Total number of printed pages: 2 **Programme: UG/3rd/UECE301**

2022

ELECTRONIC DEVICES

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	Explain the lattice structure of single crystalline Silicon with the help of a diagram and compute the volume density of Si atoms in this structure.	5
	b)	Compare the surface density of (100) and (111) Si-crystal planes.	5
	c)	Write the Schrodinger equation for a particle inside a 3D infinite-wall potential box and determine its complete solution.	10
2.	a)	State Bloch's theorem and explain its physical significance. Write all the four boundary conditions for a Kronig-Penny potential.	2+6
	b)	For a particle in a periodic 1D potential $V(x) = V_0 \sum_{k=-\infty}^{\infty} \delta(x - ka)$, show that certain energy ranges are forbidden. Draw the resulting reduced bandstructure diagram.	10+2
3.	a)	Explain the concept of effective mass of charge carriers in semiconductors.	5
	b)	Derive the expression for the number of electrons and holes in Semiconductors using Boltzmann approximation. Using it, determine the location of Fermi-level for intrinsic semiconductors.	6+4
	c)	Show that the occupation of donor impurity level is negligible at room temperature.	5
4.	a)	Draw the charge density, electric field and electric potential varies for a p-n junction diode as a function of position.	6
	b)	Differentiate between drift and diffusion current components of electrons. In equilibrium condition, show that a built-in potential will be developed across a p-junction.	6
	c)	Derive the expression for the depletion region width across a reverse-biased p-n junction diode.	8
5.	a)	Derive the expression for continuity equation for holes in a semiconductor. Solve it show how the minority carrier concentration profile on the n-side of a p-n junction diode under forward bias.	5+5

	b)	State the law of junction. Draw and show how different components of currents vary along the length of a p-n junction diode. Plot the V-I characteristics of a p-n junction diode and derive the value of its dynamic resistance under forward bias condition.	2+4+4
6.	a)	Draw energy band diagram for a p-n-p transistor at equilibrium and after the application of Forward Active bias.	6
	b)	Define (i) emitter injection ratio, (ii) base transport factor and (iii) Common-Base current gain for a p-n-p transistor.	6
	c)	Express the collector current as a function of base current and explain the output characteristics in common-emitter configuration. What is base width modulation and explain how it affects the output characteristics?	4+4
7.	a)	With the help of neat schematic diagram explain the working of an n-channel JFET for zero and reverse bias junction voltage.	6
	b)	Using energy band diagram, explain the mechanism of tunnelling in Zener diode during its breakdown.	6
	c)	Explain the process steps involved to fabricate an n-channel MOSFET in a p-type wafer.	8
