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

   (ii) If the a.c. input to a half-wave rectifier is an r.m.s value of $400/\sqrt{2}$
         volts, then diode PIV rating is
         (a) $400/\sqrt{2}$ V   (b) 400 V
         (c) $400 \times \sqrt{2}$ V   (d) none of the above.

   (iii) In Enhancement n-channel MOSFET, an induced n-type channel can be
         produced between the source and the drain if
         (a) VGS = 0   (b) VGS is positive
         (c) VGS is negative   (d) None of these.

   (iv) Which of the following devices has the highest input impedance?
         (a) JFET   (b) MOSFET
         (c) Crystal diode   (d) ordinary transistor.

   (v)   The active components in an IC are
         (a) Resistors   (b) Capacitors
         (c) Transistors and diodes   (d) None of the above.

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

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

   (viii) The gain of an amplifier with feedback is known as
         (a) Resonant gain   (b) Open loop gain
         (c) Closed loop gain   (d) None of the above.

   (ix) In a Common Base BJT, for a fixed emitter base junction forward bias,
         increase in reverse bias across the collector base junction,
         (a) increases emitter current   (b) decreases emitter current
         (c) keeps emitter current constant   (d) makes emitter current zero.

   (x)   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.

Group – B

2. (a) Explain the mechanism of Zener breakdown in p-n junction and
       explain how it differs from avalanche breakdown.

   (b) Explain the drift and diffusion mechanism of charge carriers in a semiconductor.

   (c) Calculate the thermal equilibrium electron and hole concentration in a
       germanium sample for a given doping density. Assume that the
       germanium sample is at T=300k in which $N_d = 5 \times 10^{13}$ cm^{-3} and $N_a = 0$.
       Assume that $n_i = 2.4 \times 10^{13}$ cm^{-3}.

                                                    (3 + 2) + 4 + 3 = 12

3. (a) Plot the volt-ampere curve for a P-N junction diode and explain the
       nature of this curve.

   (b) What is ripple factor? Evaluate the ripple factor and efficiency of a
       half-wave rectifier.

   (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
       (iii) AC power input
       (iv) Efficiency of rectification

                                                    3 + (2 + 3) + 4 = 12

Group – C

4. (a) Discuss the static characteristics of an n-p-n transistor in Common
       Base configuration.

   (b) Explain the circuit diagram for Fixed-biased configuration considering an n-
       p-n transistor in CE mode. Derive the expression for its stability factors.
                                                    6 + (3 + 3) = 12

5. (a) Derive the relationship between α and β in a BJT.
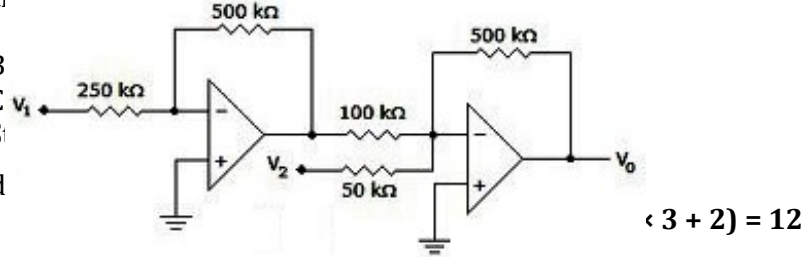
(b) Draw the collector to base bias BJT amplifier circuit

Derive
(i) B
(ii) C V_1
(iii) S

What d

500 kΩ

500 kΩ

250 kΩ

100 kΩ

V_2

50 kΩ

‹ 3 + 2) = 12

(b) In Fig.1. If V_1=0.5V and V_2=0.1V, find V_o

V_o

Fig.1

6 + 6 = 12

Group – D

6. (a) With the help of appropriate diagram explain the operation of an n-channel JFET.

(b) Draw and explain the drain and transfer characteristics of such n-channel JFETs.

6 + 6 = 12

7. (a) Why is FET called unipolar transistor? What do you mean by pinch-off voltage for n-channel JFET?

(b) What is the major physical difference between an enhancement-type and a depletion-type MOSFET? Draw the typical volt-ampere drain characteristics curve of a p-channel enhancement type MOSFET.

(c) In an n-channel JFET, I_{DSS} is 6 mA and V_p = -6V. Find the minimum value of V_{DS} for pinch-ff operation. Determine drain current at V_{GS} = -3v.

(1 + 2) + (3 + 2) + 4 = 12

Group – E

8. Write short notes on any three of the followings:
(i) Light Emitting Diode (LED)
(ii) CMRR
(iii) Integrated Circuit
(iv) Virtual Ground.

4 + 4 + 4 = 12

9. (a) Describe the use of an op-amp as an integrator and derive its input-output relation. Draw its relevant input and output waveforms.