

INTRODUCTION TO ELECTRONICS DEVICES AND CIRCUITS (ECE1001)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Current flow in a semiconductor depends on the phenomenon of
 - (a) drift
 - (b) diffusion
 - (c) recombination
 - (d) all the above
- (ii) Avalanche breakdown is primarily dependent on the phenomenon of
 - (a) collision
 - (b) doping
 - (c) recombination
 - (d) ionization
- (iii) Which of the following statements is true for a semiconductor?
 - (a) It has zero conductivity at all temperatures
 - (b) Its conductivity decreases with increase in temperature
 - (c) Its conductivity increases with increase in temperature
 - (d) It behaves exactly like a conductor
- (iv) In a Common Base BJT, for a fixed emitter base junction forward bias, increase in reverse bias across the collector base junction,
 - (a) Increases emitter current
 - (b) Decreases emitter current
 - (c) Keeps emitter current constant
 - (d) Makes emitter current zero
- (v) In a transistor, the base is:
 - (a) Very thick and lightly doped
 - (b) Very thin and heavily doped
 - (c) Very thick and heavily doped
 - (d) Thin and lightly doped
- (vi) A transistor used as an amplifier operates in:
 - (a) Cut-off region
 - (b) Saturation region
 - (c) Active region
 - (d) Breakdown region
- (vii) The value of drain current when V_{gs} = pinch off voltage is
 - (a) 1mA
 - (b) 0
 - (c) 2mA
 - (d) 0.5A

- (viii) Compared to a BJT, a FET has:
 (a) Higher input impedance (b) Lower input impedance
 (c) Same input impedance (d) No input impedance
- (ix) If a capacitor is placed in the feedback path of an OP-AMP circuit, then the circuit can act as
 (a) integrator (b) multiplier
 (c) subtractor (d) divider
- (x) In a voltage follower circuit, the gain is:
 (a) 0 (b) 1 (c) Very high (d) Infinite

Fill in the blanks with the correct word

- (xi) The ripple factor value for a full-wave rectifier is ____.
- (xii) Relation between α and β is ____.
- (xiii) Relation between transconductance, amplification factor and drain resistance of JFET is ____.
- (xiv) In an OP-AMP, the output impedance is ____.
- (xv) FET is a ____ controlled device.

Group - B

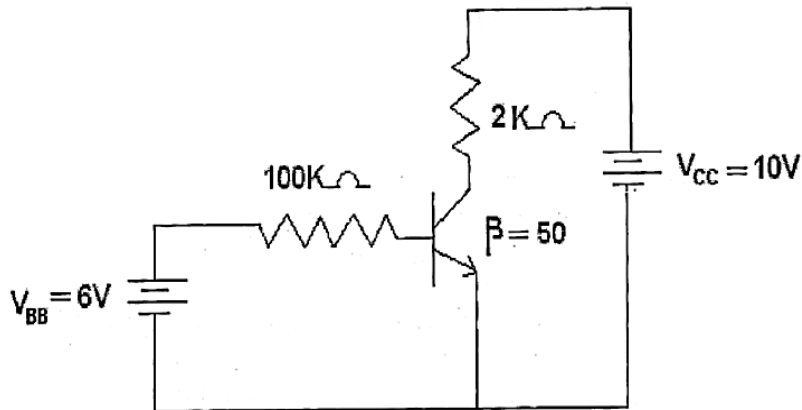
2. (a) Find the conductivity and resistivity of an intrinsic semiconductor at a temperature of 300°K . It is given that $n_i = 2.5 \times 10^{13}/\text{cm}^3$, $\mu_n = 3800 \text{ cm}^2/(\text{V.s.})$, $\mu_p = 1800 \text{ cm}^2/(\text{V.s.})$, $q = 1.6 \times 10^{-19} \text{ C}$.
 [(CO1)(Apply/IOCQ)]
- (b) State mass action law.
 [(CO1)(Remember/LOCQ)]
- (c) Compare Avalanche and Zener breakdown.
 [(CO2)(Remember/LOCQ)]
- 6 + 2 + 4 = 12**
3. (a) A half-wave rectifier is fed by a transformer with turns ratio 2:1. The primary voltage is 230V (rms). Load resistance is 500Ω . Find:
 (i) Peak secondary voltage (ii) DC output voltage
 (iii) DC load current
 [(CO3)(Analyse/IOCQ)]
- (b) A half-wave rectifier is supplied with an AC voltage of peak value 50V. The load resistance is $1\text{k}\Omega$.
 Find:
 (i) DC output voltage (ii) DC current
 (iii) Ripple factor
 [(CO3) (Understand/LOCQ)]
- (c) Explain the working of a full-wave rectifier (centre-tapped type) with a neat circuit diagram. Derive the expression for: Average (DC) output voltage, RMS value of output current, Ripple factor, Efficiency.
 [(CO3)(Evaluate/HOCQ)]
- 4 + 4 + 4 = 12**

Group - C

4. (a) A n-p-n BJT having $\alpha = 0.98$ and reverse saturation current $I_{CO} = 50\mu A$ is operating the CB mode. If the base current is $5\mu A$, calculate the emitter current and collector current. [[C04](Analyse/IOCQ)]
- (b) Explain the input and output characteristics of n-p-n BJT in CE mode. [[C04](Understand/LOCQ)]

5 + 7 = 12

5. (a) Calculate V_{CE} and I_C for the following circuit. Assume $V_{BE} = 0.7V$. [[C04](Apply/IOCQ)]



- (b) Explain the significance of load line in determining the operating point of BJT amplifier in CE configuration. [[C04](Analyse/IOCQ)]
- (c) In a CE configuration, $I_C = 2\text{ mA}$ and $I_B = 20\mu A$. Calculate: Current gain (β), Emitter current (I_E). [[C04](Evaluate/HOCQ)]

4 + 4 + 4 = 12

Group - D

6. (a) Draw and explain drain and transfer characteristics of a p-channel JFET. [[C05](Remember/LOCQ)]
- (b) In a n-channel FET the following parameters, $I_{DSS} = 12\text{ mA}$, $V_p = -8V$, and $g_{mo} = 4000\mu S$. Determine the drain current and transconductance at $V_{GS} = -5V$. [[C05](Analyse/IOCQ)]

- (c) Mention the relation between drain current, gate to source voltage and pinch off voltage in case of n-channel JFET. [[C05](Remember/LOCQ)]

6 + 4 + 2 = 12

7. (a) Describe the working principle with a schematic diagram of a p-channel enhancement type MOSFET. [[C05](Remember/LOCQ)]
- (b) Draw and explain the transfer characteristics of n-channel depletion type MOSFET. [[C05](Understand/LOCQ)]

8 + 4 = 12

Group - E

8. (a) An inverting OP-AMP circuit has an input resistance of 10Ω and a feedback resistance of 50Ω . Draw the circuit and calculate the gain of OP-AMP. [[C06](Apply/IOCQ)]

- (b) Explain the operation of an OP-AMP differentiator with proper circuit diagrams. [[CO6](Understand/LOCQ)]
- (c) Sketch the output waveform of an OP-AMP integrator with a square waveform as input. Justify your answer. [[CO6](Apply/IOCQ)]
- 4 + (2 + 3) + 3 = 12**
9. (a) The voltage gain of an amplifier without feedback is 1000. Calculate the voltage gain of the amplifier if negative feedback is introduced in the circuit. Given the feedback fraction is 0.02. [[CO6](Apply/IOCQ)]
- (b) Explain the following types of feedback topologies with block schematics:
(i) Voltage-series (ii) Voltage-shunt. [[CO6](Remember/LOCQ)]
- (c) An amplifier having a voltage amplification of -90 uses a negative feedback circuit with a loop gain of -2. What are the overall voltage amplification and the reverse transfer ratio? [[CO6](Apply/IOCQ)]
- 4 + (2 + 2) + 4 = 12**
-

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.9	43.8	8.30