

M.Sc. ELECTRONICS
First Semester
SEMICONDUCTOR MATERIALS AND DEVICES
(MSE - 103)

Duration: 3Hrs.

Full Marks: 70

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

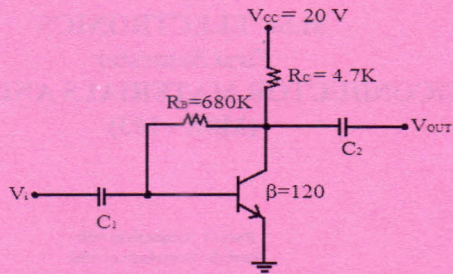
Duration: 2 hrs. 40 mins.

Marks: 50

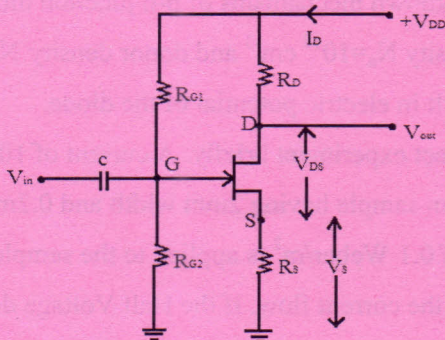
Answer any *five* of the following questions:

1. Explain the breakdown mechanisms of p-n junction diode. A silicon p-n junction has acceptor density $N_a=10^{18} \text{ cm}^{-3}$ and donor density $N_d=10^{15} \text{ cm}^{-3}$ at 300 K. Calculate the built in electric potential of the diode. (8+2=10)
2. Explain Hall Effect experiment briefly. A current of 10mA is passed through an n-type germanium sample having 2mm width and 0.2mm thickness. Then, a magnetic field of 0.1 Weber/m^2 is applied to the sample in a direction perpendicular to the current flow. If the Hall Voltage developed is 1.0mV. Calculate the Hall constant and the number of electrons/ m^3 . (5+5=10)
3. Distinguish between an ideal diode and a real diode. Explain briefly about Ebers-Moll model of BJT. (3+7=10)
4. Derive the expression for drain current of a MOSFET in its saturation region. (10)

5. For the given network, determine I_C , V_{CE} , V_B and V_C . (10)



6. In an N-channel JFET biased by the voltage divider method, determine the value of resistance R_S so that the operating point values are $I_D = 4\text{ mA}$ and $V_{DS} = 8\text{ V}$. given that, $V_{DD} = 25\text{ V}$, $R_{G1} = 1.2\text{ M}\Omega$, $R_{G2} = 0.6\text{ M}\Omega$. JFET parameters are $I_{DSS} = 12\text{ mA}$ and $V_p = -4\text{ V}$. (10)



7. Define CMRR and slew rate of Op-Amp. Draw circuit diagrams for inverting and non-inverting amplifier using Op-Amp, and derive their voltage gains. (4+6=10)
8. Discuss the theory of energy band formation in solids. (10)

M.Sc. ELECTRONICS
First Semester
SEMICONDUCTOR MATERIALS AND DEVICES
(MSE - 103)

Duration: 20 minutes

Marks – 20

(PART A - Objective Type)

I. Choose the correct answer:

1×6=6

- (i) Intrinsic carrier concentration of a semiconductor is directly proportional to
(a) T^3 (b) $T^{2/3}$
(c) $T^{3/2}$ (d) None of the above
- (ii) The intrinsic concentration of a semiconductor at 300K is 10^{13} cm^{-3} , when it is doped with donor type impurities, the majority carrier concentration becomes 10^{17} cm^{-3} . What is the value of its minority carrier density?
(a) $0.999 \times 10^{17} \text{ cm}^{-3}$ (b) 10^{17} cm^{-3}
(c) 10^9 cm^{-3} (d) None of the above
- (iii) The free electron density in a conductor is approximately 10^{22} cm^{-3} . The electron mobility is $10 \text{ cm}^2/\text{Vs}$. What is the value of its resistivity?
(a) $10^4 \Omega\text{m}$ (b) $1.6 \times 10^{-2} \Omega\text{m}$
(c) $10^{-4} \Omega\text{m}$ (d) None of the above
- (iv) Conductivity of a semiconductor is not related to
(a) mobility of the carrier.
(b) effective density of states in the conduction band.
(c) electron charge.
(d) surface states in the semiconductor.
- (v) A semiconductor specimen of breadth D , width W , carrying current I is placed in a magnetic field B to develop Hall Voltage V_H in a direction perpendicular to I and B . V_H is not proportional to
(a) B (b) I
(c) $1/W$ (d) None of the above
- (vi) What is the temperature co-efficient of threshold voltage for a Germanium diode operating at room temperature?
(a) $-1.9 \text{ mV}/^\circ\text{C}$ (b) $-2.0 \text{ mV}/^\circ\text{C}$
(c) $-2.1 \text{ mV}/^\circ\text{C}$ (d) $-2.3 \text{ mV}/^\circ\text{C}$

II. Write true or false:

1×7=7

- (a) The diffusion capacitance of a p-n junction diode increases exponentially with forward bias.
- (b) A tunnel diode operates under avalanche breakdown mode.
- (c) The I_{CEO} of a BJT is given by αI_{CBO} .
- (d) The Early effect in a bipolar junction transistor is caused by large collector-base reverse bias.
- (e) Channel length Modulation occurs in a MOSFET during accumulation state.
- (f) MOSFETs are current controlled devices.
- (g) A buffer has very large current gain.

III. Fill in the blanks:

1×7=7

- (i) A p-channel MOSFET has _____ threshold voltage.
- (ii) The reverse current of a pn-junction diode is very sensitive to _____.
- (iii) The depletion region of a p-n junction diode has no _____ carriers.
- (iv) A Zener diode is generally used in _____ regulator circuits.
- (v) Emitter current of a transistor is _____ times the base current.
- (vi) The locus of the pinch off voltage for a FET on its I_D - V_{DS} characteristic has _____ shape.
- (vii) JFET has _____ input impedance than that of a MOSFET.
