2015

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) If the differential voltage gain and the common mode voltage gain of a differential amplifier are 48 dB and 2 dB respectively, then its common mode rejection ratio is

   (a) 23 dB (b) 25 dB

   (c) 46 dB (d) 50 dB

   ii) Zener breakdown occurs

   (a) mostly in germanium junctions

   (b) due to rupture of covalent bonds

   (c) in light-doped junctions

   (d) due to thermally-generated minority carriers

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) The ripple factor of power supply is a measure of
   (a) its filter efficiency (b) diode rating
   (c) its voltage regulation (d) purity of power output

v) In a transistor, β may be expressed in terms of α as below:
   (a) $\alpha/(1 + \alpha)$ (b) $\alpha/(1 - \alpha)$
   (c) $(1 + \alpha)/\alpha$ (d) $(1 - \alpha)/\alpha$

vi) In a pnp germanium transistor, the cut in voltage is about
   (a) – 0.1 volt (b) – 0.01 volt
   (c) – 0.5 volt (d) none of these

vii) The ideal value of stability factor of a biasing circuit is
   (a) 1 (b) 5 (c) 10 (d) 100

viii) Which of the following statements is not true in case of FET?
   (a) it has high input impedance
   (b) it is noisier that bipolar transistor
   (c) it has large gain-bandwidth product
   (d) all of above

ix) When a reverse bias is applied to a diode, it will
   (a) Raise the potential barrier
   (b) Lower the potential barrier
   (c) Increases the majority-carrier current greatly
   (d) None of these

x) The negative feedback in an amplifier
   (a) reduces the voltage gain
   (b) increases the voltage gain
   (c) does not affect the voltage gain
   (d) can convert it into an oscillator if the amount of feedback is enough

GROUP - B

2. (a) Distinguish between Zener breakdown and Avalanche breakdown.

   (b) A sample of silicon at a given temperature T in intrinsic condition has a resistivity of $25 \times 10^4 \Omega$-cm. The sample is now doped to the extent of 4×10^{10} donor atoms/cm^3 and 10^{10} acceptor atoms/cm^3. Find the total conduction current density if the electric field of 4V/cm is applied across the sample. Given that μ_n= 1250 cm^2/V-s, μ_p = 475 cm^2/V-s at the given temperatue.

   (c) What is junction capacitance? **(4+6+2) = 12**

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

   (b) Explain the operation of a full wave rectifier with centre tapped transformar.

   (c) A full wave P-N diode rectifier uses load resistor of 1500 Ω. No filter is used. Assume each diode to have idealized charecteristic with R_f = 10 Ω and R_r = ∞. The wave voltage applied to each diode has amplitude of 30 volts and frequency 50 Hz. Calculate (i) peak, d.c. and rms load current, (ii) d.c. power output, (iii) a.c. power input, (iv) rectifier efficiency.

(2+3)+3+4 = 12

GROUP - C

4. (a) What is meant by d.c operating point or Q point in the context of transistor characteristics? What is load line? Why is transistor biasing necessary?

   (b) Compare and contrast BJT with FET.

   (c) A transistor has I_B = 105 μA and I_C = 2.05 mA. Find (i) β of transistor, (ii) α of transistor, (iii) emitter current I_E, (iv) the new value of β, if I_B changes by 27 μA and I_C changes by +0.65 mA. **(2+1+2)+3+4 = 12**

5. (a) Discuss the static characteristics of an npn transistor in Common Base configuration.

   (b) Draw the circuit diagram for collector-to-base-biased configuration considering an n-p-n transistor in CE configuration. Derive the expression for its stability factor. **6+(3+3) = 12**

Group - D

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

   (b) Explain the basic operation of depletion type n channel MOSFET with a suitable diagram.

   (c) The pinch-off voltage of an n-channel junction FET is V_P = 5 V and the drain to source saturation current I_{DSS} = −40 mA. The value of drain to source voltage V_{DS} is such that it is operated in saturation region. The drain current is given by I_D = −15 mA. Determine V_{GS}. **(1+2)+5+4 = 12**

7. (a) Differentiate between enhancement type and depletion type MOSFET. What do you mean by threshold voltage?

   (b) Draw an n-channel enhancement type MOSFET diagram with proper biasing.

   (c) Explain why the channel is tapered towards drain terminal of an enhancement type MOSFET. **(4+1)+4+3 = 12**

GROUP - E

8. (a) Write the properties of an ideal op-amp.

   (b) Design CMRR and slew rate of an op-amp.

   (c) A 5mV, 1 kHz sinusoidal signal is applied to the input of an op-amp integrator for which R = 100k Ω and C = 1μF. Calculate the output voltage. **4+(2+2)+4 = 12**

9. (a) What are the effects of negative feedback?

   (b) Expain how gain is stabilized in a negative feedback circuit.

   (c) An amplifier has voltage gain with feedback of 100. If the gain without feedback changes by 20% and the gain with feedback should not vary more than 2%, determine the values of open loop gain A and feedback ratio β. **4+4+4 = 12**