INTRODUCTION TO ELECTRONIC 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) In breakdown region the Zener diode behaves like
(a) a constant voltage source (b) a constant current source
(c) a source of resistance (d) None of the above

(ii) In an N-type semiconductor, the majority carriers are:
(a) Holes (b) Electrons (c) Protons (d) Photons

(iii) The Q-point in a voltage amplifier is selected in the middle of the active region because
(a) It gives better stability
(b) The circuit needs a small dc voltage
(c) The biasing circuit then needs less number of resistors
(d) It gives distortion less output.

(iv) A transistor having a high input impedance, and a lowoutput impedance is operating in
(a) CB mode (b) CE mode (c) CC mode (d) All mode

(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 FET is a
(a) current driven device (b) voltage driven device
(c) both current and voltage control device (d) none of the above

(vii) For an n-channel FET, the direction of drain current flow is
(a) Gate to source (b) Source to drain
(c) drain to source (d) Drain to Gate

(viii) The input impedance of ideal OP-AMP is
(a) infinity (b) zero (c) one (d) none of the above

(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) The negative feedback in an amplifier leads to which of the following?
(a) Increase in current gain (b) Increase in voltage gain
(c) Decrease in voltage gain (d) Decrease in bandwidth

Fill in the blanks with the correct word

(xi) The full form of PIV is_____.

(xii) The ripple factor of a half-wave rectifier is _____.

(xiii) An example of direct bandgap semiconductor is _____.

(xiv) The Shockley equation is for JFET_____.

(xv) The depletion voltage of p-channel depletion type MOSFET is of _____ sign.

Group - B

2. (a) Explain the difference between metal, insulator and semiconductor with proper band diagram. *[(CO1)(Understand /LOCQ)]*
(b) Find the conductivity and resistivity of an intrinsic semiconductor at a temperature of 300^0K. It is giventhat $n_i = 2.5 \times 10^{13}/cm^3$, $\mu_n = 3800\ cm^2/(V.s.)$, $\mu_p = 1800\ cm^2/(V.s.)$, $q=1.6\times10^{-19}$ C. *[(CO1)(Apply/IOCQ)]*
(c) State mass action law. *[(CO1)(Remember/LOCQ)]*

4 + 6 + 2 = 12

3. (a) Evaluate the ripple factor and efficiency of a full-wave rectifier circuit. *[(CO3)(Analyse/IOCQ)]*
(b) Draw and explain the operation of a half-wave rectifier circuit with proper circuit diagram and waveforms. *[(CO3)(Remember/LOCQ)]*

6 + 6 = 12

Group - C

4. (a) Explain base width modulation and its effects. *[(CO4)(Understand/LOCQ)]*
(b) A n-p-n BJT having $\alpha = 0.98$ and reverse saturation current ICO = 50 μA is operating the CB mode. If the base current is 5 μA, calculate the emitter current and collector current. *[(CO4)(Analyse/IOCQ)]*
(c) Define stability factor? Explain its significance. *[(CO4)(Remember/LOCQ)]*

3 + 5 + 4 = 12

5. (a) What is the load line of a BJT? Explain its significance. *[(CO4)(Apply/IOCQ)]*
(b) A transistor having $\alpha = 0.975$ and a reverse saturation current ICO=10μA is operated in CE configuration. Evaluate β for this configuration? If the base current is 250 μA, evaluate the emitter current and the collector current. *[(CO4)(Evaluate/HOCQ)]*

(2 + 2) + (4 + 2 + 2) = 12

Group - D

6. (a) Describe the working principle of p-channel JFET along with relevant diagram. *[(CO5) (Remember/LOCQ)]*

(b) The drain current of a JFET is about 5mA. When I_{DSS} is equal to 10mA and V_p=-5V. Determine the value of V_{GS}. *[(CO5) (Understand/LOCQ)]*

(c) Define transconductance for a JFET. *[(CO5) (Remember/LOCQ)]*

7 + 3 + 2 = 12

7. (a) Mention the differences between BJT and FET. *[(CO5) (Remember/LOCQ)]*

(b) Draw and explain the output drain characteristic of an Enhancement type MOSFET. *[(CO5) (Understand/LOCQ)]*

(c) Find the transconductance by assuming the reverse gate voltage of a JFET changes from 5.0V to 4.9V and the drain current changes from 1.2mA to 1.5 mA. *[(CO5) (Analyze/IOCQ)]*

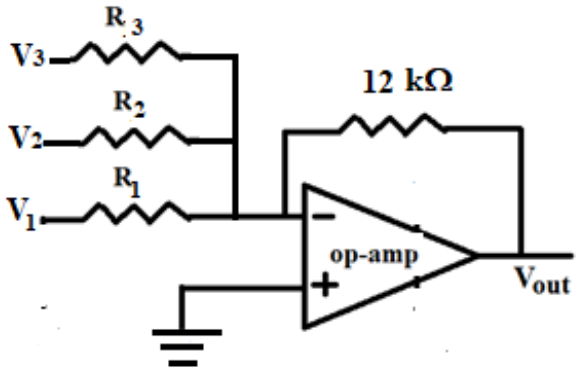
3 + 7 + 2 = 12

Group - E

8. (a) Explain the operation of an OP-AMP as an integrator with proper circuit diagram. *[(CO6)(Remember/LOCQ)]*

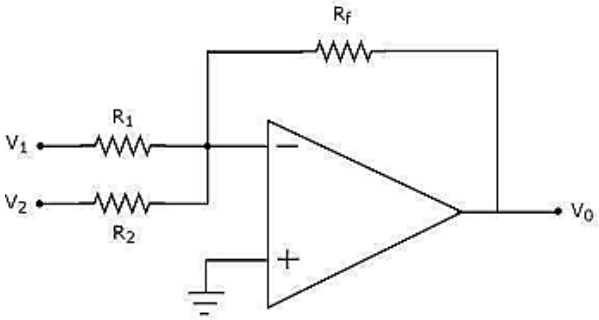
(b) An inverting OP-AMP circuit has an input resistance of 10Ω and a feedback resistance of 50Ω. Draw the circuit and calculate the gain of OP-AMP. *[(CO6)(Apply/IOCQ)]*

(c) Given a summing amplifier designed using inverting OP-AMP with feedback resistance, R_f=12 kΩ. The output voltage obtained from the summing amplifier is given as, Vout=-($2V_1$+$3V_2$+$4V_3$), where V_1, V_2, V_3 are the input voltages as indicated in figure below. Evaluate R_1, R_2, R_3. *[(CO6)(Apply/IOCQ)]*



3 + 4 + 5 = 12

9. (a) Determine the expression of output voltage, V_0 for the circuit given below



[(CO6)(Analyse/IOCQ)]

(b) 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)]*

(c) Sketch the output waveform of an OP-AMP differentiator with a triangular input. Justify your answer. *[(CO6)(Apply/IOCQ)]*

5 + 4 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83	45.83	8.34