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.

   (b) Write short notes on any three:
   (i) Fermi Dirac distribution principle
   (ii) Mass Action Law
   (iii) Moore's Law
   (iv) Barkhausen criterion
   (v) LED.

3 + (3 × 3) = 12

9. (a) Explain the concept of virtual ground in an OPAMP. How is it different from a 'real' ground?

   (b) Draw the open loop characteristics of an OPAMP. Show how an OPAMP can be used as a voltage comparator.

5 + (2 + 5) = 12

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 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) Zener breakdown occurs
   (a) mostly in Germanium junctions
   (b) due to rupture of covalent bonds
   (c) in lightly doped junctions
   (d) due to thermally generated minority carriers.

   (ii) With increase of temperature in a p-n junction diode
   (a) Zener breakdown voltage increases while Avalanche breakdown voltage decreases
   (b) Both Zener breakdown voltage and Avalanche breakdown voltage decrease
   (c) Both Zener breakdown voltage and Avalanche breakdown voltage increase
   (d) Zener breakdown voltage decreases while Avalanche breakdown voltage increases.

   (iii) The Q-point in a voltage amplifier is selected in the middle of the active region because
   (a) it gives better stability
   (b) the circuit needs a small dc voltage
   (c) the biasing circuit then needs less number of resistors
   (d) it gives distortion less output.

   (iv) When the base width of a BJT becomes zero, the transistor is said to be in
   (a) punch through (b) cut off
   (c) saturation (d) breakdown.

(v) In energy band diagram of n-type semiconductor, the donor energy level is
(a) slightly below conduction band (b) in conduction band
(c) slightly above valence band (d) in valence band.

(vi) In a bridge rectifier, if V_m is the peak voltage across the secondary, the PIV is
(a) V_m (b) $2V_m$
(c) $V_m/2$ (d) $V_m/\sqrt{2}$.

(vii) The CMRR of an ideal op amp is
(a) zero (b) infinity
(c) less than unity (d) greater than unity.

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

(ix) Positive feedback is used in
(a) amplifiers (b) oscillators
(c) rectifiers (d) detectors.

(x) The maximum rectification efficiency in case of full wave rectifier is
(a) 100% (b) 81.2%
(c) 66.6% (d) 40.6%.

Group - B

2. (a) Explain the operation of a centre tapped full wave rectifier with the help of a circuit diagram.

(b) The forward resistance R_F of a diode is 20Ω. This diode is used in a half wave rectifier circuit. The applied input voltage is $v = 50\sin \omega t$ and load resistance R_L is 800 Ω.
Determine: (i) The dc load current
(ii) The dc power output
(iii) Rectification efficiency

6 + 6 = 12

3. (a) Show how a Zener diode can be used as a reference diode in a circuit.

(b) A 12V, 0.36W Zener diode operates at a minimum current of 2mA. It is connected to a supply voltage of 15V with a series resistance R and a load resistance R_L. Calculate R and the range over which R_L can be varied.

7 + 5 = 12

Group - C

4. (a) Why is the emitter region of a transistor more heavily doped than the base?

(b) Draw the common-base input characteristics of a transistor and explain the Early effect.

(c) An n-p-n transistor with α of 0.98 is operated in the CB mode. Calculate the base current and the collector current if the emitter current is 3mA and the reverse saturation current is 10μA.

2 + 6 + 4 = 12

5. (a) What is transistor biasing? Mention the factors for determining the choice of the quiescent point.

(b) What is thermal runaway in BJTs? Justify the use of a self-bias circuit in improving the circuit stability.

(2 + 2) + (2 + 6) = 12

Group - D

6. (a) Does any current flow through an n-channel enhancement and a depletion MOSFET with a zero gate-to-source voltage and a positive drain bias? Justify your answer. Draw the static characteristics of an n-channel MOSFET operated in both the enhancement and depletion modes.

(b) An n-channel enhancement mode MOSFET shows a saturation drain current of 5mA for V_{GS} = 8V. If the threshold voltage is 4V calculate the saturation drain current for V_{GS} = 10V.

(3 + 5) + 4 = 12

7. (a) When is the channel of a JFET said to be pinched off. Explain pinch of voltage with the help of appropriate illustration.

(b) Draw the drain characteristics of a JFET, indicate the different regions of operation and explain how it can be used as a Voltage Variable Resistor (VVR).

6 + 6 = 12