BASIC ELECTRONICS
(ECEN 1011)

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

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   If the temperature of an n-type semiconductor is increased then it becomes
   (a) more n-type   (b) P-type
   (c) intrinsic   (d) none of the above.

   (ii)   Semiconductors have
   (a) Zero Temperature Coefficient of Resistance
   (b) Positive Temperature Coefficient of Resistance
   (c) Negative Temperature Coefficient of Resistance
   (d) None of the above.

   (iii)   PIV of Bridge wave rectifier is
   (a) greater than PIV of half wave rectifier
   (b) less than PIV of half wave rectifier
   (c) equal to PIV of half wave rectifier
   (d) equal to PIV of full wave rectifier.

   (iv)   Transistor works as an amplifier in
   (a) active region   (b) reverse active region
   (c) saturation region   (d) cutoff region.

   (v)   If $\alpha = 0.98$, then the value of β of the transistor is
   (a) 0.49   (b) 49   (c) 50   (d) none of these.

   (vi)   Voltage Shunt Amplifier is
   (a) current amplifier   (b) voltage amplifier
   (c) transconductance amplifier   (d) transresistance amplifier.

   (vii)   JFET is a
   (a) voltage controlled device   (b) current controlled device
   (c) temperature controlled device   (d) none of these.

(viii)   An ideal Op-Amp has
(a) Infinite Gain   (b) Infinite Input Impedance
(c) Zero Output Impedance   (d) All of the Above.

(ix)   Ripple factor of a full wave rectifier is
(a) 0.406   (b) 1.21   (c) 0.482   (d) None of these.

(x)   When a reverse bias is applied across a diode, it will
(a) Raise the potential barrier
(b) Lower the potential barrier
(c) Increases the majority-carrier current greatly
(d) None of these.

Group- B

2.   (a)   Distinguish between metal, semiconductor and insulator.
                                         [(CO1)(Understand/LOCQ)]
     (b)   Calculate the resistivity of intrinsic silicon at 300K if it has intrinsic carrier concentration of $n_i = 1.5 \times 10^{16}$ m^{-3}, electron mobility $\mu_n = 0.13$ m^2/Vs, hole mobility $\mu_p = 0.05$ m^2/Vs.   [(CO1)(Analyze/IOCQ)]
     (c)   Explain how a Zener diode can be used for voltage regulation using a relevant circuit diagram?   [(CO2)(Analyze/IOCQ)]
                                         2 + 4 + 6 = 12

3.   (a)   Explain the operation of Bridge Rectifier.   [(CO3)(Understand/LOCQ)]
     (b)   Can built-in potential of a Diode be measured by voltmeter?   Explain.
                                         [(CO2)(Understand/LOCQ)]
     (c)   A Bridge Rectifier feeds a load resistance of 2.5 KΩ from 100V (RMS) Supply. Each diode of the rectifier has a forward biased resistance of 50Ω. Calculate (i) the DC Load Voltage, (ii) the Ripple Voltage at the Output, and (iii) % Load Regulation.   [(CO3)(Evaluate/HOCQ)]
                                         5 + 2 + 5 = 12

Group - C

4.   (a)   What is thermal runaway ?   [(CO4)(Remember/LOCQ)]
     (b)   Explain Early Effect, Punch Through and Avalanche Multiplication.
                                         [(CO4)(Remember/LOCQ)]
     (c)   A transistor having α = 0.925 and Reverse Saturation Current $I_{CO} = 10$ μA operates in CE configuration.   Find the value of β. If the Base Current is 300 μA, find the values of the Emitter and Collector Currents.
                                         [(CO4)(Analyze/IOCQ)]
                                         2 + 6 + 4 = 12

5.   (a)   Define Stability Factor of Bipolar Junction Transistor and state its significance.
                                         [(CO4)(Understand/LOCQ)]

(b) Draw the circuit diagram for fixed bias considering an npn transistor in CE mode. Derive the expression for its stability factor. Mention the merits and demerits of this arrangement. [(CO4)(Evaluate/HOCQ)]

4 + 8 = 12

Group - D

6. (a) Describe the working principle of JFET with neat diagram. Draw the drain characteristics of JFET and mark the various regions of operation.
[(CO5)(Understand/LOCQ)]

(b) Explain how it can be used as a Voltage Variable Resistor (VVR).
[(CO5)(Apply/IOCQ)]

8 + 4 = 12

7. (a) Explain the phenomena of Accumulation, Depletion and Inversion in Enhancement Type MOSFET. [(CO5)(Understand/LOCQ)]

(b) Can Depletion Type MOSFET be operated in Enhancement Mode? Explain.
[(CO5)(Analyze/IOCQ)]

(c) Explain the term "Pinch-Off Voltage" in FET. [(CO5)(Remember/LOCQ)]

6 + 4 + 2 = 12

Group – E

8. (a) An amplifier has voltage gain of 500 without feedback. Calculate the voltage gain with negative feedback, given that the feedback ratio is 0.04.
[(CO6)(Analyze/IOCQ)]

(b) Draw the circuit and find the input-output relationship of Op-amp based.
(i) Adder
(ii) Integrator. [(CO6)(Evaluate/HOCQ)]

4 + (4 + 4) = 12

9. Write short notes on any three: **(3 × 4) = 12**
(i) Channel length modulation
(ii) Fermi level
(iii) Barkhausen criterion
(iv) Feedback topologies. [(CO6)(Remember/LOCQ)]

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	51.04	27.08	21.88

Course Outcome (CO):

After the completion of the course students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question