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) The forward voltage drop across a silicon diode is about
(a) 2.5 V   (b) 3 V   (c) 10 V   (d) 0.7 V

(ii) By which process impurity is added to an intrinsic semiconductor?
(a) Doping   (b) Recombination
(c) Atomic modification   (d) Ionization.

(iii) Although current is blocked in reverse-biased diode
(a) there is some current due to majority carriers
(b) there is some current due to minority carriers
(c) there is avalanche current
(d) none of the above.

(iv) If both junction of transistor operated in reversed biased then transistor operated in
(a) Cut off region   (b) Active region
(c) Inverted region   (d) Saturation region.

(v) If biasing is not done in an amplifier circuit, it results in
(a) decrease in the base current   (b) unfaithful amplification
(c) excessive collector bias   (d) none of the these.

(vi) The ripple factor of half wave and full wave rectifier are
(a) 1.11 and 0.48   (b) 0.49 and 1.12
(c) 1.21 and .81   (d) 1.21 and 0.48.

(vii) A summing amplifier can have
(a) only one input   (b) only two inputs
(c) any number of inputs   (d) none of these.

(viii) Negative feedback
(a) increases the input and output impedances
(b) increases the input impedance and bandwidth
(c) decreases the output impedance and bandwidth
(d) does not affect impedance or bandwidth.

(ix)   An ideal Op-Amp has
      (a) infinite voltage gain, A_v (b) infinite input impedance, R_i
      (c) zero output resistance   (d) all of the above.

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

Group – B

2. (a)   A germanium diode draws 40 mA current with a forward bias of 0.25 V. The junction is at room temperature of 300 K. Calculate the reverse saturation current.
                                      [(CO2)(Analyze/HOCQ)]
  (b)   Explain the V-I characteristics of pn junction diode.   [(CO2)(Understand/LOCQ)]
  (c)   A half-wave rectifier with a diode having forward resistance 20 ohm, is fed with a sinuisoidal voltage of 40 V and frequency 50 Hz. The load resistance is 200 ohm. Evaluate (i) dc load current (ii) dc power output (iv) ripple voltage across load resistance and (iv) rectification efficiency.   [(CO3)(Evaluate/HOCQ)]
                                          3 + 3 + 6 = 12

3. (a)   What is ripple factor? Evaluate the ripple factor and efficiency of a half-wave rectifier.
                                      [(CO3)(Evaluate/HOCQ)]
  (b)   Explain the operation of a full wave rectifier with centre tapped transformer.
                                    [(CO3)(Understand/LOCQ)]
  (c)   AC voltage of 230 volt is applied to a half wave rectifier through a transformer of turn ratio 10:1. The load resistance value is 1 kΩ and diode resistance is 20 Ω.
      Determine
      (i) I_m, I_{dc}, and I_{rms} (ii) DC power output.   [(CO3)(Evaluate/HOCQ)]
                                      (2 + 4) + 3 + 3 = 12

Group – C

4. (a)   Discuss the static characteristics of an n-p-n transistor in Common Emitter configuration.   [(CO4)(Remember/LOCQ)]
  (b)   Compare and contrast BJT with FET.   [(CO4, CO5)(Analyze/IOCQ)]
  (c)   A transistor is operating in the CE mode. Calculate V_{CE} if β = 125 assuming V_{BE}=0.6 V.
                                      [(CO4)(Evaluate/HOCQ)]
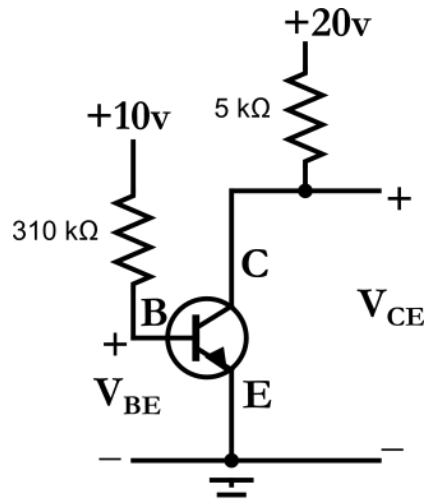
   **4 + 4 + 4 = 12**

5. (a) Explain (i) Early effect (ii) Punch through in BJT.   [(CO4)(Understand/LOCQ]
   (b) Explain the input and output characteristics of BJT in CB mode.
                                                           [(CO4)(Understand/LOCQ)]
   (c) A transistor having α = 0.95 and a reverse saturation current I_{CO} = 10 μA is operated in CE configuration. Evaluate β for this configuration? If the base current is 200 μA, evaluate the emitter current and the collector current.   [(CO4)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

Group – D

6. (a) Why is FET called unipolar transistor? What do you mean by pinch-off voltage for n-channel JFET?   [(CO5)(Remember/LOCQ)]
   (b) Draw the typical Transfer and Drain characteristics of an n-channel JFET.
                                                           [(CO5)(Remember/LOCQ)]
   (c) In an n-channel JFET, I_{DSS} is 6 mA and V_p= -6 V. Find the minimum value of V_{DS} for pinch-ff operation. Determine drain current at V_{GS}= -3 V.   [(CO5)(Evaluate/HOCQ)]

(2 + 2) + 4 + 4 = 12

7. (a) Explain the basic construction and operation of a P-channel JFET.
                                                           [(CO5)(Remember/LOCQ)]
   (b) In what respect, a JEFT differs from MOSFET?   [(CO5)(Analyze/IOCQ)]
   (c) Assume that the reverse gate voltage of a JFET changes from 5 V to 4.9 V and the drain current changes from 1.2 mA to 1.5 mA. What is the value of Transconductance?
                                                           [(CO5)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

Group – E

8. (a) Describe the inverting and non-inverting OP-AMPs.   [(CO6)(Remember/LOCQ)]
   (b) Draw and explain the principal operation of an Op-Amp as an Adder.
                                                           [(CO6)(Analyze/IOCQ)]
   (c) Find the output voltage V_0 of the three input (input voltages are -5 V, +3 V and +4 V) summing amplifier circuit given below: [(CO6)(Evaluate/HOCQ)]
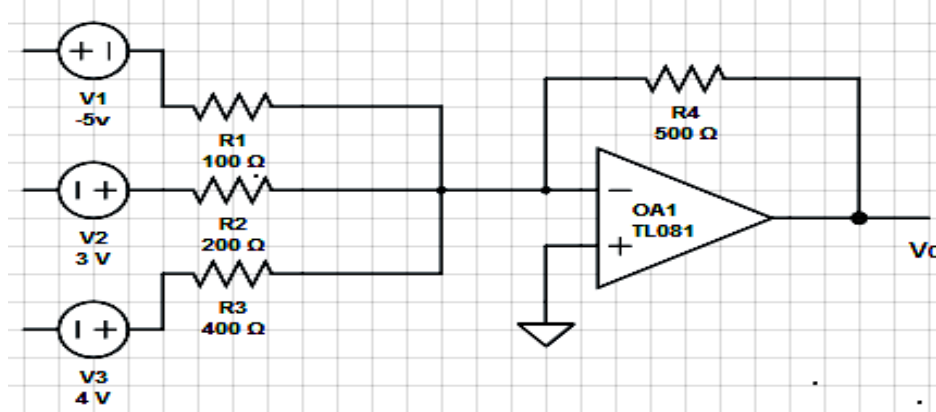
(3 + 3) + 4 + 2 = 12

9. (a) Explain the working principle of a feedback amplifier with the help of a block diagram. Find out an expression for the voltage gain with feedback.
                                                           [(CO5)(Understand/LOCQ)]

(b)   Explain Barkhausen criteria.   [(CO5) (Understand/LOCQ)]
(c)   Explain the operation of an (i) OP-AMP Integrator (ii) OP-AMP Differentiator with
       proper circuit diagrams.   [(CO5)(Understand/LOCQ)]
4 + 3 + 5 = 12

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	50	12.5	37.5

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