

Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year



GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

www.gs.mgu.ac.in

www.mgu.ac.in

Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
International and Inter University Centre for Nanoscience and Nanotechnology

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
MG1MDCUCN101	Introduction Nanotechnology in Medicine and Healthcare	3	3	0	“	MDC
MG1MDCUCN102	Nanotechnology In Sustainable Polymers	3	3	0	“	MDC
SEMESTER II						
MG2MDCUCN101	Introduction To Polymer Nanotechnology Applications	3	3	0	“	MDC
MG2MDCUCN102	Nanotechnology In Plastics Packaging	3	3	0	“	MDC
SEMESTER III						
MG3MDCUCN201	Polymers For Nanomedicine	3	3	0	“	MDC
MG3MDCUCN202	Impact Of Micro and Nano Plastics on The Ecosystem	3	3	0	“	MDC
MG3VACUCN201	Polymer Adhesives and Coatings	3	3	0	“	VAC
MG3VACUCN202	Nano Revolution in Green Tyre	3	3	0	“	VAC
SEMESTER IV						
MG4SECUCN201	Fiber Reinforced Polymer (FRP) Composites	3	3	0	“	SEC
MG4SECUCN202	AI In Polymer Manufacturing and	3	3	0	“	SEC

	Characterization					
MG4VACUCN201	Nanostructures from Natural Origin	3	3	0	“	VAC
MG4VACUCN202	Fundamentals Of Nanostructured Polymer Foams	3	3	0	“	VAC
SEMESTER V						
MG5SECUCN301	Biodegradable Polymers for Drug Delivery and Tissue Engineering	3	3	0	“	SEC
MG5SECUCN302	Non-Destructive Testing of Polymer Composites	3	3	0	“	SEC
MG5VACUCN301	Natural Fiber Reinforced Polymer Composites (NFRPCs): Product Designs and Their Applications	3	3	0	“	VAC
MG5VACUCN302	Intellectual Property and Patenting in The Polymer Sector	3	3	0	“	VAC
SEMESTER VI						
MG6SECUCN301	Polymer-Based 4D Printing for Advanced Manufacturing	3	3	0	“	SEC
MG6SECUCN303	Business Planning for Polymer Entrepreneurs	3	3	0	“	SEC
Total Credits						

*Only for 4-Years Honours Students


**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation	Intermediate	Highe	Advance	PG
--------------	------------	--------------	-------	---------	----

	(100-199	(200-299)	r (300-399)	d (400-499)	Level (500-599)
--	----------	-----------	----------------	-------------	--------------------

Type	Major	Minor	MDC	SEC	VAC	AEC

	MAHATMA GANDHI UNIVERSITY Graduate School
	4 + 1 Integrated UG and PG Programme

School	International and Inter University Centre for Nanoscience and Nanotechnology (IIUCNN)		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Nanotechnology in Medicine and Healthcare		
Course Type	MDC		
Course Level	100-199		
Course Code	MG1MDCUCN101		
Course Overview	This course provides an understanding of applications of nanotechnology in medical field. Students will gain knowledge about the fundamentals of nanotechnology and its various applications in medical field. They will be able to develop critical thinking skills to analyse and develop new strategies based on nanotechnology to solve medical problems.		
Semester	1	Credit	3
Total Student Learning Time	Instructional hours for theory	Instructional hours for practical/lab work/field work	
	45 (L) + 15(T)	NA	
Pre-requisite	Knowledge of basic chemistry and biology		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Gain a foundational understanding of nanotechnology principles and their applications in healthcare.	R, U, An	
2	Understand various applications of nanotechnology in medical diagnostics and	R, U, A, E	

	therapeutics.		
3	Students will critically evaluate the safety, ethical considerations, and future directions of nanotechnology in healthcare.	U, An, C, S	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Fundamentals of Nanotechnology in Healthcare Introduction to Nanotechnology; Nanomaterials for Biomedical Applications; Nanotechnology-based Drug Delivery Systems	15	1
Module 2	Hours	CO No
Applications of Nanotechnology in Medicine Nanotechnology in Medical Imaging; Therapeutic Applications of Nanotechnology; Nanotechnology in Disease Prevention and Control	15	2
Module 3	Hours	CO No
Safety, Ethics, and Future Directions Nanotoxicology and Safety Assessment; Emerging Trends and Future Directions; Case Studies and Applications	15	3

Mode of Transaction	Classroom Activities: <ul style="list-style-type: none"> • Interactive lectures • Group discussions and problem-solving exercises • Quizzes and Assignments Field activities: Lab based activities:
Mode of Assessment	<ul style="list-style-type: none"> • Internal Exams • Semester Exam • Assignments and Seminars

Learning Resources


1. Amna, T., & Hassan, M. S. (Eds.). (2021). Innovative Approaches for Nanobiotechnology in Healthcare Systems. IGI Global.
2. Bhowmick, T. K., Gayen, K., & Maity, S. K. (Eds.). (2024). Nanobiotechnology: Applications of Nanomaterials in Biotechnology, Medicine and Healthcare. CRC Press.
3. Online resources – Online polymer introductory courses from websites like Khan Academy, National Institute of Open Schooling (NIOS), MOOC, and NPTEL offer free learning modules on polymers
4. Invited lectures by visiting academic and industrial scientists. Held regularly on Wednesday afternoon and Saturday morning throughout the academic year.

Relevance of Learning the Course/ Employability of the Course

Studying nanotechnology in medicine and healthcare holds immense promise for transforming diagnostics, treatment strategies, and patient outcomes. It represents a frontier where interdisciplinary research combining nanoscience, biology, and medicine can lead to innovative solutions for challenging medical issues.

The field of nanotechnology in medicine and healthcare offers a wide range of job opportunities across various sectors. Some key job roles and areas where nanotechnology is applied include:

- Research and Development (R&D)
- Clinical Applications
- Business and Commercialization
- Academic and Education

	MAHATMA GANDHI UNIVERSITY
	Graduate School
	4 + 1 Integrated UG and PG Programme

School	International and Inter University Centre for Nanoscience and Nanotechnology (IIUCNN)		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Nanotechnology In Sustainable Polymers		
Course Type	MDC		
Course Level	100-199		
Course Code	MG1MDCUCN102		
Course Overview	This course provides a comprehensive introduction to the exciting and rapidly evolving field of nanotechnology as applied to sustainable polymer science. Students will gain a solid foundation in the principles of nanotechnology, understanding the synthesis, characterization, and properties of nanomaterials. The course will delve into the integration of nanomaterials into polymer matrices to develop advanced materials with enhanced sustainability, performance, and functionality.		
Semester	1	Credit	3
Total Student Learning Time	Instructional hours for theory	Instructional hours for practical/lab work/field work	
	45 (L) + 15(T)	NA	
Pre-requisite	All Discipline		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	To understand the fundamental concepts of nanotechnology and polymer science.	R, U	
2	To explore the synthesis and characterization techniques of various nanomaterials.	R, U, C	
3	To learn about the different methods of incorporating nanomaterials into polymer matrices.	U, A	
4	To evaluate the impact of nanomaterials on the properties and performance of polymers.	R, U, An	
5	To assess the environmental and economic sustainability of polymer nanocomposites	R, U, An, E	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Nanotechnology and Polymers Overview of Nanotechnology and Its Significance, Basic Concepts of Polymer Science, Types of Polymers and their Properties, Challenges in Conventional Polymer-Based Materials.	15	1
Module 2	Hours	CO No
Nanomaterials and Polymer Nanocomposites Classification of Nanomaterials (Carbon-Based, Metal, Ceramic, Etc.), Synthesis Methods (Top-Down, Bottom-Up), Characterization Techniques (Microscopy, Spectroscopy, etc.), Properties of Nanomaterials (Optical, Electrical, Magnetic, Etc.), Polymer Nanocomposites,	15	2,3,4


Types of Polymer Nanocomposites (Reinforcing, Intercalated, Exfoliated), Processing Techniques for Nanocomposites, Influence of Nanomaterials on Polymer Properties (Mechanical, Thermal, Electrical, Etc.).		
Module 3	Hours	CO No
Sustainable Nanotechnology in Polymers Green Synthesis of Nanomaterials, Bio-Based Nanomaterials and Their Applications, Degradable and Compostable Nanocomposites, Life Cycle Assessment, Economic and Environmental Impact of Nanotechnology, Functional Nanopolymers (Conductive, Magnetic, Optical), Sustainable Self-Healing Polymers.	15	5

Mode of Transaction	Classroom activities: <ul style="list-style-type: none"> • Interactive lectures • Group discussions and problem-solving exercises • Quizzes and Assignments Lab based activities:
Mode of Assessment	<ul style="list-style-type: none"> • Assignments • Internal examination • End-semester examination

Learning Resources

-

Relevance of Learning the Course/ Employability of the Course
<p>This course highly relevant to addressing global challenges like climate change. It equips students with skills to innovate in materials science, creating environmentally friendly solutions. Graduates are sought after in diverse sectors such as materials engineering, chemical industry, automotive, aerospace, energy, and environmental consulting. This interdisciplinary field offers excellent career prospects and opportunities to contribute to a sustainable future.</p>

	MAHATMA GANDHI UNIVERSITY
	Graduate School 4 + 1 Integrated UG and PG Programme

School	International and Inter University Centre for Nanoscience and Nanotechnology (IIUCNN)		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Polymer Nanomaterials for Energy Applications		
Course Type	MDC		
Course Level	100-199		
Course Code	MG2MDCUCN101		
Course Overview	This course delves into the exciting and rapidly growing field of polymer nanomaterials for energy applications. Students will explore the synthesis, characterization, and properties of polymer-based nanostructures and their role in enhancing energy conversion, storage, and utilization technologies.		
Semester	2	Credit	3
Total Student Learning Time	Instructional hours for theory	Instructional hours for practical/lab work/field work	
	45 (L) + 15(T)	NA	
Pre-requisite	Understanding of Basic Chemistry		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
---------------	--------------------------------	-------------------------	----------------

	<i>Upon completion of this course, students will be able to;</i>		
1	To understand the fundamental principles of polymer science and nanotechnology.		
2	To explore the synthesis and characterization techniques of polymer-based nanomaterials for energy applications.		
3	To evaluate the properties and performance of polymer nanomaterials in energy devices.		
4	To investigate the latest advancements and challenges in the field of polymer nanomaterials for energy.		
5	To develop critical thinking and problem-solving skills for addressing energy-related issues using polymer nanotechnology.		
6			

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Energy and Nanotechnology Energy Crisis, Sustainable Energy Sources, Basics of Polymer Science, Introduction to Nanotechnology and its Principles, Characterization Techniques for Nanomaterials (SEM, TEM, AFM, XRD, FTIR, Etc.)		
Module 2	Hours	
Polymer Nanomaterials for Energy Conversion Organic Solar Cells: Principles, Materials, Device Architecture, Polymer-Based Dye-Sensitized Solar Cells, Polymer-Based Perovskite Solar Cells, Polymer-Based Thermoelectric Materials and Devices.		
Module 3	Hours	

Polymer Nanomaterials for Energy Storage and Harvesting

Lithium-ion Batteries: Components, Working Principle, And Challenges, Polymer Electrolytes and Solid-State Batteries, Sodium-Ion Batteries and Polymer-Based Electrodes, Supercapacitors: Principles, Materials, and Applications, Piezoelectric and Pyroelectric Polymers, Polymer-Based Nanogenerators, Energy Harvesting from Ambient Sources (Solar, Wind, Vibration).

Mode of Transaction	Classroom activities: <ul style="list-style-type: none">• Interactive lectures• Group discussions and problem-solving exercises• Quizzes and Assignments Lab based activities:
Mode of Assessment	<ul style="list-style-type: none">• Assignments• Internal examination• End-semester examination


Learning Resources

- Textbooks
 1. Polymer Nanocomposites: Synthesis, Characterization, and Applications by Yiu-Wing Mai and Zhong-Zhen Yu
 2. Polymer Nanomaterials for Energy and Environmental Applications by Niranjana Karak
 3. Nanostructured Polymer Blends and Composites in Textiles by Visakh P. M., Long Yu
- Research articles
- Review articles

Relevance of Learning the Course/ Employability of the Course

This course equips students with cutting-edge knowledge in sustainable and renewable energy technologies, making them highly relevant in today's green energy landscape. This multidisciplinary course prepares students for careers in nanotechnology, materials science, and energy sectors, enhancing their employability in roles focused on energy storage, conversion, and generation. Proficiency in these areas meets the increasing demand for innovative solutions in the energy industry, positioning graduates at the forefront of technological

advancements.

	<p style="text-align: center;">MAHATMA GANDHI UNIVERSITY</p> <p style="text-align: center;">Graduate School</p>
	<p style="text-align: center;">4 + 1 Integrated UG and PG Programme</p>

School	International and Inter University Centre for Nanoscience and Nanotechnology (IIUCNN)		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Nanotechnology In Plastics Packaging		
Course Type	MDC		
Course Level	100-199		
Course Code	MG2MDCUCN102		
Course Overview	Nanotechnology, the manipulation of matter at the nanoscale, has revolutionized various industries, including plastics and packaging. By incorporating nanomaterials into plastics, manufacturers can create packaging materials with enhanced properties, such as increased strength, barrier properties, antimicrobial activity, and sustainability. This course explores the principles, applications, and challenges of nanotechnology in plastics packaging.		
Semester	2	Credit	3
Total Student Learning Time	Instructional hours for theory		Instructional hours for practical/lab work/field work
	45 (L) + 15(T)		NA
Pre-requisite	All Discipline		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	<i>Upon completion of this course, students will be able to;</i>		
1	Understand the fundamentals of nanotechnology and its applications in polymer science.	U, R	
2	Explore the various types of nanomaterials used in plastic packaging and the methods of incorporating nanomaterials into plastic packaging.	U, R, An	
3	Evaluate the impact of nanotechnology on the properties and performance of plastic packaging, its application and assess the environmental and health implications of nanotechnology in packaging.	An, E	
4	Develop critical thinking and problem-solving skills related to nanotechnology in packaging.	An, E	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Nanotechnology and Plastics Packaging Basics Of Nanotechnology and its Potential in Packaging, Overview of the Plastics Packaging Industry, Challenges in Conventional Plastic Packaging	15	1
Module 2	Hours	
Nanomaterials for Packaging Applications Types of Nanomaterials (Nanoparticles, Nanotubes, Nanofibers, Etc.), Properties and Characteristics of Nanomaterials, Synthesis and Characterization Techniques, Polymer Matrix and Nanomaterial	15	2

Interactions, Processing Techniques for Nanocomposites, Mechanical, Thermal, and Barrier Properties of Nanocomposites		
Module 3	Hours	
Functional Packaging with Nanotechnology Antimicrobial Packaging Using Nanomaterials, Intelligent Packaging with Nanosensors, Active Packaging with Nanomaterials for Controlled Release, Biodegradable and Compostable Nanocomposites, Life Cycle Assessment of Nanomaterial-Based Packaging. Applications in Food, Pharmaceutical, and Medical Packaging.	15	3,4

Mode of Transaction	Classroom activities: <ul style="list-style-type: none"> • Interactive lectures • Group discussions and problem-solving exercises • Quizzes and Assignments Lab based activities:
Mode of Assessment	<ul style="list-style-type: none"> • Assignments • Internal examination • End-semester examination

Learning Resources

1. Textbooks
 - Nanotechnology in Food Packaging by Vimal Katiyar, Vikas Yadav, and Saurabh Nanavati
 - Polymer Nanocomposites for Food Packaging Applications by Jasim Ahmed, Brijesh K. Tiwari, Syed H. Imam, and M.A. Rao
 - Nanotechnology-Enhanced Food Packaging by Jorge Barros-Velázquez
2. Journal Articles
3. Review Articles

Relevance of Learning the Course/ Employability of the Course
This is a highly relevant course due to the growing demand for sustainable and functional packaging solutions. Graduates of this course will possess a unique skill set, making them highly employable in the packaging industry, nanotechnology research, and related sectors. They will be equipped to develop

innovative packaging materials with enhanced properties, contributing to a more sustainable future.