GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022-2023

BASIC ELECTRONICS ENGINEERING

EC101 BL

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)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No
1. (i)	The Fermi level of one p-type semiconductor lies a) in the middle of forbidden gap b) near conduction band c) near valence band d) inside the valence band	1	CO1
ii)	Ripple factor (γ) for a full wave diode rectifier circuit is a) 0.41 b) 0.48 c) 1.21 d) 1.57	1	CO2
iii)	Fermi level represents the energy level with probability of occupancy a) 0 % b) 33 % c) 50 % d) 100 %	1	CO 1
iv)	Forbidden energy gap for Germanium is a) 0.1 eV b) 0.32 eV c) 0.72 eV d) 1.1 eV	1	CO 2
v)	The mobility-to-diffusivity ratio for electrons has the unit a) V b) V^{-1} c) m/V d) V/ms	1	CO 1
vi)	Transconductance of a FET is defined as a) I_d / V_{ds} b) I_d / V_{gs} c) V_{gs} / V_{ds} d) V_{ds} / I_d	1	CO 4

vi) When both the junctions are forward biased, BJT operates in — 1 — CO 3
   a) saturation region
   b) cut-off region
   c) active region
   d) inverse active region

viii) Barkhausen criteria is associated with — 1 — CO 5
   a) Rectifier
   b) Amplifier
   c) Clipper
   d) Oscillator

ix) Temperature co-efficient of a semiconductor is — 1 — CO 2
   a) positive
   b) negative
   c) zero
   d) either zero or positive

x) A practical op-amp has — 1 — CO 5
   a) High input impedance and low output impedance
   b) High input impedance and high output impedance
   c) Low input impedance and high output impedance
   d) Low input impedance and low output impedance

xi) For a BJT, if common base current gain (α) is 0.995, then the common emitter current gain will be — 1 — CO 3
   a) 0.005
   b) 99.5
   c) 100
   d) 199

xii) Gate voltage of an enhancement mode p-channel MOSFET is kept — 1 — CO 4
   a) positive
   b) negative
   c) zero
   d) both (a) and (b)

GROUP – B
(Short Answer Type Questions)

(Answer any ***three*** of the following) **3x5=15**

		Marks	CO No
2.	Derive an expression for drift current in n-type semiconductor. Define electrical conductivity (σ) of charge carriers.	5	CO 1
3. a)	Write the differences between Zener and avalanche breakdown. Explain how Zener diode can act as a voltage regulator.	5	CO2
b)	Derive the relationship between α and β for a BJT. Explain early effect in brief.	3	CO3
4.	Draw the structure of an n-channel JFET and discuss its working principle.	2	CO4
5.	What is Barkhausen criterion? Derive the expression for overall gain in positive feedback amplifier.	5	CO5
6.	Write down ideal characteristics of an op-amp. Define slew rate and CMRR of an op-amp.	5	CO5

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3x5=15**

		Marks	CO No
7. a)	Define band gap in materials. Differentiate between conductor, semiconductor and insulator with the help of band diagram.	4	CO 1
b)	Define depletion region and built-in potential of a p-n junction. Draw the energy band diagram of a forward biased and reverse biased p-n junction.	6	CO 2
c)	What do you mean by mobility of charge carriers? If the intrinsic carrier concentration of a semiconductor at 300K is $2.5\times10^{19}/m^3$ and the mobility of electrons and holes are 0.13 m^2/Vs and 0.05 m^2/Vs respectively, then calculate the conductivity due to electrons and holes separately.	5	CO 1
8. a)	Explain the working principle of a full wave diode rectifier and calculate V_{dc}, V_{rms}, peak inverse voltage, ripple factor and power efficiency of the circuit.	6	CO 2
b)	At room temperature, copper has free electron density of $8.4\times10^{28}/m^3$. Find electron drift velocity in a copper conductor having a cross section of 10^{-6} m^2 and carrying a current of 5.4A.	4	CO 1
c)	Discuss V-I characteristics of a Zener diode. Discuss how Zener breakdown voltage changes with temperature and why.	5	CO 2
9. a)	'FET is a voltage-controlled device.' – Explain. Write down the advantages of FET over BJT.	5	CO1
b)	Sketch the structure of an n-channel depletion type MOSFET and describe.	5	CO1
c)	Define transconductance and amplification factor of an FET. What is the significance of pinch-off voltage in the operation of FET?	5	CO1
10. a)	Draw an adder circuit using op-amps to obtain output voltage $V_0 = 3V_1 - 5V_2$ (where V_1, V_2 are two input voltages)	5	CO5
b)	Design and explain the working principle of a subtractor circuit using op-amp.	5	CO5
c)	Discuss the voltage transfer characteristics of an op-amp. An inverting amplifier has feedback resistance $R_f = 5$ kΩ, R_1=500 Ω. Determine the output voltage and voltage gain of this circuit when 0.1V input voltage is applied.	5	CO5
11. a)	Fermi Dirac distribution	5	CO4
b)	Bridge rectifier	5	CO4
c)	BJT as an amplifier	5	CO3
d)	Integrator circuit using op-amp		
e)	Clipper circuit		