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) The wavelength emitted during recombination depends on the
(a) forward voltage (b) forward current
(c) band gap energy of the material (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) Reverse saturation current in silicon PN junction diode nearly doubles for every
(a) 20°C rise in temperature (b) 50°C rise in temperature
(c) 60°C rise in temperature (d) 10°C rise in temperature.

(iv) A transistor is cut off when
(a) both the emitter and the collector junctions are forward biased
(b) both the emitter and the collector junctions are reverse biased
(c) the emitter junction is reverse biased and the collector junction is forward biased
(d) the emitter junction is forward biased and the collector junction is reverse biased.

(v) The ripple factor of bridge rectifier is
(a) 0.482 (b) 0.812 (c) 1.11 (d) 1.21.

(vi) The doping of the emitter region of a transistor is _____ that of the base region.
(a) greater than (b) equals to (c) less than (d) none of these

(vii) Field Effect Transistor is advantageous in comparison with Bipolar Junction Transistor because of
(a) High Input Impedance (b) High Gain
(c) High Gain Bandwidth Product (d) Current Controlled Behaviour.

(viii) When you apply a triangular waveform to the input of a differentiator, the output is
(a) A dc level
(b) An inverted triangular waveform
(c) A square waveform
(d) The first harmonic of the triangular waveform.

(ix) The Common – mode gain for OPAMP is
(a) Very high (b) Very low (c) Always unity (d) Unpredictable.

(x) Negative feedback
(a) Increases the input and output impedance's
(b) Increases the input impedance and the bandwidth
(c) Decreases the output impedance and the bandwidth
(d) Does not affect impedance's or bandwidth.

Group- B

2. (a) Explain the difference between a metal, an insulator and a semiconductor. [(CO1)(Understand/LOCQ)]
(b) Distinguish between Zener breakdown and Avalanche breakdown. [(CO2)(Understand/LOCQ)]
(c) Derive the expressions of Drift and Diffusion Currents for electrons and holes in Semiconductors. [(CO1,CO2)(Analyze/IOCQ)]
4 + 4 + 4 = 12

3. (a) Draw the circuit diagram and input–output waveform for a half wave rectifier and explain its operation. [(CO3)(Analyze/IOCQ)]
(b) What are the differences between half wave, full wave and bridge rectifiers? [(CO3)(Understand/LOCQ)]
(c) Draw the V-I characteristic curve for p-n junction (forward and reverse bias) and explain the nature. [(CO2)(Analyze/IOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Draw input and output characteristics for common base p-n-p transistor. [(CO4)(Analyze/IOCQ)]
(b) Why BJT is a bipolar device and why it is a current control device. [(CO4)(Remember/LOCQ)]
(c) A transistor having $\alpha = 0.975$ and a reverse saturation current I_{CO}=10uA, is operated in CE configuration. What is β for the configuration? If the base current is 250uA, calculate the collector current. [(CO4)(Evaluate/HOCQ)]
4 + 4 + 4 = 12

5. (a) Explain, Early Effect and thermal runaway ? [(CO4)(Understand/LOCQ)]

(b) State and discuss the Stability Factors in BJT biased circuit. [(CO4)(Analyze/IOCQ)]

(c) Discuss the points of merit of Self Biased Circuit over Fixed Bias Circuit. [(CO4)(Analyze/IOCQ)]

4 + 4 + 4 = 12

Group - D

6. (a) Explain the difference between Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET). [(CO5)(Understand/LOCQ)]

(b) When is the channel of a JFET said to be pinched off? [(CO5)(Analyze/IOCQ)]

(c) The pinch off voltage of a p-channel JFET is V_p=5V, and I_{DSS}= -40mA. The Drain – source voltage V_{DS} is such that the a saturation drain current I_{DS} =-15mA is maintained. Find the gate-source voltage V_{GS}. [(CO5)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

7. (a) Explain with a diagram the structure of an n-channel Enhancement Type MOSFET. [(CO5)(Understand/LOCQ)]

(b) A MOSFET operated in the depletion mode can work in the enhancement mode also, yes or no? Justify your answer. [(CO5)(Analyze/IOCQ)]

(c) Draw the drain characteristics for an n-channel MOSFET operated in depletion mode and show the different regions. [(CO5)(Analyze/IOCQ)]

4 + 4 + 4 = 12

Group – E

8. (a) State and explain the Barkhausen Criteria of Oscillation. [(CO6)(Remember/LOCQ)]

(b) Why negative feedback is preferred over positive feedback? [(CO6)(Analyze/IOCQ)]

(c) An amplifier has a voltage gain of -100. The feedback ratio is -0.04. Find (i) the voltage gain with feedback, (ii) the amount of feedback in dB, (iii) the output voltage of the feedback amplifier for an input voltage of 40 mV, (iv) the feedback factor and (v) the feedback voltage. [(CO6)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

9. (a) State the characteristics of ideal operational amplifier and compare the values of the parameters of ideal and practical operational amplifiers. [(CO6)(Remember/LOCQ)]

(b) Explain the application of Op-Amp as Differentiator with circuit diagram. [(CO6)(Apply/IOCQ)]

(c) The inverting amplifier circuit has input resistance R_1 = 1 Kohm and feedback resistance R_f = 3 Kohm. Determine the output voltage and output current for an input voltage of 2V. [(CO6)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37	46	17

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 analyse 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. Analyse 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 analyse 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