

**PAPERIV: ELECTIVE PAPER- C: NANOSCIENCE AND TECHNOLOGY**

Semester	Subject Code	Category	Instruction Hours						Credits
			Lecture		Theory		Practical		
			Per Week	Per Semester	Per Week	Per Semester	Per Week	Per Semester	
IV	21CPCH 4Bb	Elective	3	45	3	45	0	0	3

**COURSE OBJECTIVES:**

- ❖ To understand preparation, characterization and synthesis of nanomaterials.
- ❖ To understand about the importance and applications of nanotechnology in various fields.

**COURSE OUTCOMES:**

- On the successful completion of course, students will be able to

CO Number	CO statement	Knowledge level
<b>CO1</b>	Learn about the synthesis and chemical process of nanoscience	K2 & K3
<b>CO2</b>	Apply principles and characterization of nanoscience by XRD, SEM, EDAX, TEM,	K3 & K4
<b>CO3</b>	Analyse the various application of nanotechnology in remediation of pollution	K3 & K4
<b>CO4</b>	Get knowledge about the tissue engineering and degradation of cell culture	K2 & K3
<b>CO5</b>	Gain clear knowledge about drug delivery and gene delivery systems	K2 & K3

\* CO – Course Outcomes

Knowledge level K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze

**MAPPING WITH PROGRAM OUTCOMES**

COS	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>	S	M	S	M	M	S
<b>CO2</b>	M	S	M	S	S	M
<b>CO3</b>	S	M	M	M	S	S
<b>CO4</b>	M	S	M	S	M	M
<b>CO5</b>	M	S	M	S	M	S

**UNIT– I : Synthesis of Nanomaterials Chemical Processes****9 hours**

Chemical precipitation and co-precipitation, polyol – borohydride reduction methods – Sol-Gel synthesis; Microemulsions synthesis – Hydrothermal – Solvothermal synthesis methods – Microwave assisted synthesis – Sonochemical assisted synthesis – Core-Shell nanostructure – Organic – Inorganic hybrid nanocomposites – Quantum dot (QDs) synthesis.

**UNIT – II: Nanostructured Materials Characterization Techniques****9 hours**

X-ray diffraction (XRD) – SEM – EDAX – TEM – Elemental mapping – FTIR – UV-Visible spectrophotometer – Laser Raman Spectroscopy – Nanomechanical – Characterization using Nanoindentation – Differential Scanning Calorimeter (DSC) – Differential Thermal Analyzer (DTA) – Thermo gravimetric Analysis (TGA) – TEM – X-ray Photoelectron Spectroscopy (XPS) – Electrochemical Characterisation measurements.

**UNIT – III: Nanotechnology - Environmental and Health Effects****9 hours**

Environmental pollutants in air, water, soil, hazardous and toxic wastes – application of nanotechnology in remediation of pollution – The challenge to occupational health and hygiene – toxicity of nanoparticles – effects of inhaled nanosized particles – skin exposure to nanoparticles – impact of CNTs on respiratory systems – hazards and risks of exposure to nanoparticles – monitoring nanoparticles in workplace and sensors.

**UNIT – IV: Tissue Engineering****9 hours**

Introduction – Stem cells – Morphogenesis – Generation of tissue in the embryo – Tissue homeostasis – Cellular signaling – Extracellular matrix as a biologic scaffold for tissue engineering – Natural polymers in tissue engineering applications – Degradable polymers for tissue engineering – Degradation of bioceramics – Cell source – Cell culture: harvest – selection, expansion and differentiation – Cell nutrition – Cryobiology.

**UNIT – V: Drug Delivery Systems and Fundamentals of Drug Nanoparticles****9 hours**

Production – Size – Surface area – Suspension and Settling, Magnetic and Optical Properties, Biological Transport – Manufacturing of Nanoparticles: Ball-Milling – High-Pressure Homogenization – Spray-Drying Production in Nonaqueous Liquids – Hot-Melted Matrices – Pelletisation Techniques – Direct Compress – Delivery of Nanoparticles – Brain Delivery – Ocular

Drug Delivery – Gene Delivery Systems – Carriers in Cancer Therapy – Cardiovascular System – Vascular Delivery to the Lungs – Targeting Lymphatics.

**Distribution of hours: Theory – 100%**

#### **TEXT BOOKS**

<b>S. No</b>	<b>Authors</b>	<b>Title</b>	<b>Publishers</b>	<b>Year of Publication</b>
1.	Sanjay Mathur and Mrityunjay Singh	Nanostructured Materials and Nanotechnology– II, Eds.	Wiley	2008
2.	Carl C. Koch	Nanostructured Materials	Noyes Publications, New York	2002
3.	G. A. Nazri and G. Pistoia	Science and Technology	Kulwer Academic Publishers, Dordrecht, Netherlands	2004
4.	P. Brown and K. Stevens	Nanofibers and Nanotechnology in Textiles	Woodhead publication London	2006
5.	J. Altmann, Routledge	Military Nanotechnology: Potential Applications and Preventive Arms Control	Taylor and Francis Group	2006
6.	Jennifer Kuzma and Peter VerHage	Nanotechnology in Agriculture and Food Production	Woodrow Wilson International Center	2006
7.	D. Shi, B. Aktas, L. Pust, F. Mikailov	Nanostructured Magnetic Materials and their Applications, Ed.	Springer	2002

#### **REFERENCE BOOKS**

<b>S. No</b>	<b>Authors</b>	<b>Title</b>	<b>Publishers</b>	<b>Year of Publication</b>
1.	K. K. Chattopadhyay	An Introduction to Nanoscience and Nanotechnology	Prentice Hall Learning Pvt. Ltd.	2009
2.	Charles P. Poole	An Introduction to Nanotechnology	Wiley-Interscience	2008

3.	Victor E. Borisenko	A Handbook on Nanoscience and Nanotechnology	Wiley VCH	2008
4.	T. Pradeep	A Textbook of Nanoscience and Nanotechnology	McGraw Hill Education	2017
5.	B. K. Parthasarathy	Nanoscience and Nanotechnology	Isha books	2017
6.	B. S. Murthy	Textbook of Nanoscience and Nanotechnology	Springer	2013
7.	Hari Singh Nalwa	Encyclopedia of Nanoscience and Nanotechnology	American Scientific Publishers	2004

### **TEACHING METHODOLOGY:**

- Board and chalk
- PowerPoint presentation
- Group discussion
- Seminar and Assignments
- Animated videos
- Board and chalk

### **SYLLABUS DESIGNER:**

Dr. T. Gomathi, Assistant Professor, Department of Chemistry