

GUJARAT TECHNOLOGICAL UNIVERSITY

NANO TECHNOLOGY (39) NANOMAGNETISM AND NANOFLUIDS SUBJECT CODE: 2163906 B.E. 6th SEMESTER

Type of course: Material Science, Nano Science

Prerequisite: Basics of magnetic material science and fundamental of physics and chemistry

Rationale: The purpose of this course is to develop understanding of nanoparticles behavior in magnetic materials for various applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (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: Introduction to magnetic materials, types of magnetic materials Magnetization, Susceptibility, Magnetic Hysteresis curve, non – linear Magnetic Behaviour and Effect of temperature on magnetization.	9	19%
2	Nano Magnets: Introduction, Properties of Nano Magnets, B-H curve of Nano Magnets, Temperature Effect of Nano Magnets.	9	18%
3	Nano Fluid: Introduction, Properties of Nano Fluid, Magnetization of Nano fluid, Temperature Effect of Nano fluid. Applications of Nanofluid	10	20%
4	Preparation Of Nano magnets and nano Fluid: Preparation technique of Nano Magnets, Various synthesis technique for Nano Fluid.	10	20%
5	Recent And Advance Application Magnetic Materials: Applications of Magnetic Materials, Smart cooling Nanofluids	12	23%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
18	17	28	7	00	00

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. Molecular Nanomagnets by Dante Gatteschi, Roberta Sessoli, Jacques Villain, OUP Oxford, ISBN-10: 0199602263.
2. Nanofluids: Synthesis, Properties and Applications by Sohel Murshed, C A Nieto Castro, Nova Science Publishers ISBN-10: 1633216772.
3. Nanofluids Properties and Their Applications by Debendra Das Devdatta Kulkarni LAP Lambert Academic Publishing, ISBN-10: 365916609X.
4. Introduction to Magnetism and Magnetic Materials by D.C. Jiles Springer, ISBN 10: 0412386402
5. Magnetic Materials by Rainer Hilzinger, Werner Rodewald, Wiley VCH, ISBN10: 3895783528

Course Outcome:

After learning the course the students should be able to:

1. Understand basic properties of Magnetic materials. And their behavior under magnetic field and temperature
2. Understand nano- magnets their basic properties of Magnetic materials and their behavior under magnetic field and temperature
3. Introduced to Nano Fluid, properties of Nano Fluid, magnetization of Nano fluid, Temperature Effect of Nano fluid.
4. Understand about preparation of nano magnets and nano fluid of various chemical and physical techniques.
5. Recent And Advance Application Magnetic Materials

List of Experiments:

(Perform any Five experiments from below list and one open ended project)

1. Preparation of Nano fluid.
2. Preparation of Nano magnet.
3. Preparation of Nano magnetic thin film.
4. Determine the thermal conductivity of fluid.
5. Comparison Between fluid and Nano fluid of their thermal properties.
6. Preparation of Ferrofluid.
7. Preparation of ZnO based Nanofluid.
8. Preparation of TiO₂ based Nanofluid
9. Preparation of CuO based Nanofluid
10. Preparation of doped CuO Nanofluid for Cooling application.

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. Study the nano materials related problem in magnetic based industries.
2. Prepare the nano magnetic thin film for magnetic storage device.

Major Equipment: Apparatus of Magnetic Hysteresis Loop & Magnetization Curve

List of Open Source Software/learning website:

<http://www.aspbs.com/jon.htm>

<http://www.northeastern.edu/nanomagnetism/>

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.