| Reg. No | | | | | | | | | | | | | | | |
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# B.Tech DEGREE EXAMINATION, MAY 2024

Third Semester

## 18ECC211J - SOLID STATE SEMICONDUCTOR DEVICES

*(For the candidates admitted during 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** and **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 |
|---|---|---|---|---|
| 1. | The Hall effect is a phenomenon used to measure<br>(A) Temperature gradient in a conductor<br>(B) Magnetic field and carrier concentration in a semiconductor<br>(C) Depletion width in a semiconductor<br>(D) Fermi level in a metal | 1 | 1 | 1 |
| 2. | Which of the following factors affects the mobility of charge carriers in a semiconductor?<br>(A) The magnitude of the applied electric field<br>(B) The temperature of the semiconductor material<br>(C) The type of impurities present in the material<br>(D) The thickness of the depletion region | 1 | 1 | 1 |
| 3. | When a semiconductor device is at thermal equilibrium, the net current due to drift and diffusion is<br>(A) Maximum<br>(B) Independent of temperature<br>(C) Carrier concentration<br>(D) zero | 1 | 1 | 1 |
| 4. | In a diode, the reverse saturation current<br>(A) Increases with increasing reverse bias<br>(B) Decreases with increasing temperature<br>(C) Remains constant with temperature<br>(D) Is not affected by temperature changes | 1 | 1 | 1 |
| 5. | Match the following<br>1) Zener Diode - Direct bandgap<br>2) Step Recovery Diode - Dark Current<br>3) Laser - Harmonic Oscillators<br>4) Avalanche photodiode - Indirect Bandgap<br>(A) 1- 3,2-1,3-4,4-1<br>(B) 1-4,2-1,3-2,4-1<br>(C) 1-2,2-1,3- 4,4-3<br>(D) 1-4,2-3,3-1,4-2 | 1 | 1 | 2 |
| 6. | The reverse bias current of the varactor diode is 1mA and the reverse bias resistance of the diode is 1kΩ. Calculate the input voltage of the diode<br>(A) 1V<br>(B) 0.5V<br>(C) 10V<br>(D) 100V | 1 | 2 | 2 |
| 7. | Identify, The following diode which is used as a variable capacitor<br>(A) Gunn diode<br>(B) Step recovery diode<br>(C) Varactor diode<br>(D) Zener diode | 1 | 1 | 2 |
| 8. | Select the diode from the following list that has negative resistance properties<br>(A) Step recovery diode<br>(B) Zener diode<br>(C) Tunnel diode<br>(D) Laser | 1 | 1 | 2 |

9. If the base-emitter voltage of the silicon BJT is 0.6V, what is the operating region of the BJT? 1 2 3
(A) Break down (B) Cut off
(C) Saturation (D) Active

10. If $V_{BE}$ voltage of the BJT is 0.2V and Vcc = 5V in CE configuration, What is the output of the transistor? (Assume the transistor is acting as a switch) 1 2 3
(A) 0.2V (B) 5V
(C) 1V (D) 0.5V

11. Recall, the relation between β and α 1 1 3
(A) $\beta = 1 / (1 - \alpha)$ (B) $\beta = (1 - \alpha) / \alpha$
(C) $\beta = \alpha / (1 - \alpha)$ (D) $\beta = \alpha / (1 + \alpha)$

12. Choose the phase difference between the input and output voltages in a common base configuration 1 1 3
(A) 180 degree (B) 90 degree
(C) 0 degree (D) 270 degree

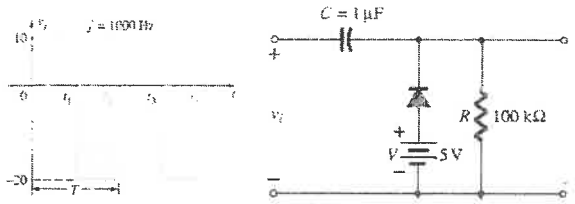
13. Recall, the characteristics of MOSFET are ---------- 1 1 4
(A) Input and output characteristics (B) Drain and transfer characteristics
(C) VI characteristics (D) Gate characteristics

14. What is CMOS? 1 1 4
(A) Complementary metal oxide field effect transistor (B) Continuous metal oxide field effect transistor
(C) Collector metal oxide field effect transistor (D) Curved metal oxide field effect transistor

15. At VGS =0, what happens to the channel of Depletion MOSFETs? 1 1 4
(A) Conduct (B) Doesn't conduct
(C) Rarely conduct (D) Insulate

16. A Halfware rectifier is equivalent to 1 1 5
(A) Clamper circuit (B) Clamper circuit with negative bias
(C) Clamper circuit with positive bias (D) Clipper circuit

17. Determine $v_o$ for the following network with the input shown (for ideal diode) 1 2 5




(A) 0V (B) 1V
(C) 2V (D) 5V

18. what is the efficiency of half wave rectifier 1 1 5
(A) 80% (B) 40%
(C) 20% (D) 10%

19. How many MOSFETs are necessary to make a NOT gate 1 2 5
(A) 1 (B) 2
(C) 3 (D) 4

20. The most popular type of ICs are---------- 1 1 5
(A) Thin film (B) Thick film
(C) Hybrid (D) Monolithic

## PART - B (5 × 4 = 20 Marks)

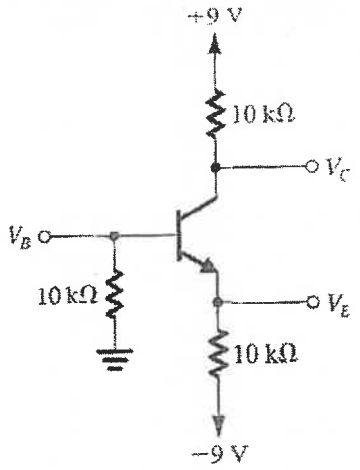
Answer **any 5** Questions

| | | Marks | BL | CO |
|---|---|---|---|---|
| 21. | Derive the drift and diffusion current density of PN junction diode | 4 | 2 | 1 |
| 22. | Explain Fermi Dirac function of semiconductor | 4 | 1 | 1 |
| 23. | Calculate the capacitance of a varactor diode when it is reverse-biased with a voltage of 6V. The varactor diode has a capacitance-voltage (C-V) curve with a slope (k) of 20 pF/V | 4 | 2 | 2 |
| 24. | What is negative resistance property? Relate this property with a high frequency diode | 4 | 1 | 2 |
| 25. | Draw the three configurations of BJT | 4 | 1 | 3 |
| 26. | Derive drain current of E MOSFET | 4 | 1 | 4 |
| 27. | Write the applications of integrated circuits | 4 | 1 | 5 |

## PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

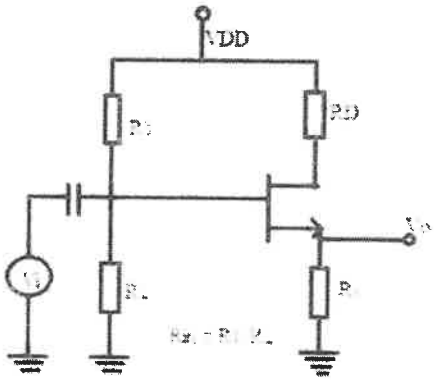
| | | Marks | BL | CO |
|---|---|---|---|---|
| 28. | (a) (i) A silicon semiconductor at room temperature (300 K) as an intrinsic carrier concentration of 1.5 × 10^16 cm^(-3). If it is doped with 2 × 10^18 cm^(-3) phosphorus atoms, calculate the electron concentration and hole concentration at this temperature<br>(II) Explain the voltage rectification characteristics of PN junction diode | 12 | 3 | 1 |
| | **(OR)** | | | |
| | (b) Explain the construction and VI Characteristics of Zener diode | | | |
| 29. | (a) Explain the following diodes<br>(i) Laser (ii) PIN Photodiode | 12 | 2 | 2 |
| | **(OR)** | | | |
| | (b) Discuss the variable capacitance property of the Varactor diode | | | |
| 30. | (a) For the circuit shown below, the measurement indicates that $V_B$=-1.5V. Calculate $V_E$ ,α,β and $V_c$. If the transistor β value is infinity, what value of $V_b$, $V_c$ and $V_E$ in result?($V_{BE}$=0.7V) | 12 | 3 | 3 |




**(OR)**

(b) Draw the hybrid Pi model of the transistor under CB configuration and explain the four parameters

31. (a) The following CD MOSFET amplifier circuit includes voltage divider bias, the two resistors like R1 = 2.5 M Ohm & R2 = 1.5 M Ohm respectively, then what is the Rin value? 12 2 4




**(OR)**

(b) (i) Compare BJT and MOSFET
(ii) Discuss the configurations of PMOSFET and NMOSFET

32. (a) Briefly explain zener diode voltage regulators 12 1 5

**(OR)**

(b) Explain the following
(i) Diode clampers (ii) Diode multipliers

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