## Group – E

8. (a) Define degenerative and regenerative feedback system. What are the possible topologies of a feedback amplifier?

   (b) What is Barkhausen criterion for the feedback oscillator?

   (c) An amplifier has a gain of 60 and distortion 10% without feedback. Determine (i) gain and (ii) distortion when negative feedback is applied, the feedback factor being 6.

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

9. (a) Explain the operation of an OP-AMP differentiator.

   (b) Compare the properties of a practical op-amp with those of ideal one.

   (c) When a voltage $V_1$ = 40 μV is applied to the non-inverting input terminal and a voltage $V_2$ = -40 μV is applied to the inverting input terminal of an OP-AMP, an output voltage $V_0$ = 100 mV is obtained. But when $V_1 = V_2$ = 40 μV, one obtains $V_0$ = 0.4 mV. Calculate the voltage gains for the difference and the common-mode signals, and the common mode rejection ratio.

**3 + 3 + 5 = 12**





# BASIC ELECTRONICS ENGINEERING
# (ECEN 1001)

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

   (ii) Band gaps of Si and Ge are respectively
   (a) 2 · 2 eV and 1· 2 eV (b) 1·1 eV and 0 · 67 eV
   (c) 0 · 67 eV and 1·1 eV (d) 1· 2 eV and 2 · 2 eV.

   (iii) An example of uni-polar electronic device is
   (a) Diode (b) JFET (c) BJT (d) Varactor diode.

   (iv) The current $I_{CBO}$ flows in the
   (a) emitter and base leads (b) collector and base leads
   (c) emitter and collector leads (d) none of these.

   (v) Highest input impedance is obtained in
   (a) BJT amplifier (b) JFET amplifier
   (c) MOSFET amplifier (d) diode rectifier.

   (vi) The effective channel length of a MOSFET in saturation decreases with increase in
   (a) gate voltage (b) drain voltage
   (c) source voltage (d) body voltage.

   (vii) A sinusoidal signal applied to the inverting terminal of an op-amp will experience at the output terminal, a phase shift of
   (a) 270° (b) 90° (c) 180° (d) 0°.

(viii) For a step input, the output of an integrator is
(a) a pulse (b) a triangular waveform
(c) a spike (d) a ramp.

(ix) An oscillator whose frequency is changed by a variable dc voltage, is known as
(a) a crystal oscillator (b) a VCO
(c) an Armstrong oscillator (d) a piezoelectric device.

(x) CMOS inverter uses little power because during operation
(a) both MOS are turned on
(b) both MOS are turned off
(c) none of the MOS are turned on
(d) one of the MOS devices is turned on.

## Group – B

2. (a) Sketch simple energy band diagram for intrinsic semiconductor at 0 K temperature. Show how the band diagram changes after addition of donor atoms to intrinsic semiconductor and indicate the change of Fermi level. Explain the electrical properties of this kind of materials using band diagrams.

(b) Why the built in barrier voltage in a p-n junction cannot be measured by a voltmeter?

(c) A current of 2 mA flows through a p-type Si bar having a length of 120 μm and cross-sectional area 100 $\mu m^2$ when a voltage of 5 V is applied across the bar. Calculate resistance, resistivity and impurity doping concentration of the sample.

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

3. (a) Explain with a circuit diagram the use of a zener diode as a reference diode.

(b) Explain the operation of a bridge rectifier with the help of a circuit diagram.

(c) The current flowing in a certain p-n junction at room temperature is $2\times10^{-7}$ amp when a large reverse biased voltage is applied. Calculate the current flowing when 0.1 volt is applied.

**4 + 5 + 3 = 12**





## Group – C

4. (a) The metal lead of the p-side of a p-n diode is soldered to the metal lead of the p-side of another p-n diode. Will the structure form an n-p-n transistor? Why?

(b) Explain the operation of NPN transistor in CB configuration with proper circuit diagram. What is early effect?

(c) The collector leakage current in a transistor is $300\,\mu A$ in CE arrangement. If the transistor is now connected in CB arrangement, what will be the leakage current? Given that $\beta = 100$.

**2 + (5 + 2) + 3 = 12**

5. (a) Derive the relation between $\alpha$ and $\beta$ for a BJT.

(b) 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.

(c) Define stability factors. Mention the factors responsible for the stability of Q-point.

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

## Group – D

6. (a) Draw the circuit diagram of a common source n channel JFET amplifier. Discuss its small signal operation.

(b) What is the pinch-off voltage for JFET? Sketch the depletion region before and after pinch-off.

(c) An n-channel Si-JFET has a donor concentration of $6 \times 10^{21}/m^3$ and channel width of 10 μm. If the dielectric constant of Si is 12, find the pinch-off voltage. Find the drain current and saturation voltage $V_{Dsat}$ for $V_{GS}$= -2V where $I_{DSS}$ = 20 mA, $\varepsilon = 12\varepsilon_o$.

**4 + 3 + 5 = 12**

7. (a) Explain the difference between enhancement and depletion type MOSFETs.

(b) Explain the basic construction of an enhancement type N-channel MOSFET. Draw and explain its static characteristics.

(c) How is the threshold voltage of MOS-transistor adjusted?

**3 + (3 + 3) + 3 = 12**