GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39)

NANOTECHNOLOGY AND ENVIRONMENT

SUBJECT CODE: 2153905

B.E. 5th SEMESTER

Type of course: Environmental Study

Prerequisite: Basic knowledge of Nanoscience and Chemistry

Rationale: To make the students understand the impact of nanotechnology and its products on the environment

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	INTRODUCTION: Identification of Specific Risks – Challenges- Human health hazard – Risk reduction – Standards – Safety – Transportation of nanoparticles – Emergency responders- Risk assessment – Environmental Impact – Predicting hazard –	9	19%
2	**NANOTOXICOLOGY:** Inhalation, deposition and Pulmonary clearance of insoluble solids – Bio persistence of Inhaled solid material – Systemic Translocation of inhaled Particulates – Pulmonary effects of CNTs – Inflammatory response– In-vivo interactions of pulmonary inflammation with oxidative stress – Interactions of CNTs with Macrophages	8	16%
3	**NANOSTRUCTURED CATALYSTS TIO_2 NANOPARTICLES FOR WATER PURIFICATION:** TiO2 as a semiconductor photocatalyst, Photo catalytic mechanism, general pathways & kinetics, Intrinsic, Photocatalytic activity, Reaction variables, Photocatalytic Degradation of Specific Waterborne pollutants.	10	21%
4	**NANOPARTICLES FOR TREATMENT OF ARSENIC:** Introduction, Environmental Chemistry of Arsenic, Treatment of Arsenic using Nanocrystalline TiO2, Treatment of Arsenic using nanoparticles other than TiO2.	11	23%
5	**NANOMEMBRANES:** Nanomembranes in Drinking water treatment, Nanomembranes in Sea	10	21%

	desalination.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
17	**22**	**21**	**10**	**--**	**--**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and 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 Books:

1. NANOTECHNOLOGIES FOR WATER ENVIRONMENT APPLICATIONS American Society of Civil Engineers (ASCE) Publications by Tian C.Zhang, Zhiqiang Hu, Rao Y. Surampalli, R.D.Tyagi, KeithC.K.Lai and Irene Mc.Lao
2. NANOTECHNOLOGY IN WATER PURIFICATION APPLICATIONS, Caister Academic Press by T.Eugene,Michele de Kwaadsteniet, Marelize Botes and J.Manuel Lopez-Romero.
3. ENVIRONMENTAL APPLICATIONS OF NANOMATERIALS-SYNTHESIS, SORBENTS AND SENSORS, ditedby Glen E Fryxell and Guozhong Cao, Worldscibooks, UK
4. ENVIRONMENTAL NANOTECHNOLOGY, Mark Wisener, Jeo Yues Bolteru, 2007, McGraw Hill.
5. NANOTECHNOLOGY – TOXICOLOGICAL ISSUES AND ENVIRONMENTAL SAFETY Simeonova P.P, Opopol N, and Luster M.I ,Springer 2006.
6. NANOSCIENCE AND NANOTECHNOLOGY – ENVIRONMENTAL AND HEALTH IMPACTS, Grassian V.H,John Wiley & Sons, 2008
7. NANOTECHNOLOGY AND ENVIRONMENT ,Sellers.K, Mackay.C, Bergeson.L.L,Clough S.R, CRC Press, 2009
8. NANOTECHNOLOGY FOR ENVIRONMENTAL DECONTAMINATION , Ram.M, Andreescu.S.E, Hanming.D, 2011, McGrawHill

Course Outcome:

After learning the course the students should be able to:

1. To notify the learner about the various ethical issues related to nanotechnology
2. To know about nanostructured catalysts for water purification.
3. To have knowledge about nanoparticles for treatment of arsenic, environmental risks of Nanomaterials

List of Experiments:

Experiment 1

To measure pH level in water sample

Experiment 2

To test the presence of total Hardness in water sample and measure its quantity

Experiment 3

To test the presence of Residual chlorine in water sample and measure its quantity

Experiment 4

To test the presence of Chloride in water sample and measure its quantity

Experiment 5

To test the presence of Fluoride in water sample and measure its quantity

Experiment 6

To test the presence of Iron in water sample and measure its quantity

Experiment 7

To test the presence of Ammonia in water sample and measure its quantity

Experiment 8

To test the pH, Conductivity, TDS, Turbidity, DO in given nanofluid.

Design based Problems (DP)/Open Ended Problem:

Open Ended /design based project: Apart from above experiments a group of students (Maximum Three) has to undertake one open ended problem/design problem. **(Students are free to select any area of science and technology may be based on their branch to define the project)**

Aims:

1. To provide experience in laboratory based experimentation, data recording and analysis and drawing of conclusions.
2. To develop report writing skills for scientific material
3. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.
4. To develop skills in literature searches and reviews.

Evaluation of Open ended / design based small project:

1. Open ended / design based small project will be evaluated by external examiner with appropriate marks allotment given by GTU time to time.
2. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
3. Evaluation should be done on **the approach of the student on his/her efforts** (not on completion) to study the design module of given task.

Examples:

1. Determination of impurities in drinking water
2. Determination of impurities and other a wanted chemical in river water.

Major Equipment:

1. Distill Water Unit
2. PH Meter

3. Necessary Chemicals and glassware for pH level Test, Residual chlorine Test, Chloride Test, Fluoride Test, Iron Test, Total Hardness Test, Ammonia Test

List of Open Source Software/learning website:

http://www.nanotech-now.com/academic.htm#study

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.