Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-7

Subject: Nanotechnology-BETCH17329

Type of course: Minor Stream

Prerequisite: None

Rationale: The course aims to introduce the fundamental concepts of nanotechnology, with a focus on the synthesis, characterization, and applications of nanomaterials. Nanotechnology is a rapidly developing field that involves the design and creation of new materials and devices at the nanoscale. Students will gain an understanding of the principles of nanotechnology, various methods for synthesizing nanomaterials, techniques used for their characterization, and their applications across different fields.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
3	0	0	3	60	30	10	0	50	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE – End Semester Examination; MSE- Mid Semester Examination; CA - Continuous Assessment; ALA-Active Learning Activities.

Course Content:

Sr. No	Course content	Hrs.	% Weightage
1	**Fundamentals and Properties of Nanotechnology** Introduction to nanotechnology, definition, history, and impact of nanoscience in various fields, along with properties of nanomaterials such as size and shape dependent behavior, color, melting point, density of states, band gap, and magnetism.	09	20
2	**Nanoparticles synthesis:** Top down and bottom-up approach, colloids, emulsions, micelles, polymers, mechanical attrition and high energy ball milling.	09	20

3	**Nanomaterials characterization:** Scanning electron microscopy, Transmission electron microscopy, Fourier transform infrared spectroscopy, Energy dispersive spectroscopy, atomic force microscopy, X-ray diffraction, Dynamic light scattering, UV-Vis spectrophotometer.	09	20
4	**Fabrication:** Lithography, chemical vapor deposition, physical vapor deposition, sol-gel synthesis, molecular self-assembly, crystal growth, epitaxy, etching, masking.	09	20
5	**Applications of nanotechnology in chemical industry:** Catalysis, fuel cells, drug delivery and diagnostics, coatings, nanocomposite polymers, fluid inks, dyes, block copolymers, dendrimers, carbon nanotubes applications.	09	20

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Case Study on Nanotechnology in Chemical Industry:** Students will select one application Individually (catalysis, fuel cells, drug delivery, coatings, etc.) and prepare case study explaining its working, advantages, and industrial importance. Submit as a PDF on GMIU Web Portal.	10
2	**Nanomaterials and Applications Table:** Students will Select Individual topic and prepare a table showing nanomaterials such as carbon nanotubes, dendrimers, block copolymers, and nanocomposites along with their properties and applications in various industries. Submit Report as a PDF on GMIU Web Portal.	10
3	**Poster on Drug Delivery or Fuel Cells:** Students will design Individually a poster explaining the role of nanotechnology in drug delivery systems or fuel cells with diagrams and key points. Submit Individual Report as PDF/image on GMIU Web Portal.	10
4	**Synthesis of Nanomaterial from Waste (Creative Activity):** Students will develop Individually a concept or small-scale model for synthesizing useful nanomaterials from waste materials. They must explain the process, materials used, and potential applications in industry. A report with diagram/model/PPT should be submitted Report on GMIU Web Portal.	10
5	**Prototype or Concept Model Development** Students will Individually create a simple prototype or conceptual model (physical or digital) demonstrating any nanotechnology application such as filtration, coating, or catalysis. They must explain the concept and working principle in a short report or presentation on GMIU Web Portal	10

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	40%	20%	20%	10%	10%	00%

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.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Identify the basic principles and properties of nanomaterials through study-based activities.
CO2	Gain knowledge of nanomaterials synthesis methods and their practical approaches.
CO3	Understand concepts of nanotechnology systems.
CO4	Analyze various applications of nanotechnology in chemical and industrial fields.
CO5	Apply nanotechnology concepts creatively for developing models, prototypes, and sustainable solutions.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction. Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses. The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Hand book of Nanostructured Materials and Nanotechnology, H. Nalwa, Vol. 1 to 5, Academic Press, 1999.
[2] Hand book of Nanotechnology, B. Bhusan, Springer, 2004.
[3] Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects, D.Schodek, P. Ferreira, M.F. Ashby, 2009.

[4] Nanoscale materials in Chemistry, K.J. Klabunde, Wiley, 2001.
[5] Introduction to Nanotechnology, C.P. Poole Jr. and F.J.Owens, Wiley, 2003.
[6] Nanotechnology, M. A. Ratner and D. Ratner, Pearson, 2003.
[7] The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R Rao, Achim Müller, A. K. Cheetham, Wiley, 2004.