SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology, Surat

Bachelor of Technology (B.Tech)

B. Tech. Semester IV

Subject Name: Nanoscience& Nanotechnology **Subject Code: BTCH14401**

Type of course: **Professional Elective II**

Prerequisite: Basic Chemistry, thermodynamics and material Science

Rationale: Students will understand the concept of nanotechnology and nanoscience in the chemical industries and in consumer products. There are numerous ways to synthesize nano materials with advantage of enhanced properties such as higher strength, lighter weight, and greater chemical reactivity then their larger scale counterparts.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	00	00	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Introduction** Introduction and classification, Summary of electronic properties of atoms and solids, Effects of nanometer length scale, Fabrication methods, Preparation, Safety and storage issues.	8	18
2.	**Strategies for the scalable synthesis of quantum dots and related nano dimensional materials-I:** Introduction, Defining nano-dimensional materials, General methods available for the synthesis of nano-dimensional materials.	2	6
3.	**Strategies for the scalable synthesis of quantum dots and related nano dimensional materials-II:** Reactive methods in high boiling solvents, hydrothermal and solvothermal methods, gas-phase synthesis of semiconductor nanoparticles, synthesis in a structured medium, the suitability of such methods for scaling.	9	20

4.	**Nanotechnology and Ceramics:** Introduction, Vapour Condensation methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical/Flame decomposition of metal organic precursors.	6	12
6.	**Tools to Characterize Nanomaterials:** X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Dynamic Light Scattering (DLS), Scanning Tunneling Microscopy (STM), Spectroscopy.	10	22
7	**Applications of Nanomaterials:** Applications in chemical engineering like nanocatalysts, nanocomposites, bio-analytical tools, nano/microarrays, nanodevices, and lab-on-a-chip.	10	22

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**30**	**35**	**05**	**00**	**00**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Introduction to Nanotechnology	Poole C., and Owens F.	John Wiley	2004	1st Edition
2	Textbook of Nanoscience and Nanotechnology	B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday	University Press	2012	ebook 2013
3	Nanoscale Materials in Chemistry	Kenneth J. Klabunde,	John Wiley & Sons	2009	2nd Edition

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand nanoscience and nanostructured materials *(R, U-Cognitive level)*	15

CO-2	Illustrate various synthesis methods of nanomaterials *(R,U -Cognitive level)*	20
CO-3	Analyze the principles of basic characterization techniques *(R, U, A -Cognitive level)*	15
CO-4	Discuss the scope of nano materials and learn about their applications in Chemical Engineering *(R, U, N -Cognitive level)*	20
CO-5	Invent nanomaterials as per requirement and develop customized solutions for nanomaterials application *(A, C -Cognitive level)*	30

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	1	1	1	1	1	1	1	2	3	1	1	2	1
CO-2	3	3	1	3	1	1	2	1	2	2	3	3	2	2	1
CO-3	3	2	2	3	2	2	3	1	3	2	3	3	3	3	1
CO-4	3	2	3	2	3	3	2	1	3	2	3	3	3	2	2
CO-5	1	3	1	3	3	3	3	2	3	3	3	3	1	2	3
Rationale*	**13**	**12**	**8**	**12**	**10**	**10**	**11**	**6**	**12**	**11**	**15**	**13**	**10**	**11**	**8**

Rationale*: All COs are satisfying the well-defined POs & PSOs

List of Open Source/learning website:

- https://nptel.ac.in/courses/113/104/113104102/
  Nanomaterials and their properties
- https://nptel.ac.in/courses/113/107/113107081/
  Crystal structure and imperfections
- https://nptel.ac.in/courses/117/108/102108078/
  Nano fabrication fundamentals
- https://nptel.ac.in/courses/113/107/113107081/
  structural analysis of nanomaterials
- https://nptel.ac.in/courses/113/106/113106093/
  Nanotechnology science & applications