GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3173910
Semester – VII
Subject Name: NANOTECHNOLOGY AND SUSTAINABLE INDUSTRY

Type of course: Nanotechnology has broader societal implications and social challenges along with various industrial applications of nanotechnology.

Prerequisite: Basic Knowledge of Applications of Nanomaterials, Environmental Issues, Industrial Advancements

Rationale: To make the students understand the industrial demands and to understand the basic knowledge on social, ethical & political impact of nanoscience and nanotechnology

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
1	**INDUSTRIAL APPLICATIONS OF NANOTECHNOLOGY** 1.1 Nanoscience and Nanotechnology. 1.2 Implications for Sustainability 1.2.1 Resource Efficiency 1.2.2 Substitution of Hazardous Chemicals 1.3 Industrial Applications 1.3.1 Catalysts 1.3.2 Energy Generation and Storage 1.3.3 Transport 1.3.4 Drinking Water and Wastewater Treatment 1.3.5 Electronics 1.3.6 Agrifood and Forest Products 1.3.7 Construction 1.3.8 Sustainability Assessment: Life-Cycle Analysis	8
2	**Applications of Nanotechnology in Aerospace**	9

	2.1 Introduction	
	2.2 Sensors 2.3 Electromagnetic Interference/Electrostatic Discharge 2.3.1 Nanomaterials on Deep Space Exploration Spacecraft 2.4 Avionics/Electronics 2.4.1 Nanomaterials-Based Memory for Spaceflight 2.4.2 Wiring 2.4.3 Thermal Management in Electronics 2.5 Structures. 2.5.1 Primary and Secondary Structures 2.5.2 Nondestructive Evaluation	
	2.6 Propulsion 2.6.1 Gas Turbine Engines 2.6.2 Propellants 2.7 Power and Energy Storage 2.7.1 Lithium Ion Batteries 2.7.2 Supercapacitors 2.7.3 Power Generation 2.8 Life Support Systems 2.9 Sustainability: Repair and Processing 2.10 Radiation Protection and Sensing 2.11 Challenges in Nanomaterials for Aerospace 2.12 Affordability and Manufacturability 2.13 Challenge: Managing Expectations	
3	**How Nanotechnologies Can Enhance Sustainability in the Agrifood Sector** 3.1 Introduction 3.2 Applications in Primary Production 3.2.1 Agriculture 3.2.1.1 Fertilizers 3.2.1.2 Pesticides 3.2.1.3 Precision Agriculture 3.2.2 Horticulture 3.2.3 Animal Husbandry 3.2.4 Water Treatment 3.3 Postharvest Processing	9

	3.3.1 Process Innovation 3.3.1.1 Separation 3.3.1.2 Fractionation 3.3.1.3 Emulsification 4.3.2 New Food Products 3.4 Retail and Consumer 3.4.1 Packaging 3.4.1.1 Barrier Properties 3.4.1.2 Antimicrobial Properties 3.4.2 Logistics 3.4.3 Convenience 3.5 Societal Acceptance of Applications in Agrifood 3.5.1 Risk Perception 3.5.2 Regulatory Issues	
4	**Solar Photocatalytic Drinking Water Treatment for Developing Countries** 4.1 The Need for Safe Drinking Water 4.2 Solar Disinfection of Water 4.3 Enhancement Technologies for SODIS 4.4 Solar Reactors and CPC Collectors for Drinking Water Disinfection 4.5 Semiconductor Photocatalysis 4.5.1 Mechanism of Photocatalysis 4.5.2 Photocatalytic Materials 4.5.3 Immobilized Versus Suspended 4.5.4 Photocatalyst 4.6 Photocatalytic Disinfection of Water 4.7 Issues to Be Addressed 4.7.1 Photoreactor Design 4.7.2 Photocatalyst Longevity 4.7.3 Visible-Light-Active Photocatalyst Materials	9
5	**Nanotechnology in Electronics** 5.1 Introduction 5.2 Semiconductor Transistors 5.3 Carbon Nanostructures 5.4 Graphene Electronics	7

	5.5 Quantum Dots Electronics	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	Understanding U Level	Application A Level	Analyze N Level	Evaluate E Level
30	30	20	20	

Legends: R: Remembrance; U = Understanding; A = Application 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

Text Books:

1. Nanotechnology for Sustainable Manufacturing EditEd by david RickERby CRC PressTaylor & Francis Group

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand aspect of iimplications for sustainability associated with Nanotechnology based industrial production.	20 %
CO-2	Explain aapplications of Nanotechnology in Aerospace and Agrifood Sector	40%
CO-3	Explain basic aspect and application of Solar Photocatalytic for Drinking Water Treatment	20%
CO-4	Explain aspect of Nanotechnology in Electronics	20%

TUTORIAL-

Students will be encouraged to form groups and work upon Industrial Designs

1. Group 1: Protection of Industrial Design in India: Issues and Challenges.
2. Group 2: Dangers of Molecular Manufacturing.

CASE STUDY

Reflections and Suggestions

1. An Exploration of Patent Matters Associated with Nanotechnology
2. Public Perceptions & Education –Awareness of Nanotechnology products in global market

3. Nanotechnology Industrial -Vision, Innovation, And Policy

INDUSTRY VISIT-

Students will be taken to various industries as a part of the study program, to get a real life experience of the course structure.