

**B. Tech Odd Semester Examination, February, 2023****Electronics & Communication Engineering**  
(3rd Semester)Course No.: ECE-301  
**(Electronics Devices)***Full Marks: 50**Pass Marks: 25**Time: 2 hours*

- Note:**
1. Attempt any five questions.
  2. Begin each answer in a new page.
  3. Answer parts of a question at a place.
  4. Assume reasonable data wherever required.
  5. The figures in the right margin indicate full marks for the question.
  6. All the mathematical symbols and abbreviations have their usual meanings.
1. a) Discuss the concept of Fermi level for semiconductors.  
b) Derive the expression for Fermi level of extrinsic semiconductors and sketch the position in case of intrinsic, P-type, N-type semiconductors.  
c) Explain in context to semiconductor, doping and its need. 2+4+4
  2. a) Draw the energy band diagram of a PN junction and derive the expression for total shift in the energy level.  
b) A silicon diode has reverse saturation current of  $2.5 \mu\text{A}$  at  $300^\circ\text{K}$ . Find forward voltage for a forward current of  $10 \text{ mA}$ . 7+3

3. a) Explain -
- Law of mass action
  - Hall effect
  - Drift and diffusion current
  - Ohmic contact
  - Potential barrier
  - Opto-electronic Devices
- b) Determine the resistivity of germanium.
- In intrinsic condition at K
  - With donor impurity of 1 in
  - With acceptor impurity of 1 in
  - With both the above impurity simultaneously.
- Given that for germanium at room temperature
- $$n_i = 2.5 \times 10^{13} / \text{cm}^3 ,$$
- $$\mu_p = 1800 \frac{\text{cm}^2}{\text{sV}}, \text{ and a number of germanium atoms} / \text{cm}^3 = 4.4 \times 10^{22} .$$
- 6+4
4. a) What are relative advantages of LCD over LED?
- b) Draw the bridge rectifier circuit and explain its working giving input and output waveform.
- c) A half wave rectifier uses a diode with an equivalent forward resistance of  $0.3\Omega$ . If the input ac voltage is 10 V (rms) and the load resistance of  $2\Omega$ , calculate and in the load.
- 3+4+3

5. a) Explain with circuit diagram, how zener diode can be used as a voltage regulator.
- b) In CE configuration collector supply voltage , load resistance  $R_c$  is  $8 \text{ K}\Omega$ . Draw dc load line. Determine the operating point Q for zero signal if base current is  $15 \mu\text{A}$  and  $\beta$  is 40. 6+4
6. a) Draw the structure of a JFET and explain its principle of operation with neat diagram along with its V-I characteristics.
- b) Explain why BJTs are called bipolar devices while FETs are called unipolar devices.
- c) The reverse saturation current of an NPN transistor in common base circuit is  $12.5 \mu\text{A}$ . For an emitter current of  $2 \text{ mA}$ , collector current is  $1.97 \text{ mA}$ . Determine the current gain and base current. 4+2+4
- $V_{GS} = 10\text{V}$   
 $\mu_n = 3800 \frac{\text{cm}^2}{\text{sV}}$
- Explain four distinct regions of the output characteristics of a JFET.
- b) An N-channel JFET has a pinch-off voltage of  $-4.5 \text{ V}$  and  $I_{DSS} = 9 \text{ mA}$ . At what value of  $V_{GS}$  will  $I_{DS}$  equal to  $3 \text{ mA}$ ? What is its  $g_m$  at this  $I_{DS}$ . 6+4
8. a) Explain channel length modulation in MOSFET.
- b) With the help of neat sketch explain the construction of depletion and enhancement type N-channel MOSFETs.
- c) How FETs and conventional BJTs are different from each other? 3+5+2

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