PAPER ID-312055

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM III) THEORY EXAMINATION 2024-25
ELECTRONIC DEVICES

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 07 = 14**

Q no.	Question	CO	Level
a.	Define the term 'Effective mass'.	1	K2
b.	Why Silicon is preferred over Germanium in electronic devices?	1	K2
c.	State 'Einstein relations' in semiconductor.	2	K1
d.	Differentiate between Schottky barrier diode and p-n junction diode.	3	K2
e.	Why is it necessary to stabilize the operating point of a transistor amplifier?	4	K2
f.	A pnp transistor is operating in the active region with collector current 6.4 mA and emitter current 6.6 mA. Calculate the large signal current gain (α)?	4	K3
g.	Why MOSFET is preferred over BJT in switching?	5	K2

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 21**

Q no.	Question	CO	Level
a.	What is Fermi energy level? Sketch the energy band diagram for an intrinsic semiconductor, n-type and p-type extrinsic semiconductor? Indicate the position of the Fermi energy level, the donor and acceptor level?	1	K2
b.	With suitable diagram prove that the barrier potential (V_0) in an open circuited p-n junction is: $$V_0 = V_T ln\left(\frac{N_A N_D}{n_i^2}\right)$$ Where, n_i is intrinsic carrier concentration, N_A , N_D are the concentration of acceptor and donor ions, and V_T is the voltage equivalent to temperature.	2	K3
c.	With suitable circuit diagram explain the working of a Zener diode as a voltage regulator?	3	K2
d.	An npn transistor with amplification factor (α) is operated in the common base configuration. If the emitter current is 3 mA and reverse saturation current is 10 μA. Calculate the base current and the collector current?	4	K3
e.	Show that transconductance g_m of a JFET is related to drain current: $$g_m = \frac{2}{\lvert V_P \rvert}\sqrt{I_{DS} I_{DSS}}$$	5	K3

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	State De-Broglie hypothesis. Calculate the De-Broglie wavelength of an electron travelling at a velocity of 10^5 m/Sec?	1	K3

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b.	Write the time independent Schrodinger's wave equation and determine its free electron solution.	1	K3

4. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	What is space charge region at a junction? Derive the expression for the width of the space charge in a p-n junction at thermal equilibrium condition?	2	K3
b.	An n type Germanium crystal has a current density of 100 A/m^2. The crystal has resistivity of 0.5 Ω-m and electron mobility of 0.4 m^2/V-s. Calculate the drift velocity and the time taken by the electron to travel 10 micrometer in the crystal. Assume q equal to 1.602×10^{-19}C.	2	K3

5. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	With the help of Energy band diagram explain forward and reverse bias conditions in a p-n semiconductor diode? Draw the Voltage-Current characteristics curve of P-N junction diode.	2	K3
b.	Differentiate between transition and diffusion capacitance of a p-n junction diode. Obtain an expression of the diffusion capacitance?	2	KK2

6. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Draw the common emitter configuration to obtain the input and output characteristics. Explain the behavior of the transistor in active, cutoff, and saturation mode?	4	K2
b.	Draw a self bias circuit; explain quantitatively why such a circuit is an improvement on fixed bias circuit in terms of I_{co}, β, V_{BE}, and stability factor?	4	K3

7. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Differentiate between enhancement and depletion MOSFET? Explain the working and characteristics of n-channel MOSFET in enhancement mode?	5	K2
b.	An n-channel JFET has I_{DSS} equals to 10 mA and V_P equals to -2V. Determine the minimum value of V_{DS} for pinch-off region and drain current I_D for VGS equals -2V in the pinch-off region.	5	K3