RV University

School of Computer Science and Engineering

B.Tech (Hons.) Degree Examination

Semester : 1
Course Code : CS1804
Course Title : Exploring Science 1
Duration : 2 hours

Max. Marks: 30

Instructions to the students

- Ensure that questions are printed on both sides of the question paper.
- All questions are mandatory. Part A contains 2 questions of 5 marks each, and Part B contains 2 questions of 10 marks each.
- Feel free to use calculators (simple or scientific) where necessary. Graphing calculators are not allowed.
- Electronic devices (including, but not limited to mobile phones, laptops, headphones/earpods, smart devices, etc.) are strictly prohibited. Possessing/using them may lead to disqualification from the exam.
- To ensure your work is evaluated effectively, please present your answers in a clear and structured manner. **All the subsections of a question should be answered together.**
- The constants are provided at the end of this paper for reference, assume standard constant values if not mentioned.

S. No	Question	Marks	Level	CO
	Part A			
1	a) Calculate the surface area to volume ratio and its error for a spherical nanomaterial with a radius of 10 ± 0.1 nm. b) The expression for Wein's displacement law is given as $\lambda T = b$. Modelling the star as a blackbody, calculate its surface temperature if the peak wavelength emitted is due to a Hydrogenic transition of wavelength 94.9 nm. c) Explain the difference between a primitive unit cell and a unit cell. d) How does the central dogma explain the flow of genetic information in a cell? e) Why do mutations in DNA sometimes lead to diseases?	1×5	L2	CO1, CO2, CO3, CO4
2	Describe the structure and function of lipids in cells.	5	L3	CO4
	Part B			
3	a) Explain how the Miller indices are related to a family of planes and thus, the inter-planar spacing. b) State and explain Einstein's photoelectric equation. How does this photoelectric effect relate to the wave-particle duality of light and how does it challenge classical wave theories of light? c) List and explain the five key experimental observations that classical theories of light could not explain, leading to the development of quantum theory.	$1 + 4 + 5$	L2	CO2, CO3

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4	**a)** Compare and contrast the properties of bulk materials and nanomaterials in terms of their surface-to-volume ratio. Analyze how these differences influence the applications of nanomaterials in fields such as catalysis, drug delivery, and sensors. **b)** Consider a compound that crystallizes in a body-centered cubic (BCC) Bravais lattice. Identify the number of lattice points, n, associated with the unit cell. Using this information, calculate what fraction of the unit cell volume is occupied by atoms of this compound, if it's atomic radius is 0.128 nm. **c)** A cubic compound with lattice constant 1 Å undergoes x-ray diffraction. The most intense peak of the diffraction pattern was found to be consisting of diffraction due to at least two different family of planes. The diffraction due to the first family of planes results in first order of diffraction ($n = 1$). The diffraction due to second family of planes results in second order of diffraction ($n = 2$). If the Miller indices of the first family of planes was (200), obtain the Miller indices of all the planes involved in forming the diffraction peak. *Hint: The wavelength, λ and the glancing angle θ remain the same implying that $d_1/n_1 = d_2/n_2$. Making use of this relation, obtain the Miller indices.*	2 + 4 + 4	L3	CO2

Constants:

- $b = 2.89 \times 10^{-3}$ m·K
- $c = 3 \times 10^{8}$ m·s^{-1}
- $R_H = 1.097 \times 10^{7}$ m^{-1}
- $k_B = 1.38 \times 10^{-23}$ J·K^{-1}
- $m_e = 9.1 \times 10^{-31}$ kg
- $q = 1.6 \times 10^{-19}$ C
- $h = 6.626 \times 10^{-34}$ J·s
- $g = 9.8$ ms^{-2}

Course Outcomes

CO1 Understand principles of conducting scientific experiments, collecting data, estimating errors in measurements and writing reports.

CO2 Apply the fundamental principles of crystallography and analyze the structure of solids and nanomaterials.

CO3 Apply the foundational concepts of quantum mechanics leading to the formulation of quantum technologies.

CO4 Examine the building blocks of life by making use of bioinformatics for genomic study.

Marks Distribution									
L1	L2	L3	L4	L5	L6	CO1	CO2	CO3	CO4
0	15	15	0	-	-	1	12	10	7