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Code No. : 12322 AS N

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. II-Semester Advanced Supplementary Examinations, September-2023

Quantum Mechanics and Materials Science

(Common to EEE & ECE)

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Why are X-rays used for crystal diffraction studies?	2	1	1	1,2,12
2.	What are the effects of crystal defects?	2	2	1	1,2,12
3.	Calculate the de-Broglie wave length associated with 0.1keV proton. Given Mass of the proton is 1.67×10^{-27} kg and $h=6.624 \times 10^{-34}$ J-s	2	3	2	1,2,12
4.	How does a quantum computer different from a classical computer? Write any two differences between them.	2	2	2	1,2,12
5.	Write down limitations of classical free electron theory.	2	1	3	1,2,12
6.	Mention the significance of law of mass-action in intrinsic and extrinsic semiconductors.	2	2	3	1,2,12
7.	What are the three important requisites for laser action to takes place?	2	1	4	1,2,12
8.	A step index fibre with a core refractive index of 1.5 and relative refractive index of 1%. Estimate the numerical aperture and acceptance angle of fibre.	2	3	4	1,2,12
9.	Show that super conductors exhibit perfect dia magnetism (Meissner effect)	2	2	5	1,2,12
10.	Distinguish between polar and non-polar dielectric materials.	2	1	5	1,2,12
Part-B (5 × 8 = 40 Marks)					
11. a)	What is Schottky defect? Evaluate the expression for equilibrium concentration of Schottky defects at a temperature T.	5	2	1	1,2,12
b)	A beam of mono-energetic neutrons corresponding to 27°C of energy $E=kT$ is allowed to fall on a crystal. A first order reflection is observed at a glancing angle of 30°. Calculate the inter planar spacing of the crystal. (Given that $h= 6.624 \times 10^{-34}$ J-s, $m_n=1.67 \times 10^{-27}$ kg and $k=1.38 \times 10^{-23}$ J/K)	3	3	1	1,2,12
12. a)	Describe the experimental verification of matter waves using Davisson-Germer's experiment with suitable diagram.	5	2	2	1,2,12
b)	Compute the energy difference between the ground state next two excited states of an electron in I-D box of length 10^{-8} cm.	3	3	2	1,2,12

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13. a)	Distinguish between intrinsic and extrinsic semiconductor? Derive expression for electrons concentration of an intrinsic semiconductor.	5	3	3	1,2,12
b)	For a silicon semiconductor with a band gap of 1eV, determine the Fermi level at 300K if $m_e^* = 0.2m_0$ and $m_h^* = 0.4m_0$ ($m_0 = 9.1 \times 10^{-31}$ kg)	3	3	3	1,2,12
14. a)	What is acceptance angle? Derive the expression for Numerical aperture of an optical fibre.	5	3	4	1,2,12
b)	What are the advantages of optical fibres over co-axial cables?	3	2	4	1,2,12
15. a)	List various types of polarizabilities that occur in a dielectric. Derive the expression for electronic polarizability and show that it is independent of temperature.	5	2	5	1,2,12
b)	Distinguish between Type -I and Type -II Super conductors.	3	3	5	1,2,12
16. a)	Describe Powder Method of XRD to evaluate inter planar spacing of the crystal.	4	2	1	1,2,12
b)	Arrive at the Schrödinger time independent wave equation for a free particle.	4	2	2	1,2,12
17.	Answer any <i>two</i> of the following:				
a)	State Hall effect. Derive the Hall voltage and Hall coefficient for p-type semiconductor.	4	2	3	1,2,12
b)	Describe the construction and working of Ruby laser with its energy level diagram.	4	1	4	1,2,12
c)	Differentiate between hard and soft magnetic materials on the basis of domain theory of ferromagnetism.	4	3	5	1,2,12

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level - 1	20%
ii)	Blooms Taxonomy Level - 2	40%
iii)	Blooms Taxonomy Level - 3 & 4	40%
