Roll No:

BTECH
(SEM III) THEORY EXAMINATION 2021-22
ELECTRONIC DEVICES AND CIRCUITS

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a.	Write the equation for diffusion current density (J) for electrons in semiconductors.
b.	What is the effect of Temperature (T) on the conductivity (σ) of a semiconductor?
c.	What is the difference between BJT and MOSFET?
d.	What is Pinch off voltage (Vp) in MOSFET?
e.	What is the Bark-hausen criterion for oscillator?
f.	Name the various internal capacitance for BJT.
g.	A Hartley oscillator have following parameters $L_1 = 500\mu H$, $L_2 = 150\mu H$ and $C = 150pF$. Find the frequency of oscillations.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a.	Draw & Explain the Silicon (Si) semiconductor energy band diagram.
b.	An N-type semiconductor is implanted with Boron. The donor and acceptor concentrations are $N_D = 10^{16}/cm^3$ and $N_A = 4x10^{18}/cm^3$. Calculate the Contact Potential (V_o) and Depletion layer width (W). (Given, $n_i = 1.5x10^{10}/cm^3$, $\epsilon_o = 8.85x10^{-14}$ F/cm, $\epsilon_r = 11.8\ \epsilon_o$)
c.	Derive the expression for Depletion Layer width (W) of a semiconductor PN Junction.
d.	Draw the symbols and show the directions of currents of NPN & PNP BJT, N-channel & P-Channel depletion & enhancement type MOSFETs.
e.	Draw & explain Ebers-Moll model for BJT. Mention its real-life importance.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Derive the expression for minority carrier lifetime (τ) in a semiconductor
(b)	Derive the expression for Einstein Relation ($D/\mu = kT/q$) for semiconductors.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Explain the process of Forward and Reverse bias PN junction. Show with energy band diagram that how Fermi Level changes according to biasing?
(b)	A pure semiconductor is doped with donor impurities (N_D) as $1:10^6$in Si atoms. The Si material has $5x10^{22}$ atoms/cm^3.Given that motilities $\mu_n = 1300\ cm^2$ / v.s, $\mu_p = 500\ cm^2$/ v.s. Find: Conductivity due to Majority Carriers (σ_n). Conductivity due to Minority Carriers (σ_p).

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5. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Draw the four basic feedback topologies. Compare the input and output resistance among the feedback topologies.
(b)	Explain the operation & working of anyone Optoelectronic Device such as: Photodiode, Solar Cells, or LED.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Mention the conditions for oscillation. Derive the expression for the frequency of oscillation in Phase shift Oscillator.
(b)	Measurements of V_{BE} and any two terminal currents (I_C, or I_B, or I_E) on a number of NPN transistors are tabulated below. For each, calculate the missing terminal current value and find α, β and I_s as indicated by the table:

Transistor	**A**	**B**	**C**	**D**	**E**
V_{BE} (mV)	690	690	580	780	820
I_C (mA)	1	1		10.10	
I_B (mA)	50		7	120	1050
I_E (mA)		1.07	0.137		75
α					
β					
I_s					

7. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Draw & explain the MOSFET Small Signal model.
(b)	Consider a MOSFET process technology for which $L_{min.}$ = 0.4µm, t_{ox} = 8nm, μ_n = 450 cm^2 /v.s, V_{th} = 0.7 volts,. Find: I. Find C_{ox} and k_n` II. For a MOSFET with W/L = 8 µm/0.8 µm, calculate the value of V_{GS}, and $V_{DS\,(min.)}$ needed to operate the transistor in the saturation region with a dc current I_D = 100µA. III. For the device in (b), find the value of V_{GS} required to cause the device to operate as 1000 Ω resistor for very small V_{DS}.