



University of Kerala

Discipline	PHYSICS				
Course Code	UK3DSEPHY202				
Course Title	BASICS OF NANOSCIENCE AND NANOTECHNOLOGY				
Type of Course	DSE				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	-				
Course Summary	Materials Structure and Bonding. Crystals and Imperfections in Solids, Electrical and Optical Properties of Materials, Generation of Nanoscience and Nanotechnology, Applications of Nanoscience and Nanotechnology for a Sustainable Future: Addressing Global Challenges				

BOOKS FOR STUDY:

1. Materials Science and Engineering: An Introduction, 10th Edition by William D. Callister Jr, David G. Rethwisc, Wiley (2018)
2. Textbook of Nanoscience And Nanotechnology, B.S Murthy, P. Shankar. Baldev Raj, B.B. Rath, James Murday, Orient Blackswan, (2021)
3. Nanotechnology: Principles and Practices, Third Edition, by Sulabha K. Kulkarn (2014)
4. Introduction To Nanoscience And Nanotechnology By Chattopadhyay, PHI, India
5. Introduction to Nanotechnology, Charles P. Poole Jr., Frank J. Owens, Wiley-Interscience

BOOKS FOR REFERENCE:

1. Fundamentals of Nanotechnology, CRC press, by G.L. Hornyak, J.J. Moone, H.F. Tihhale, J. Dutta
2. Nano Essentials- T.Pradeep, TMH
3. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
4. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.

WEB REFERENCE

1. <https://nptel.ac.in/courses/113/104/113104076/>

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	Materials Structure and Bonding		12	
	1	Why Study Materials Science and Engineering? (Book1: Chapter 1)	1	1
	2	Crystal Structure- Fundamental Concepts, Unit Cell, *Elementary ideas and examples of Metallic Crystal structures (Book1: Chapter 3)	2	1
	3	Elementary ideas and examples of Three-Dimensional Crystal systems, Planes in the Crystals, Crystallographic Directions, (Book1: Chapter 3)	4	1
	4	Crystalline and non-crystalline materials Single crystals, Polycrystals (Book1: Chapter 3)	2	2,3
	5	Atomic packing factors of FCC, BCC, Hexagonal close packed crystal structure (Book1: Chapter 3)	3	2,3
II	Inter-atomic bonding		8	
	6	Atomic bonding in solids - bonding forces and energies (Book1: Chapter 2)	3	1
	7	Primary Interatomic bonds - Ionic bonding, Covalent bonding (Book1: Chapter 2)	3	1
	8	Metallic bonding, Secondary bonding (van der Waals bonding) (Book1: Chapter 2)	2	1
III	Electrical and Optical Properties of Materials		16	
	9	Electrical Conductivity, Electronic and Ionic Conduction (Book1: Chapter 18)	3	4

	10	Energy Band Structures in Solids, Conduction in Terms of Band and Atomic Bonding Models, Electron Mobility (Book1: Chapter 18)	4	4
	11	Semiconductivity- Intrinsic Semiconduction, Extrinsic Semiconduction (n-Type Extrinsic Semiconduction & p-Type Extrinsic Semiconduction) (Book1: Chapter 18)	4	4
	12	Electromagnetic Radiation, Light Interactions with Solids, Atomic and Electronic Interactions (Book1: Chapter 21)	2	4
	13	Optical properties of Non metals: Refraction, Reflection, Absorption, Transmission, Colour (Book1: Chapter 21)	3	4
IV	Generation of Nanoscience and Nanotechnology		12	
	14	Nano – History and Scope, Cluster and Magic Numbers, Early applications of nanotechnology -Nano-gold (Book 2: Chapter 1)	2	4
	15	Applications of Nanomaterials, Nature: The Best Nanotechnologist - web-spinning spider, lotus-leaf effect, Water striders (Book 2: Chapter 1)	2	4
	16	Effect of nano-dimensions on materials behaviour: Elastic properties & Melting point (Book 2: Chapter 2)	2	4,5
	17	Clusters- Types of Clusters, Semiconductor nanoparticles, Excitons (Book 3: Chapter 8)	3	4,5
	18	The Era of new nanostructures of Carbon – Buckminsterfullerene, Carbon Nanotubes (CNTs), Multi walled CNTs (Book 4: Chapter 8, Book 5: Chapter 5 Section 5.1 & 5.2 ONLY)	3	5
V*	Applications of Nanoscience and Nanotechnology for a Sustainable Future		12	
	19	Can small things make a big difference? Nanoscience and Properties, Classification of nanostructured materials (Book 2: Chapter 1, Book 5: Chapter 4)	4	4
	20	Fascinating nanostructures (Book 2: Chapter 1)	4	5
	21	Nanotechnology and Environment (Book 3, Chapter 11)	4	6

COURSE OUTCOMES

CO No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the fundamentals of nanoscale systems and its physical, chemical and electrical properties	U	PSO-1,2
CO-2	List and classify the fundamental crystal structure of materials	Ap	PSO-2,3
CO-3	Outline the various bonds occurs in materials	U	PSO-1,3
CO-4	Formulate the concepts of electrical and optical properties of materials and compare it with that of nanomaterials	C	PSO-3,4
CO-5	Design models to demonstrate the influence of surface effects on the mechanical, physical, and chemical properties of materials such as CNTs and MWCNTs	C	PSO-5
CO-6	Analyse the fundamental applications of nanotechnology and point out how it supports for a sustainable future in modern era	An	PSO-6,7

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

Name of the Course: BASICS OF NANOSCIENCE AND NANOTECHNOLOGY

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

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the fundamentals of nanoscale systems and its physical, chemical and electrical properties	PO 1,3,4,5,6, 8/ PSO-1,2	U	F, C	L	-
CO-2	List and classify the fundamental crystal structure of materials	PO 1,2,3,4,5, 8/ PSO-2,3	Ap	F, C	L	-
CO-3	Outline the various	PO	U	F, C	L	-

	bonds occurs in materials	1,2,3,4,6/ PSO-1,3				
CO-4	Formulate the concepts of electrical and optical properties of materials and compare it with that of nanomaterials	PO 1,2,3,4,6/ PSO-3,4	C	F, C	L	-
CO-5	Design models to demonstrate the influence of surface effects on the mechanical, physical, and chemical properties of materials such as CNTs and MWCNTs	PO 1,2,3,7/ PSO-5	C	F, C	L	-
CO-6	Analyse the fundamental applications of nanotechnology and point out how it supports for a sustainable future in modern era	PO 1,3,4,5,7, 8/ PSO-6,7	An	F, C	L	-

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

Mapping of COs with PSOs and POs :

	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8
CO-1	2	2	-	-	-	-	-	2	-	1	1	-	2	-	1

CO-2	-	2	1	-	-	-	-	1	2	2	1	-	-	-	2
CO-3	2	-	1	-	-	-	-	1	2	2	1	-	1	-	-
CO-4	-	-	3	2	-	-	-	2	2	1	1	-	1	-	-
CO-5	-	-	-	-	3	-	-	1	2	2	-	-	-	2	-
CO-6	-	-	-	-	-	2	2	1	-	2	2	-	-	1	1

Correlation Levels:

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

Assessment Rubrics:

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

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	-	-	-



University of Kerala