University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK3DSECHE206**				
Course Title	**CHEMISTRY OF NANOMATERIALS -I**				
Type of Course	**DSE**				
Semester	3				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours			4
Pre-requisites	Higher secondary Chemistry				
Course Summary	This course covers the fundamental principles of materials science and engineering, including atomic structure, crystallography, mechanical properties, electrical properties, thermal properties, and magnetic properties. It also explores the synthesis, processing techniques of materials and it's vide applications in various fields**.**				

Detailed Syllabus:

Module	Unit	Course Description CHEMISTRY OF NANOMATERIALS -I	Hrs 60
I	**INTRODUCTION TO MATERIALS SCIENCE**		**9**
	1.1	Definition and scope of materials chemistry	3
	1.2	Historical Perspective	1
	1.3	Classification of Materials- Metals and alloys, Polymers, Ceramics and glasses, Composites, Advanced Materials- Semiconductors, Biomaterials, Smart materials, Nanomaterials	3
	1.4	Importance of materials chemistry in technology and industry	2
II	**ATOMIC AND MOLECULAR STRUCTURE OF MATERIALS**		**9**
	2.1	Introduction, Atomic Structure-Fundamental Concepts	1
	2.2	Bonding Forces and Energies- Primary Interatomic Bonds- Ionic, covalent, metallic bonding; Secondary bonding or Vander Waal's forces	2
	2.3	Structure of Crystalline Solids- Fundamental concepts Bravais lattices, unit cell, Crystal systems, Crystallographic Points, directions, and Planes Closed Packed Crystal structures- BCC, FCC, HCP	3
	2.4	Defects in Crystals: Imperfections and their impact on properties.	3
III	**PHYSICAL PROPERTIES OF MATERIALS**		**9**
	3.1	Mechanical properties- Stress, strain, and elastic deformation, Tensile testing - Plastic deformation	2

	3.2	Thermal properties - Heat capacity and thermal conductivity; Thermal expansion and its measurement	2
	3.3	Optical properties - Reflection, refraction, and dispersion, Absorption and transmission of light	2
	3.4	Electrical & Magnetic Properties- Conductivity, resistivity Dielectric materials and polarization Magnetic materials -Ferromagnetism, paramagnetism, and diamagnetism	3
IV	**SYNTHESIS, PROCESSING AND APPLICATIONS OF MATERIALS**		**18**
	4.1	Solid-state reactions Powder preparation methods (milling, comminution) Sintering and densification techniques	2
	4.2	Gas-Phase Reactions Chemical vapor deposition (CVD), Physical vapour deposition (PVD) Plasma-enhanced CVD Physical vapor deposition (PVD) techniques (sputtering, evaporation)	3
	4.3	Liquid phase reactions Sol-gel processing, Hydrothermal, solvothermal Chemical vapor deposition (CVD) Electroplating and electroless deposition Spin coating and dip coating	2
	4.4	Emerging Processing Techniques Additive manufacturing (3D printing) Self-assembly and biomimetic synthesis	2
	4.5	Electronic and Optoelectronic Applications Applications in microelectronics, photonics, and telecommunications	2
	4.6	Materials for Energy storage and Conversion: Energy Storage Materials: Batteries, supercapacitors, and fuel cells Energy Conversion Materials: Solar cells, thermoelectric materials, and hydrogen storage materials	3
	4.7	Biomaterials and Medical Applications Implants, prosthetics, medical devices, drug delivery systems, tissue engineering and regenerative medicine	2
	4.8	Environmental and Sustainable Applications Recycling, green materials, and sustainable manufacturing Materials for pollution control, water treatment	2
V	**OPEN ENDED MODULE: Learning through problem solving, seminars, open discussions, assignment discussions, Quizzes, Open book exams etc**		12
		1.Defention and scope of material chemistry 2. Importance of materials chemistry in technology and industry 3. Bravais lattices, unit cell, Crystal systems 4.Closed Packed Crystal structures- BCC, FCC, HCP 5.Mechanical, thermal, optical, electric and magnetic properties of materials 6. Emerging Processing Techniques of materials 7. Materials for Energy storage and Conversion 8.Applications of materials in various fields	

References

1. W.D Callister. Jr, *Materials Science and Engineering*, Wiley India Pvt. Ltd, 2007
2. Raghavan V, *Materials Science and Engineering*, 4th Edition, Prentice Hall of India, 1998
3. Joel I. Gersten and Frederick W. Smit, "*The Physics and Chemistry of Materials*", Wiley, 2007
4. Fahlman, B.D., *Materials Chemistry*, Springer, 2007
5. James F. Shackelford, *Introduction to Materials Science for Engineers*, 8th Edition, 2020
6. William F. Smith and Javad Hashemi, *Foundations of Materials Science and Engineering*; 6th Edition, Mc Graw Hill, 2022

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will get to know the different classes of materials and its importance in technology and industry	U	1,3
CO-2	Understand the interatomic bonding in solids and the type of bond allows them to explain a material's properties	R, U	1,2
CO-3	Describe the difference in atomic/molecular structure between crystalline and noncrystalline materials.	U	1,2,3
CO-4	Describe how face-centered cubic and hexagonal close-packed crystal structures may be generated by the stacking of close-packed planes of atoms. Identify the imperfections in crystals	Ap	1,3
CO-5	Define and differentiate between various physical properties of materials, including mechanical, thermal, optical, and magnetic properties.	U	1,2,3
CO-6	Describe the fundamental principles and various techniques involved in the synthesis of materials, encompassing metals, ceramics, polymers, and composites.	U	1,2,3,5
CO-7	Relate the material properties (mechanical, thermal, optical, electrical, etc.) to their suitability for specific applications.	U	1,3,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CHEMISTRY OF NANOMATERIALS -I

Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	1,3	U	F, C	L	
2	CO-2	1,2	R, U	C	T	
3	CO-3	1,2,3	U	C	L	
4	CO-4	1,3	Ap	F, C	L	
5	CO-5	1,2,3	U	M	T	
6	CO-6	1,2,3,5	U	C	L	
7	CO-7	1,3,5	U	M	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2	-	3	-	-	2	1	-	-	-	-	-	-
CO 2	3	3	-	-	-	3	2	-	-	-	-	-	-
CO 3	2	1	3	-	-	3	2	-	-	-	-	-	-
CO 4	3	-	2	-	-	2	2	-	-	-	-	-	-
CO 5	3	3	2	-	-	3	3	-	-	-	-	-	-
CO 6	3	2	3	-	3	3	3	-	-	-	-	-	-
CO7	2	-	3	-	2	3	2	-	-	-	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments

- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓		✓
CO 6	✓		✓	
CO 7	✓		✓	