B.Tech. DEGREE EXAMINATION, NOVEMBER 2023
Fourth Semester

18ECE321T – RF AND MICROWAVE SEMICONDUCTOR DEVICES
(For the candidates admitted from the academic year 2020-2021 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.	In a PN junction, with no external voltage, the electric field between acceptor and donor ions is called	1	1	1	1
	(A) Threshold (B) Peak (C) Path (D) Barrier				
2.	Schottky diode operates only with	1	1	1	1
	(A) Minority carriers (B) Capacitor (C) Inductor (D) Majority carriers				
3.	The varactor is usually	1	1	1	
	(A) Forward biased (B) Unbiased (C) Reverse biased (D) In the breakdown region				
4.	The PIN diode is most suited for _____ applications.	1	1	1	1
	(A) Microwave switching (B) Microwave rectifying (C) Microwave amplifying (D) Microwave oscillating				
5.	The gunn effect is also known as	1	1	2	1
	(A) Transfer transient effect (B) Transient avalanche effect (C) Auto electronic effect (D) Transferred electron effect				
6.	To prevent an IMPATT diode from burning, a constant bias source is used to maintain _____ at safe limit	1	1	2	1
	(A) Average Voltage (B) Average Current (C) Average bias Voltage (D) Average Resistance				
7.	Which of the following devices have negative resistance?	1	1	2	1
	(A) Vacuum diode (B) Tunnel diode (C) Gas diode (D) TRAPATT diode				
8.	In order to achieve high current density, a compromise in _____ is made in a TRAPATT diode	1	1	2	1
	(A) Operating Frequency (B) Size (C) Gain (D) No Compromise is made on any parameters				

9. One major disadvantage of BJTs over FETs is that   1   1   3   1
   (A) They have low bandwidth   (B) They have good noise figure
   (C) They have low gain   (D) They do not have good noise figure

10. The frequency of operation of FET is limited by   1   1   3   1
    (A) Gate length   (B) Drain to source voltage
    (C) Gate to source voltage   (D) Effective area of FET

11. Production transistors commonly used for microwave communications are   1   1   3   1
    (A) MOSFETs   (B) MESFETs
    (C) JFETs   (D) MISFETs

12. BJTs are suitable for RF applications because of   1   1   3   1
    (A) Power Capacity   (B) Good Performance interms of frequency
    (C) Noise characteristics   (D) Good Performance interms of frequency power capacity and noise characteristics

13. HEMT used in the microwave circuit is a   1   1   4   1
    (A) Source   (B) High Power Amplifier
    (C) Detector   (D) Low Noise Amplifier

14. The channel charging delay in HEMT is   1   1   4   1
    (A) Maximum at high current densities   (B) Minimum at low current densities
    (C) Minimum at high current densities   (D) Maximum at low current densities

15. The optimum value of Lgd in HEMT is   1   1   '4   1
    (A) 32 times that of the gate length Lg   (B) 4.2 times that of the gate length Lg
    (C) 2.3 times that of the gate length Lg   (D) 2.4 times that of the gate length Lg

16. The method used for fabrication of GaAs FET is   1   1   4   1
    (A) Ion Implantation   (B) Disposition
    (C) Diffusion   (D) Conduction

17. _____ management is probably one of the most critical aspects of the package design.   1   1   5   1
    (A) Mechanical   (B) Thermal
    (C) Electrical   (D) Computer Integrated

18. The thermal conductivity of diamond is   1   1   5   1
    (A) 41.6W/in°C   (B) 40W/in°C
    (C) 40.6W/in°C   (D) 40.06W/in°C

19. _____ effects result in poor RF performance with respect to things such as gain, efficiency and intermodulation distortion etc.   1   1   5   1
    (A) Resistive   (B) Deductive
    (C) Reactive   (D) Inductive

20. The most critical heat producing component for most RF systems is the _____ stage   1   1   5   1
    (A) Frequency amplifier   (B) Current amplifier
    (C) Voltage amplifier   (D) Power amplifier

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

	Marks	BL	CO	PO
21. Describe the effect of doping profile on the capacitance of pn junctions.	4	2	1	1
22. What is tunneling phenomenon?	4	2	2	1
23. A TRAPATT diode has the following parameters. Doping Concentration $N_A = 2 \times 10^{15}$ cm^{-3} Current density $J = 20$kA/cm^2 Calculate the avalanche zone velocity.	4	3	2	4
24. State Ridley – Watkins Hilsun theory.	4	2	2	1
25. Elucidate the Pinch – off voltage of JFET.	4	2	3	1
26. Explain the figure of merit of RF power transistors.	4	2	4	1
27. Explore spreading resistance with relevant expressions.	4	2	5	1

PART – C (5 × 12 = 60 Marks)
Answer ALL Questions

	Marks	BL	CO	PO
28. a. Illustrate the working principle of varactor diode with neat schematic and give the applications.	12	4	1	1

(OR)

	Marks	BL	CO	PO
b. Examine the energy band diagram for an n-Ge-p-GaAs junction with relevant expressions.	12	3	1	4
29. a. Illustrate the operational principle of an IMPATT diode and deduce its output power and efficiency.	12	3	2	1

(OR)

	Marks	BL	CO	PO
b. Investigate the modes of operation for Gunn diodes with relevant characteristics.	12	4	2	1
30. a. Describe in detail the principle of operation of MISFET with neat schematic and V-I characteristics.	12	4	3	1

(OR)

b. A typical n-channel Ga As MESFET has the following parameters   12 3 3 4

     Electron concentration $N_d = 8 \times 10^{17}$ cm^{-3}

     Channel height $a = 0.1 \mu m$

     Relative dielectric constant $\varepsilon_r = 13.1$

     Channel length $L = 14 \mu m$

     Channel width $z = 36 \mu m$

     Electron mobility $\mu = 0.08 m^2/Vs$

     Drain Voltage $V_d = 5V$

     Gate Voltage $V_g = -2V$

     Saturation drift velocity $v_s = 2 \times 10^5$ m/s

     Calculate the pinch-off voltage, velocity ratio and the saturation current at $V_g = 0$

31. a. Elucidate the operational mechanism of HEMT and the operational   12 4 4 1
characteristics.

(OR)

b. A HEMT has the following parameters.   12 3 4 4

     Threshold Voltage $V_{th} = 0.13V$

     Donor Concentration $N_d = 2 \times 10^{24}$ m^{-3}

     Schottky barrier potential $\varphi_{ms} = 0.8V$

     GaAs bandgap $E_{gg} = 1.43V$

     Al GaAs bandgap $E_{ga} = 1.8V$

     Compute the conduction band edge different between GaAs and Al GaAs and the sensitivity of HEMT

32. a. Interpret the thermal resistance networks for Electronic systems.   12 4 5 1

(OR)

b. Investigate the technique used to measure the fracture strength of   12 3 5 4
semiconductor diode.

* * * * *