(viii)   Input impedance of MOSFET is
     (a) less than that of FET but more than BJT
     (b) more than that of FET and BJT
     (c) more than that of FET but less than BJT
     (d) less than that of FET and BJT.

(ix)   An ideal OPAMP has
     (a) zero input impedance   (b) infinite gain
     (c) unity gain   (d) infinite output impedance.

(x)   Which one of the following feedback topologies offers high input impedance?
     (a) Voltage Series   (b) Voltage Shunt
     (c) Current Series   (d) Current Shunt.

Group – B

2. (a) Explain the mechanism of Zener breakdown and Avalanche breakdown in $p-n$ junction diode.

   (b) Why the temperature coefficient of zener breakdown voltage is negative explain?

   (c) Germanium has an intrinsic concentration of 2.5×10^{19} m^{-3} at 300 k. It is doped with 5×10^{19} arsenic atoms per m^3. Assume that all the As atoms are ionized. If the electron and hole mobilities are 0.38 and 0.18 m^2 /(Vs) respectively, determine the conductivity of doped germanium.

4 + 2 + 6 = 12

3. (a) Draw the energy band diagram of open circuit $p-n$ junction diode. Explain the following term with reference to a $p-n$ junction diode: uncovered charges, depletion region, potential barrier.

   (b) Show that the rectification efficiency of Full wave rectifier is double than half wave rectifier.

   (c) The voltage across the silicon diode at room temperature of 300 k is 0.71 V when 2.5 ma current flows through it. If the voltage increases to 0.8 V, calculate the new diode current.

4 + 4 + 4 = 12

Group – C

4. (a) Explain the mechanism of current flow in a p-n-p transistor. Why is the collector current slightly less than emitter current?

   (b) Draw the circuit of common collector configuration. Why is it mainly u impedance matching?

   (c) A silicon $n-p-n$ transistor having $\beta = 100$ and $I_{co} = 22nA$ is operated CE configuration. Assuming $V_{BE} = 0.7$ V, determine the transistor curren the region of operation of transistor.
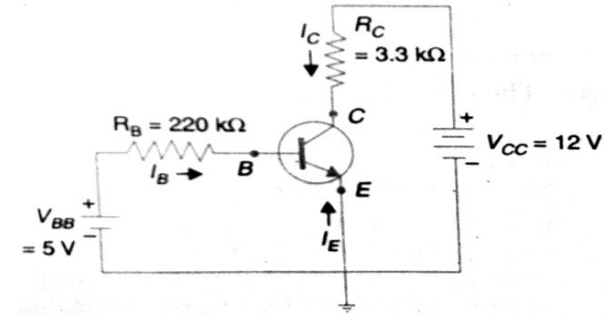
(3 + 1) + (2 + 1) + 5

5. (a) What do you mean by Q point and load line of a transistor and what a factors determining the choice of Q point?

   (b) Draw the circuit diagram of Self bias Emitter and explain why it has stability?

   (c) In a fixed biasing circuit determine I_B, I_C and V_{CE} if transistor is of s $V_{CC} = 10V$, $R_B = 2.5M\Omega$, $R_C = 15k\Omega$ and $\beta = 90$.

(3 + 1) + 4 + 4

Group – D

6. (a) Explain the working principle of n-channel JFET with a diagram.

   (b) Given $I_{DSS} = 6$ mA and $V_P = -4.5$ V determine ID at $V_{GS} = -2V$.

   (c) What do you mean by Pinch off voltage for n channel JFET? Draw tr characteristics and output characteristic curves of n channel JFET.

4 + 3 + (2 + 3)

7. (a) Differentiate between enhancement type and depletion type MC What do you mean by the threshold voltage?

   (b) Draw an n channel enhancement type MOSFET diagram with p biasing.

   (c) Explain why the channel is tapered towards drain terminal enhancement type MOSFET.

(3 +2) + 5 + 2

Group – E

8. (a) Write Barkhausen criteria for oscillation. Derive an expression for the gain of negative voltage feedback amplifier.

   (b) Mention how does negative feedback modify the input impedance and bandwidth of an amplifier.

   (c) A single stage transistor amplifier has a voltage gain of 600 without feedback, and 50 with feedback. Calculate the feedback factor.

$$(2 + 3) + 3 + 4 = 12$$

9. (a) What is CMRR of an OPAMP? What is the concept of virtual ground?

   (b) Draw the circuit diagram of an integrator using OPAMP and explain its working principle.

   (c) An OPAMP inverting amplifier has an input resistor of 10 kΩ and a feedback resistor of 50 kΩ. If the input voltage is 0.5 V find the output voltage.

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

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i)   A semiconductor has
           (a) negative temperature coefficient of resistance
           (b) zero temperature coefficient of resistance
           (c) positive temperature coefficient of resistance
           (d) none of the above.

   (ii)   A p – n junction diode is a
           (a) non – linear device   (b) bilateral device
           (c) linear device   (d) none of the above.

   (iii)   The ripple factor of a half - wave rectifier is
           (a) 1.8   (b) 2.4   (c) 1.21   (d) 0.48.

   (iv)   Avalanche breakdown is primarily dependent on the phenomenon of
           (a)ionization   (b)doping   (c)collision   (d)recombination.

   (v)   The base of a transistor is
           (a) moderately doped   (b) lightly doped
           (c) heavily doped   (d) none of the above.

   (vi)   In a BJT, I_c = 30 mA. If β= 100, then the base current is approximately
           (a) 0.03 mA   (b) 0.3 mA   (c) 1.21   (d) 0.48.

   (vii)   For self sustained oscillation the condition is
           (a) Aβ >1   (b) Aβ <1   (c) Aβ =1   (d) both (b) & (c).