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) For insulator, the forbidden gap is of the order of
(a) 5-6 Ev (b) 1 eV (c) 0.1 eV (d) zero

(ii) The conductivity of semiconductors depends on
(a) number of current carriers present per unit volume
(b) the mobility of the current carriers
(c) both (a) and (b)
(d) none of the above.

(iii) Efficiency of a full wave rectifier circuit is
(a) 81.2% (b) 40.6% (c) 65.7% (d) 72%

(iv) In a BJT with $\beta = 100$, α equals
(a) 99 (b) 0.99 (c) 1.0 (d) 1.01

(v) When emitter base junction is forward biased, and collector base junction is reverse biased in CB mode operation then the transistor operates in
(a) active (b) saturation (c) cut-off mode (d) none of the above

(vi) The polarity of voltage that is not applied to the gate terminal of p-channel JFET is
(a) negative (b) positive
(c) zero (d) none of the above.

(vii) The value of drain current when V_{gs}=pinch off voltage is
(a) 1mA (b) 0
(c) 2mA (d) 0.5A

(viii) An inverting OP-AMP with feedback resistance, R_f and an input resistance,R_1 connected to the inverting terminal has a gain
(a) $1+R_f/R_1$ (b) $-(1+R_f/R_1)$
(c) R_f/R_1 (d) $-R_f/R_1$

(ix) For an ideal OP-AMP which of the following statement is correct?
(a) Zero input impedance and infinite bandwidth
(b) Infinite input impedance and infinite bandwidth
(c) Zero input impedance and zero bandwidth
(d) Zero input impedance and infinite output impedance.

(x) What would be the value of feedback voltage in a negative feedback amplifier with A=100; β =0.03 and input signal voltage = 40mv?
(a) 0.03V (b) 0.06V
(c) 0.09V (d) 0.12V

Fill in the blanks with the correct word

(xi) Mobility of the charge carrier is given by _____.

(xii) If α=0.95 then the value of β of the transistor is _____.

(xiii) The most heavily doped region of a bipolar transistor is _____.

(xiv) Negative feedback in a circuit _____ the gain of the circuit.

(xv) The full form of MOSFET is _____.

Group - B

2. (a) Compare Fermi energy level at 0K and Fermi energy level for a finite nonzero temperature. *[(CO1)(Analyse/IOCQ)]*
(b) "Holes are minority carriers in an n-type semiconductor"- Justify the statement with the help of mass action law. *[(CO1)(Evaluate/HOCQ)]*
(c) Explain at a high temperature extrinsic semiconductor behaves like an intrinsic semiconductor. *[(CO1)(Understand /LOCQ)]*

4 + 4 + 4 = 12

3. (a) Explain current voltage characteristic of a p-n junction diode with a proper diagram. *[(CO3)(Understand/LOCQ)]*
(b) Explain with a circuit diagram the use of a Zener diode as a reference diode. *[(CO3)(Understand/LOCQ)]*
(c) Find the bias for which the reverse current in a silicon p-n junction diode is half its saturation value at room temperature. *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - C

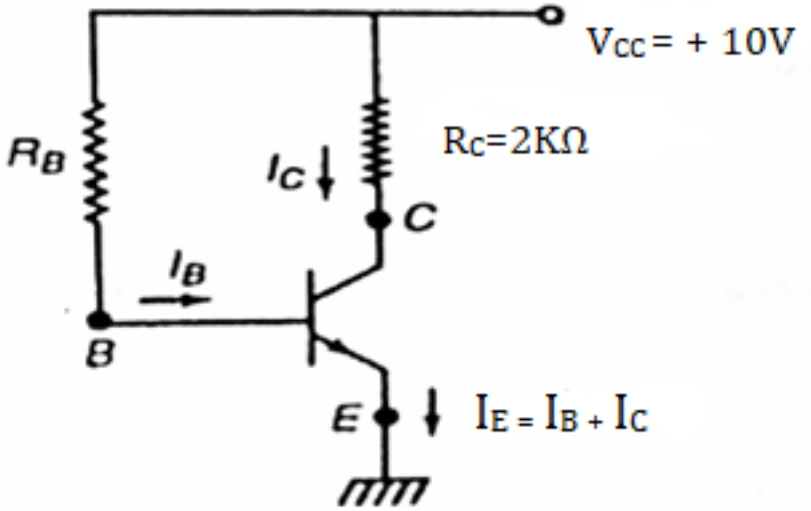
4. (a) Explain the mechanism of current flow of n-p-n transistor with schematic diagram. *[(CO4)(Understand/LOCQ)]*
(b) If a transistor has its collector-base junction forward biased and other junction reversed biased, will it work? Explain. *[(CO4)(Remember/LOCQ)]*
(c) For a transistor if $I_E = 1mA$ and $\alpha = 0.98$, determine the value of I_B. *[(CO4)(Apply/IOCQ)]*

6 + 3 + 3 = 12

5. (a) Differentiate between biasing of a transistor when it works in active, saturation and cut-off region. *[(CO4)(Understand/IOCQ)]*

(b) Draw the energy band diagram of a p-n-p transistor without biasing. *[(CO4)(Remember/LOCQ)]*

(c) Assuming β =100, V_{BE}=0.7V, R_B= 500KΩ, Calculate I_C, I_B, V_{CE} for the following amplifier circuit. *[(CO6)(Evaluate/HOCQ)]*



3 + 3 + 6 = 12

Group - D

6. (a) Compare between BJT and FET. *[(CO5)(Understand/LOCQ)]*

(b) Sketch the transfer characteristics for an n-channel JFET with Saturation Drain-to-Source Current I_{DSS} = 16 mA and Pinch-Off Voltage, V_P = -4 V. *[(CO5)(Evaluate/HOCQ)]*

(c) State and explain the parameters of FET. *[(CO5)(Analyze/IOCQ)]*

3 + 5 + 4 = 12

7. (a) Define transconductance, amplification factor and drain resistance of a JFET. *[(CO5)(Remember/LOCQ)]*

(b) Prove that $g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right)$, where symbols have their usual meanings. *[(CO5) (Analyze/IOCQ)]*

(c) An n-channel JFET has I_{DSS} =10mA and V_p=-4V. Determine the minimum value of V_{DS} for pinch off region and drain current I_D for V_{GS}=-2V in pinch off region. *[(CO5)(Remember/LOCQ)]*

4 + 4 + 4 = 12

Group - E

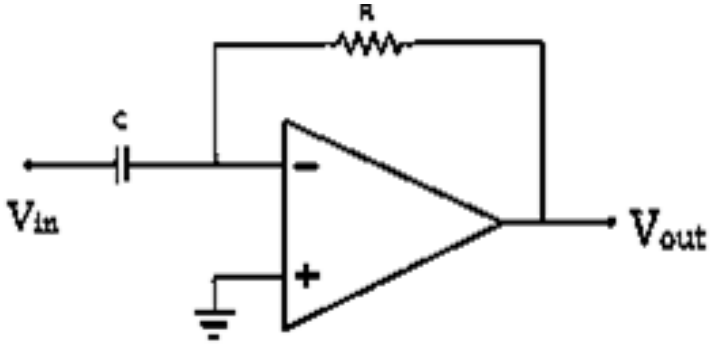
8. (a) Design a circuit to obtain V_{out}=-2V_1+3V_2+4V_3, using an OP-AMP, where V_1, V_2, V_3 are the input voltages taking minimum value of resistance as 10kΩ. *[(CO6)(Create/HOCQ)]*

(b) Derive the expression of gain in positive-feedback amplifier. *[(CO6)(Remember/LOCQ)]*

(c) Explain the significance of negative feedback on high-gain amplifiers. *[(CO6)(Remember/LOCQ)]*

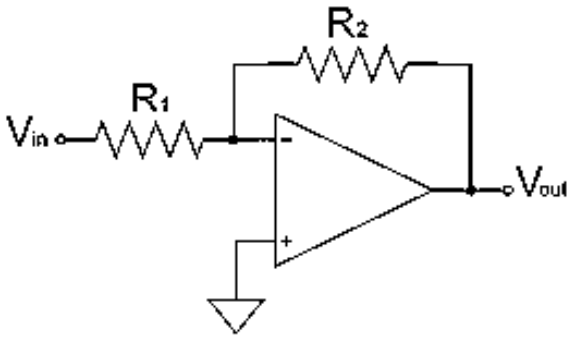
6 + 4 + 2 = 12

9. (a) Determine the expression of output voltage, V_{out} for the circuit given below.



[(CO6)(Analyse/IOCQ)]

(b) Derive the expression for voltage gain for the circuit given below (assuming ideal OP-AMP conditions)



[(CO6)(Remember/LOCQ)]

(c) If the gain of an amplifier is 90dB without feedback and 60dB with feedback, find the feedback factor of the amplifier. *[(CO6)(Apply/IOCQ)]*

5 + 5 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.92	30.21	21.87