

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**NANO TECHNOLOGY**  
**SUBJECT NAME: APPLICATION OF CNT AND METALLIC NANOPARTICLES**  
**SUBJECT CODE: 2173901**  
**B.E. VII SEMESTER**

**Type of course:** Nanomaterials and its applications

**Prerequisite:** Elements of material science, Elements of Nanoscience and Nanotechnology.

**Rationale:** The objective of this course is to make students familiar with the important concepts and applications of Nanotechnology.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		C	Theory Marks			Practical Marks		
			ESE		PA (M)		PA (V)		PA	
			(E)		PA	ALA	ESE	OEP	(I)	
4	0	0	4	70	20	10	00	00	00	100

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

**Content:**

Sr. No.	Content	Total Hrs.	% Weightage
1	<b>INTRODUCTION OF CNT</b> Basic Concept of Carbon Nanotube, the structure of Carbon Nanotubes, Symmetry of Single-walled- Carbon Nanotube, Symmetry of Double walled- Carbon Nanotube, Symmetry Operation, Symmetry-based Quantum Numbers.	10	18%
2	<b>PROPERTIES OF CARBON NANOTUBES</b> Mechanical Properties, Thermal Stability, Heat transport in Carbon Nanotubes, Electronic Properties, Optical Properties,	12	14%

	Elastic Properties, Vibrational Properties, Intrinsic Properties of individual Carbon Nano Tube.		
<b>3</b>	<b>APPLICATION OF CARBON NANOTUBES</b> Carbon Nanotubes in Electronics, Carbon Nanotubes in Energy Applications, Carbon Nanotubes For Mechanical Applications, Carbon Nanotube Sensors, Carbon Nanotubes in Field Emission and Lighting Applications, Carbon Nanotubes for Biological Applications	<b>10</b>	<b>18%</b>
<b>4</b>	<b>METAL NANOPARTICLES</b> Introduction, Size-Dependent Properties of Metal nanoparticles, Band gap measurement, Magic Metal nanoparticle, Noble Metal Nanoparticles, Geometric configuration.	<b>10</b>	<b>15%</b>
<b>5</b>	<b>SYNTHESIS PROCESS OF METAL NANOPARTICLES</b> Wet Chemical Synthesis Routes, Phase Transfer Method, Stabilization Mechanisms, Electrochemical Method	<b>10</b>	<b>17%</b>
<b>6</b>	<b>APPLICATIONS OF METAL NANOPARTICLES</b> Microelectronic Application, Solar Energy Conversion Application, Chemical Sensors Application, Quantum Dot Lasers Application, Medical Field Application.	<b>12</b>	<b>18%</b>

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>				
<b>Remembrance R Level</b>	<b>Understanding U Level</b>	<b>Application A Level</b>	<b>Analyze N Level</b>	<b>Evaluate E Level</b>

14	14	28	7	7
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**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

**Reference Books:**

1. CARBON NANOTUBES (Basic Concepts and Physical Properties) Wiley publication by S. Reich, C. Thomsen, J. Maultzsch
2. CARBON NANOMATERIALS Taylor and Francis Group, LLC publication by Y. Gogotsi.
3. METAL NANOPARTICLES (Synthesis And Characterization and Applications) Marcel Dekker, Inc publication by D. L. Feldheim, Colby A. Foss
4. Mick Wilson, KamaliKannagara.et.al.,“ NANOTECHLOGY-basic science and emergingtechnologiesCarbon Nanotubes and Metallic Nanoparticles
5. Charles P.Poole Jr et.al.,” INTRODUCTION TO NANOTECHNOLGY”, Wiley Student Edition,2008.lectronic applications-medical applications

**Course Outcome:**

- Get knowledge of applications of Nanomaterials.
- Understand the mean of metallic Nanoparticles.
- Understand properties metallic Nanoparticles and Carbon nanotubes.
- Understand the application of metallic Nanoparticles and Carbon nanotubes.
- Understand the synthesis process to prepare metallic Nanoparticles and Carbon nanotubes.

**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 the 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.

**List of Open Source Software/learning website:**

1. <http://www.nanosworld.com.com>
2. <http://www.dekker.com>

**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.