**CS/B.Tech/SEM-1/EC-101/2009-10**

# 2009
# BASIC ELECTRONICS ENGINEERING

*Time Allotted* : 3 Hours                                    Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words*
*as far as practicable.*

### GROUP – A
### ( Multiple Choice Type Questions )

1.  Choose the correct alternatives for any *ten* of the
    following :                                    10 × 1 = 10

    i)   Bandgaps of Silicon and Germanium are

         a)   0·67 eV and 1·1 eV        b)   5·89 eV and 4·56 eV

         c)   0·87 eV and 6·78 eV      d)   0·54 eV and 0·786 eV.

    ii)  Gain of inverting op-amp is

         a)   $-R_f/R_1$

         b)   $\left(1+R_f/R_1\right)$

         c)   $\left(R_f+R_1\right)/R_f$

         d)   $-\left(R_f+R_1\right)/R_1$.

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iii) In active mode of operation of BJT

    a) emitter-base junction is forward-biased and collector-base junction is reverse-biased

    b) emitter-base junction is forward-biased and collector-base junction is forward-biased

    c) emitter-base junction is reverse-biased and collector-junction is forward-biased

    d) emitter-base junction is reverse-biased and collector-base junction is reverse-biased.

iv) In CRO, circle is produced as Lissajuos figure when the phase difference between $x$ and $y$-signals is

    a) 90°            b) 180°

    c) 270°          d) 0°.

v) SCR has_terminals

    a) 3            b) 4

    c) 2            d) 6.

vi) CMRR =

    a) Mod $(A_d/A_c)$ [ $A_d$ = voltage gain for difference signal; $A_c$ = voltage gain for common mode signal ]

    b) $V_2/V_1$ [ $V_1$ = non-inverting input terminal signal; $V_2$ = inverting input terminal signal ]

    c) $A_1 - A_2$ [ $A_1$ = voltage gain when inverting terminal is grounded; $A_2$ = voltage gain when non-inverting terminal is grounded ]

    d) $V_d\,V_c$ [ $V_d$ = difference signal; $V_c$ = common-mode signal ].

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vii) The diffusion capacitance of a forward-biased $p$-$n$ junction diode varies

    a)    linearly with current

    b)    inversely with current

    c)    as the square of the current

    d)    as the square root of the current.

viii) When the reverse voltage across $p$-$n$ junction is gradually decreased, the depletion region inside the diode

    a)    does not change in width

    b)    initially increases upto certain width then decreases

    c)    continuously increases in width

    d)    continuously decreases in width.

ix) Semiconductors have

    a)    zero temperature coefficient of resistance

    b)    positive temperature coefficient of resistance

    c)    negative temperature coefficient of resistance

    d)    none of these.

x) The ripple factor of a power supply is a measure of

    a)    its filter efficiency

    b)    its voltage regulation

    c)    diode rating

    d)    purity of power output.

xi) The maximum efficiency of a full-wave rectifier can be

    a)   37·2%                  b)   40·6%

    c)   53·9%                  d)   81·2%.

xii) JFET is a

    a)   voltage controlled voltage source

    b)   voltage controlled current source

    c)   current controlled voltage source

    d)   current controlled current source.

xiii) Input and output impedances of a voltage shunt feedback are

    a)   $Z_i/(1+A\beta)$ and $Z_o/(1+A\beta)$

    b)   $Z_i(1+A\beta)$ and $Z_o/(1+A\beta)$

    c)   $Z_i/(1+A\beta)$ and $Z_o(1+A\beta)$

    d)   $Z_i(1+A\beta)$ and $Z_o(1+A\beta)$.

xiv) Unit of diffusion constant for silicon in SI unit is

    a)   $m^2/V.s$              b)   $m^2/s$

    c)   $m/s$                 d)   $V/s$.

xv) Temperature coefficient of resistance for intrinsic semiconductor is

    a)   positive

    b)   negative

    c)   infinity

    d)   does not depend on temperature.
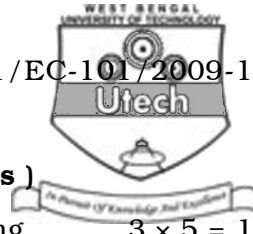
**GROUP – B**
**( Short Answer Type Questions )**
Answer any *three* of the following.         3 × 5 = 15

2. Distinguish between Avalanche breakdown and Zener breakdown. Why is Zener diode called reference diode ?

3. What are the advantages and disadvantages of bridge rectifier over full-wave rectifier using two diodes ?

4. Define CMRR of an OPAMP.

   When a voltage of $V_1 = 40\,\mu V$ is applied to the non-inverting input terminal and a voltage $V_2 = -40\,\mu V$ is applied to the inverting input terminal of an OPAMP, an output voltage $V_0 = 100\,mV$ is obtained. But when $V_1 = V_2 = 40\,\mu V$, one obtains $V_0 = 4\,\mu V$. Calculate the CMRR.

5. What are the basic differences between BJT and FET ? Define pinch of voltage.

6. Derive the expressions for the electrical conductivity of

   i)    an intrinsic semiconductor

   ii)   an N-type semiconductor

   iii)  a P-type semiconductor.

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**GROUP – C**
**( Long Answer Type Questions )**
Answer any *three* of the following.　　3 × 15 = 45

7.　a)　Explain the term "Drift" related to semiconductors.

　　b)　What is electrical conductivity ? Derive the expression for electrical conductivity of a semi-conductor.

　　c)　Show that the total electron current density is equal to the sum of drift and diffusion current density.

　　d)　Find :

　　　i)　conductivity and

　　　ii)　resistance of a bar of pure silicon of length 1 cm and cross-sectional area 1 mm$^2$ at 300 K. Given　$\mu_n = 0\cdot13$ m$^2$/Vs,　$\mu_p = 0\cdot05$ m$^2$/Vs, $ni = 1\cdot5\,{}^{*}\,10^{16}$/m$^3$.　　　　3 + 1 + 3 + 5 + 3

8.　a)　With regard to full-wave rectification explain the working of a bridge rectifier and compare its PIV with other rectifiers. Give two advantages and disadvantages of the bridge rectifier.

b) Find out the expression for efficiency, form factor and ripple factor for a half-wave rectifier.

c) A full-wave rectifier uses a double diode, the forward resistance of each element being 100 ohm. The rectifier supplies current to a load resistance of 1000 ohm. The primary to secondary turns ratio of the centre tapped transformer is 10 : 1. The transformer primary is fed from a supply of 240 V ( rms ).

Find :

i) DC load current

ii) direct current in each diode

iii) the ripple voltage and

iv) the efficiency of rectification. ( 4 + 2 ) + 3 + 6

9. a) Formulate the expression for voltage gain, current gain and output resistance of a transistor amplifier employing $h$-parameters.

b) A transistor amplifier in CE configuration couples a source of internal resistance 1 kΩ to a load of 20 kΩ. Find the input and the output resistance if $h_{ie} = 1$ kΩ, $h_{re} = 2 \cdot 5 * 10^{-4}$ kΩ, $h_{fe} = 150$ & $1/h_{oe} = 40$ kΩ.

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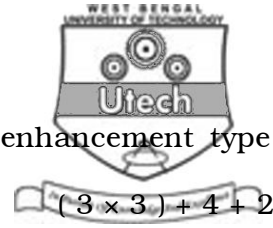
c) Differentiate between depletion and enhancement type MOSFETs. $(3 \times 3) + 4 + 2$

10. a) Draw the circuit diagram of clamper and explain the working principle of it.

b) Explain the operation of bridge rectifier with proper circuit diagram.

c) Evaluate the ripple factor and efficiency of half-wave rectifier.

11. Write short notes on any *three* of the following : $3 \times 5$

a) Clipper circuit

b) Eber-Moll model of transistor

c) Enhancement and depletion MOSFETs

d) Hybrid parameters for a transistor.

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