2014

BASIC ELECTRONICS ENGINEERING
(ECEN 1001)

Time Alloted : 3 Hours *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) Resistivity of intrinsic semiconductor is of the order of

   (a) 10^{-8} Ω m (b) 10^{10} Ω m

   (c) 10^{-3} Ω m (d) 10^{12} Ω m

   ii) Fixed bias of BJT is not generally used in amplifier because of

   (a) low operating point stability

   (b) low power output

   (c) low input impedance

   (d) high output impedance

iii) Reverse saturation current, in a p-n diode is mainly
(a) minority diffusion current
(b) minority drift current
(c) majority diffusion current
(d) majority drift current

iv) An intrinsic semiconductor at absolute zero temperature
(a) has large number of holes
(b) has same number of holes & electrons
(c) acts as metallic character
(d) acts as an insulator

v) Most commonly used transistor circuit arrangement is :
(a) common base (b) common collector
(c) common emitter (d) none of these

vi) Highest input impedance is obtained in
(a) BJT amplifier (b) JFET amplifier
(c) MOSFET amplifier (d) diode rectifier

vii) Voltage series feedback is used in
(a) voltage amplifier
(b) current amplifier
(c) trans-conductance amplifier
(d) trans-resistance amplifier

viii) The input impedance of ideal op-amp is
(a) finite (b) zero
(c) unity (d) infinite

ix) CMOS is a

(a) p-channel MOS

(b) n-channel MOS

(c) Combination of p-and n-channel MOS

(d) V-MOS

x) The maximum efficiency of full wave rectifier circuit

(a) 40.6% (b) 100%

(c) 81.2% (d) 85.6%

GROUP - B

2. (a) Sketch simple energy band diagram for intrinsic semiconductor at 0K temperature. Show how the band diagram changes after addition of donor atoms to intrinsic semiconductor and indicate the change of Fermi level. Explain the electrical properties of this kind of materials using band diagrams.

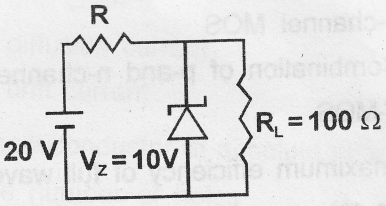
(b) Give the difference between intrinsic and extrinsic semiconductor with proper diagram and examples.

(c) Calculate the ratio of the current for a forward bias of 0.08 V to the current for the same value of reverse bias applied to a Si p-n diode at 27°C.

(2+2+2)+3+3 = 12

3. (a) Explain the mechanism of avalanche break down in p-n junction and write how it differs from Zener break down. Why Zener diode is called a reference diode?

(b) The following figure shows an electronic voltage regulator using Zener diode.



The Zener diode may be assumed to require a minimum current of 25 mA for satisfactory operation. Find the value of R for satisfactory voltage regulation of the circuit.

(c) How are the width of the space charge region and barrier height affected when a p-n junction is forward biased and reverse biased? Explain with neat diagrams.

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

GROUP - C

4. (a) "Two diode connected back to back does not form a transistor" — explain.

(b) Derive the relation between α and β. A n-p-n BJT has $\alpha = 0.99$ and reverse saturation current $I_{CEO} = 100\mu A$.If the base current is $10\mu A$, calculate the emitter current and collector current.

(c) Define stability factor. Mention the factors responsible for the stability of Q-point. **3+(2+3)+(2+2) = 12**

5. (a) Draw a circuit diagram of a BJT in CE mode for the study of output characteristics and sketch the characteristics indicating saturation, active and cut off regions.

(b) With appropriate circuit diagram explain the DC load line analysis of Semi-conductor diode.

(c) Briefly explain the drift and diffusion currents.

4+5+3 = 12

Group - D

6. (a) Draw the circuit diagram of a common source n channel JFET amplifier. Discuss its small signal operation.

   (b) Deduce the relation $\mu = r_d g_m$

   (c) An n-channel Si-JFET has a donor concentration of $5 \times 10^{21}/m^3$ and channel width of 6μm. If the dielectric constant of Si is 12, find the pinch-off voltage. Find the drain current and saturation voltage V_{Dsat} for $V_{Gs} = -2V$ where $I_{DSS} = 15mA$, $\varepsilon = 12\varepsilon_o$

   4+3+5 = 12

7. (a) Describe the construction and operating principle of MOSFET. State the advantage of MOSFET.

   (b) A JFET has a drain current of 5 mA and $V_{GS} = -6V$. Calculate the value of Pinch off voltage V_P.

   (c) What is the need for applying a sawtooth voltage in a CRT? How is such a voltage generated?

   6+3+3 = 12

GROUP - E

8. (a) Show that negative feedback improves the stability of the gain of an amplifier.

   (b) The open loop gain of an amplifier is –200. A voltage series negative feedback is used with a feedback ratio of –0.02. The input and output impedances of the amplifier are 2kΩ and 50 kΩ respectively in the absence of feedback. Determine the closed loop gain and the imput and output impedances when the feedback circuit is completed.

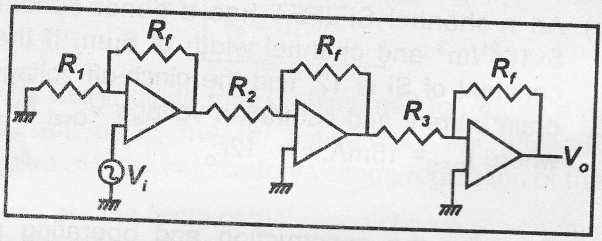
   (c) Draw the block diagram of a voltage series amplifier.

   (d) State Barkhausen criteria. **3+4+3+2 = 12**

9. (a) Explain the operation of an OPAMP integrator.

(b) What are the characteristics of an ideal OPAMP?

(c) Calculate the output voltage V_o for the circuit shown in below.



Given : R_f = 470 kΩ, R_1 = 4.3 kΩ,R_2 = 33 kΩ, R_3 = 33 kΩ and input voltage V_i = 80 μV.

(d) What is slew rate and why is it important?

3+3+4+2 = 12