Department of Chemistry

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	**Chemistry Minor Course**		
Course Title	**Nano Science and Technology**		
Course Code	**CHMI20**	**No. of Credits**	**3 (Theory)**
Course Code of Pre-requisite subject(s)	**Nil**		
Session	**July 2019**		
Name of Faculty	**Dr. S. Anandan**	**Department**	**Chemistry**
E-mail	**sanand@nitt.edu**	**Telephone No.**	**+91-9444052074 (M)**
Name of Course Coordinator	**Dr. S. Anandan**		
E-mail	**sanand@nitt.edu**	**Telephone No.**	**+91-9444052074 (M)**
Course Type	☐ **Core course**	☑ **Elective course**	

Syllabus (approved in BOS)

Unit-I

Introduction to nanoscience and nanotechnology: Underlying physical principles of nanotechnology: *Nanostructured Materials: Size is Everything.* - fundamental physicochemical principles - size dependence of the properties of nanostructured matter -quantum confinement, single electron charging, the central importance of nanoscale morphology. Societal aspects of nanotechnology: Health, environment, hype and reality.

Unit-II

The advent of the nanomaterial.Top down and bottom up approaches to building materials. Properties of nanomaterials such as nanoparticles, carbon nanotubes. Overview of self-assembly. Inert gas condensation, arc discharge, RF plasma, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, ball milling, molecular beam epitaxy, chemical vapour deposition method and electro deposition.

Unit-III

The basic tools of nanotechnology: Scanning electron microscopy (SEM), TEM and EDAX analysis and X-ray diffraction, A brief historical overview of atomic force microscopy (AFM) and an introduction to its basic principles & applications. Optical microscope and their description, operational principle and application for analysis of nanomaterials, UV-Vis-IR spectrophotometers, Principle of operation and application for band gap measurement.

Unit-IV

Metal nanoparticles: Size control of metal nanoparticles and their characterization, study of their properties, optical, electronic, magnetic. Surface plasmon band and its applications, role in catalysis, alloy nanoparticles, stabilization in sol, glass, and other media, change of bandgap, blueshift, colour change in sol, glass, and composites, plasmon resonance.

Unit-V

Carbon nanostructures: Introduction. Fullerenes, C60, C80 and C240 nanostructures. Properties & applications (mechanical, optical and electrical). Functionalization of carbon nanotubes, reactivity of carbon nanotubes. Nanosensors: Temperature sensors, smoke sensors, sensors for aerospace and defence. Accelerometer, pressure sensor, night vision system, nano tweezers, nano-cutting tools, integration of sensor with actuators and electronic circuitry biosensors.

References:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.
2. G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press, London, 2004, chapters 3, 4 and 5.
3. C. N. R.Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume 1, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004, Chapter 4.

COURSE OBJECTIVES

To impart the basic knowledge on nanoscience and nanotechnology which includes the exotic properties of materials at nanoscale, various techniques available for the processing and characterization of nanostructured materials, applications in selected fields such as sensors.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. To know the basic principles of the formation of nanoscience and nanotechnology.	
2. To be able to predict the formation probability and stability of a newly proposed nanomaterials.	
3. To get familarise self-assembly process which leads to the formation of the nano-materials.	
4. To be able to understand the unusual property of nano-materials and its applications.	

COURSE PLAN – PART II

COURSE OVERVIEW

This course is offered to M.Sc.(Chemistry) students. This is a theory course for 3 credit points. Three theory classes will be conducted per week.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week**	**Topic**	**Mode of Delivery**
1	III week of July	**Introduction to nanoscience and nanotechnology:** Underlying physical principles of nanotechnology:	C&T, PPT
2	IV week of July - I week of August	**Unit-I** *Nanostructured Materials: Size is Everything.* - fundamental physicochemical principles - size dependence of the properties of nanostructured matter -quantum confinement, single electron charging, the central importance of nanoscale morphology. Societal aspects of nanotechnology: Health, environment, hype and reality	C&T, PPT
3	II-IV week of August	**Unit-II** The advent of the nanomaterial. Top down and bottom up approaches to building materials. Properties of nanomaterials such as nanoparticles, carbon nanotubes. Overview of self-assembly.Inert gas condensation, arc discharge, RFplasma,plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, ball milling, molecular beamepitaxy, chemical vapour deposition method and electro deposition.	C&T, PPT
4	I-IV week of September	**Unit-III** Scanning electron microscopy (SEM), TEM and EDAX analysis and X-ray diffraction, A brief historical overview of atomic force microscopy (AFM) and an introduction to its basic principles & applications. Optical microscope and their description, operational principle and application for analysis of nanomaterials, UV-Vis-IR spectrophotometers, Principle of operation and application for band gap measurement.	C&T, PPT
5	I-III week of October	**Unit-IV** Size control of metal nanoparticles and their characterization, study of their properties, optical, electronic, magnetic. Surface plasmon band and its applications, role in catalysis, alloy nanoparticles, stabilization in sol, glass, and other media, change of bandgap, blueshift, colour change in sol, glass, and composites, plasmon resonance.	C&T, PPT
6	IV week of October-II week of November	**Unit-V** **Carbon nanostructures:** Introduction.	C&T, PPT

		Fullerenes, C60, C80 and C240 nanostructures. Properties & applications (mechanical, optical and electrical). Functionalization of carbon nanotubes, reactivity of carbon nanotubes. Nanosensors: Temperature sensors, smoke sensors, sensors for aerospace and defence. Accelerometer, pressure sensor, night vision system, nano tweezers, nano-cutting tools, integration of sensor with actuators and electronic circuitry biosensors.	

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
Theory				
1	Assignment/Surprise Test/ QuiZ	III week of August	One week	5
2	Test I	I week of September	60 minutes	20
3	Assignment/Surprise Test/ QuiZ	I week of October	One week	5
4	Test II	III week of October	60 minutes	20
	Compensation Assessment	*II week of Nov*	*60 minutes*	*20*
6	Final Asessment	III week of Nov	3 hours	50

COURSE EXIT SURVEY

1. Feedback from students during class committee meetings.
2. Anonymous feedback through questionnaire at the end of the semester.

COURSE POLICY

MODE OF CORRESPONDENCE (email/ phone etc)

sanand@nitt.edu; Tel. No.:+91-9444052074

COMPENSATION ASSESSMENT POLICY

1. This assessment is for those students who missed Test I or Test II due to genuine reasons
2. Compensation assessment will be conducted during the II week of November 2018.

ATTENDANCE POLICY

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programs.

ADDITIONAL INFORMATION

The faculty will be available for consultation at times as per the intimation by the faculty.

FOR APPROVAL

Course Faculty _____ **CC-Chairperson** _____ **HOD** _____