distortion drive condition device over a wide range instantaneous drive condition drive conditi	(A) Drain to source current (C) Gate to source current (D) Advantage of using GaAs in MESFET as of the device (C) Is not affected to gate (C) The electron transit time from (B) source to drain The reduction of gate length and the gate results in (A) An increase in the conductance (B) of the device (C) An increase in the conductance (D) of the device (A) The gate length and the gate to (B) over a wide range of instantaneous drive conditions as induced by large RF signal (C) Mavantage of HJT over BJT is that it has (A) Low frequency of Operation (B) (C) Sophisticated Construction (D) The frequency at which a HEMT operates (A) The electron transit time from (B) source to gate (C) The electron transit time from (D) source to drain The reduction of gate length and the gate results in (A) An increase in the conductance (B) of the device (C) An increase in the conductance (D) of the device (A) The gate length and the gate to (B) source separation (C) The drain length and the gate to (D) channel separation (C) Multiplication (D) The Intermodulation distortion is a measure (A) Division (B) (C) Multiplication (D) Intermodulation distortion is a measure (A) How variable gain is in a device (B) over a wide range of instantaneous drive conditions as induced by large RF signal	(A) Drain to source current (B) Gate to source voltage Advantage of using GaAs in MESFET as compared to use of silicon is (A) They have high resistance for (B) They have lower mobility flow of current in the reverse direction (C) GaAs are cost effective (D) They have higher mobility As the separation between metal semiconductor surface is reduced, induction charge (A) Decreases (B) Increases (C) Is not affected (D) Remains constant 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 The frequency at which a HEMT operates is limited by (A) The electron transit time from (B) The delay time from source to gate (C) The electron transit time from (D) The delay time from source to gate (C) The electron transit time from (D) The delay time from source to gate (C) An increase in the inductance (B) A decrease in the of the device (C) An increase in the conductance (D) An increase in the of the device (C) An increase in the conductance (D) An increase in the of the device (C) An increase in the onductance of the device (C) An increase in the sparation (C) The drain length and the gate to (B) The gate length and the gate to channel separation (C) The drain length and the gate to (B) The source length and the gate to channel separation (C) The drain length and the gate to (D) The source length and the gate to channel separation (C) The drain length and the gate to (D) The source length and the gate to channel separation (C) The drain length and the gate to (B) Addition (C) Multiplication (D) Integrity 7. 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 a grant 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 small signal reader.	(A) Drain to source current (B) Gate to source voltage Advantage of using GaAs in MESFET as compared to use of silicon is flow of current in the reverse direction (C) GaAs are cost effective (D) They have higher mobility As the separation between metal semiconductor surface is reduced, induction charge (A) Decreases (B) Increases (C) Is not affected (D) Remains constant 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 The frequency at which a HEMT operates is limited by (A) The electron transit time from (B) The delay time from source to source to gate (C) The electron transit time from (D) The delay time from source to gate (C) The electron transit time from (D) The delay time from source to gate (C) The decident of gate length and the gate to channel separation in HEMT results in (A) An increase in the inductance (B) A decrease in the of the device (C) An increase in the conductance (D) An increase in the transconductance of the device (C) An increase in the of the device (D) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (D) Integrity 7. Intermodulation distortion is a measure of (A) Division (B) Addition (D) Integrity 7. 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 a small RF signal (C) How constant gain is in a device over a wide range of instantaneous drive conditions as induced by a small 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 (D) How variable gain is in a device over a wide range of instantaneous drive conditions as induced by a small 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 (D) How variable gain is in a	(A) Drain to source current (D) Gate to source voltage Advantage of using GaAs in MESFET as compared to use of silicon is 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(A) Drain to source current (B) Drain current (C) Gate to source current (D) Gate to source voltage Advantage of using GaAs in MESFET as compared to use of silicon is flow of current in the reverse direction (C) GaAs are cost effective (D) They have higher mobility As the separation between metal semiconductor surface is reduced, induction charge (A) Decreases (B) Increases (C) Is not affected (D) Remains constant 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 The frequency at which a HEMT operates is limited by (A) The electron transit time from (B) The delay time from source to source to gate (C) The electron transit time from (D) The delay time from source to gate (C) The electron transit time from (D) The delay time from source to gate (C) The decition of gate length and the gate to channel separation in HEMT results in (A) An increase in the inductance (B) A decrease in the of the device (C) An increase in the conductance of the device (C) An increase in the conductance of the device (C) An increase in the conductance of the device (C) An increase in the conductance of the device (C) An increase in the of the device (C) An increase in the conductance of the device (C) An increase in the source separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) Multiplication (D) Integrity 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 (C) How constant gain is in a (D) device over a wide range of instantaneous drive conditions as induced by large RF signal (C) How variable gain is in a device over a wide range of instantaneous drive conditions of instantaneous drive conditions as induced by large RF signal (C) How variable gain is in a device over a wide range of instantaneo	(A) Drain to source current (B) Drain current (C) Gate to source current (D) Gate to source voltage Advantage of using GaAs in MESFET as compared to use of silicon is flow of current in the reverse direction (C) GaAs are cost effective (D) They have higher mobility As the separation between metal semiconductor surface is reduced, induction charge (A) Decreases (B) Increases (C) Is not affected (D) Remains constant 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 The frequency at which a HEMT operates is limited by (A) The electron transit time from (B) The delay time from source to source to gate (C) The electron transit time from (B) The delay time from source to source to drain The reduction of gate length and the gate to channel separation in HEMT results in (A) An increase in the inductance (B) A decrease in the of the device (C) An increase in the conductance of the device (C) An increase in the conductance of the device (C) An increase in the conductance of the device (C) An increase in the othannel separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) The drain length and the gate to channel separation (C) Multiplication (D) Integrity 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 (C) How constant gain is in a (D) device over a wide range of instantaneous drive conditions of insta

18.	Since, overtime, it is the heat mechanisms that eventually cause failure of semiconductor devices	1	1	5	1
	(A) Upgradation (B) Exaltation				
	(C) Degradation (D) Dissipation				
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	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	1	1	5	1
	(A) Interactions (B) Circuit Oscillations	10			
	(C) Interactions interference and (D) Interference				
	circuit Oscillations				
	PART – B ($5 \times 4 = 20$ Marks) Answer ANY FIVE Questions	Marks	BŁ	со	PO
21	Mention the applications of varactor diode.	4	2	1	1
21.	Wention the approaches of the second				1
22.	Categorize the combination of Hetero Junctions.	4	2	1	1
23.	An IMPATT diode has the following parameters.	4	3	2	1
	Carrier drift velocity $v_d = 2 \times 10^7 \text{cm/s}$				
	Drift region length $L = 6\mu m$				
	Maximum Operating current $I_{0max} = 100V$				
	Efficiency $\eta = 15\%$ Breakdown Voltage $V_{bd} = 90V$				
	Breakdown Voltage $V_{bd} = 90V$ Compute the maximum CW output power in Watts.				
	Compute the maximum CW output power in water			_	
24	. Describe the V-I characteristics of MIS tunnel diode.	4	2	2	1
		4	2	3	1
25	. Express the cut off frequency of MESFET.				
26	List out the Electronic applications of HEMT.	4	2	4	1
20	. List out the Electronic approaches of 1222.223	9		_	_
27	. Explore the elements of RF package design.	4	2	5	1
	$PART - C (5 \times 12 = 60 Marks)$	22.5			nó.
	Answer ALL Questions	Marks 12	s BL 4	CO 1	PO 1
28. a	a. Illustrate the working principle of microwave PIN diode with neat sketch and mention the applications.	12		•	-
	(OR)				
1	b. Determine the junction current from the energy band diagram for an n-Ge	:- 12	3	1	4
	P-GaAs junction.				
20	a. Examine the V-I characteristics of BARITT diode with the physical structu	re 12	4	2	1
29.	and determine the critical Voltage.				
	(OP)				

(OR)