MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2026 Admission Onwards

SYLLABUS			
SIGNATURE COURSE			
Name of the College	Alphonsa College, Pala		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Kochurani George		
Contributors	Dr. Diana Elizabeth Jose, Dr. Sheena Varghese		
Course Name	Introduction to Nanoscience and Nanotechnology		
Type of Course	DSE		
Specialization title	Nano Chemistry		
Course Code	MG3DSECHEA09		
Course Level	200		
Course Summary	Students will be able to understand the fundamental concepts, history, and interdisciplinary aspects of nanoscience and nanotechnology. They will gain the ability to distinguish between bulk and nanoscale materials by analyzing their unique physical, chemical, and biological properties. Students will also be able to classify different types of nanomaterials, explain their synthesis methods, and recognize their structural features. Furthermore, they will develop a broad understanding of the diverse applications of nanomaterials in areas such as medicine, energy, environment, and electronics.		
Semester	3	**Credits**	4
Course Details	**Learning Approach** / **Lecture** / **Total Hours** Credits / 4 / 60		
Pre-requisites, if any			

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the fundamental concepts of nanoscience and nanotechnology	K, U	PO1, PO2, PO3
2	Compare and contrast the properties of bulk materials with those of nanomaterials	K, U	PO1, PO2, PO3
3	Classify and describe the structure, properties, and applications of various nanomaterials	U	PO1, PO2, PO3
4	Analyze the potential applications of nanoparticles in medicine, energy, electronics, and environmental fields	U, An	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	1	2	-	-	-	-	-	-	-
CO 2	1	1	2	-	-	-	-	-	-	-
CO 3	1	1	2	-	-	-	-	-	-	-
CO 4	1	1	2	-	-	1	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Fundamentals of Nanoscience			
	1.1	Introduction to Nanoscience and Nanotechnology, History of Nanoscience	3	["1"]
	1.2	Fundamental Ideas: Top-down and Bottom-up Approaches in Nanoscience	3	["1"]
	1.3	Feynman's Vision on Nanoscience, Scales of nano systems-Moore's Law	2	["1"]
	1.4	Interdisciplinary nature of nanoscience, Role of physics, chemistry, biology, and materials science	3	["1"]
	1.5	Nano in nature- Lotus effect, gecko's feet, butterfly wings and magneto-tactic bacteria	4	["1"]
2	Properties of Materials at Nanoscale			
	2.1	Bulk vs. Nanomaterials-Comparison of physical, chemical, optical, and biological properties	3	["2"]
	2.2	Role of surface-to-volume ratio, Examples: Gold (bulk vs. nano), Carbon (graphite vs. graphene/nanotube)	3	["2"]
	2.3	Quantum Effects at the Nanoscale: Quantum Confinement in Nanoparticles and Quantum Dots	3	["2"]
	2.4	Discrete energy levels and their influence on electronic and optical properties	3	["2"]
	2.5	Size-Dependent Optical Properties- Optical: Surface plasmon resonance, quantum dots Magnetic: Super paramagnetism in nanoparticles, Mechanical: Strength, flexibility in CNTs, nanowires	3	["2"]
3	Classification of nanomaterials			
	3.1	Classification of Nanostructures -Natural and Synthetic Nanomaterials, -0D, 1D, 2D, 3D nanoparticles	3	["3"]
	3.2	Carbon-Based Nanomaterials- Fullerenes (C60, C70)- Carbon nanotubes (SWCNTs, MWCNTs)- Graphene: 2D carbon lattice, Fascinating nanostructures -Nanowires, Nanorods, Nano shells, Nanotubes	3	["3"]
	3.3	Metal Nanoparticles – Synthesis (any one method) and properties of metal nanoparticles (Au, Ag)- Applications of metal nanoparticles	3	["3"]
	3.4	Metal Oxide Nanoparticles - Synthesis (any one method) and properties of metal oxide nanoparticles, Applications of metal oxide nanoparticles	3	["3"]
	3.5	Quantum Dots - Synthesis and properties of quantum dots - Applications of quantum dots	3	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Applications of Nanoparticles			
	4.1	Biological and Medical Applications- Drug Delivery, Imaging, Therapeutics, Biosensors	4	["4"]
	4.2	Energy Applications- Solar Cells, Fuel Cells, Energy Storage	4	["4"]
	4.3	Environmental Applications-Water Purification, Air Purification	4	["4"]
	4.4	Chemical and biosensors using nanomaterials and defence applications of nanotechnology	3	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture, Multimedia Presentation, Group Discussion

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments, MCQ, Viva, Involvement in classroom activities, Experiential learning **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Hornyak, G. L.; Dutta, J.; Tibbals, H. F.; Rao, A. Introduction to Nanoscience; CRC Press, 2008. 2. N. Kumar, K. Sunita, Essentials in Nanoscience and Nanotechnology, Wiley, 2016. 3. Rao, C. N. R., Müller, A., Cheetham, A. K.; Nanomaterials – An Introduction. In The Chemistry of Nanomaterials 2004, (Chapter 1). 4. Benelmekki, M. Nanomaterials: The Original Product of Nanotechnology; Morgan & Claypool, Publishers, 2019. 5. Klabunde, K. J. Nanoscale Materials in Chemistry; Wiley, 2004. 6. Pradeep, T. NANO: The Essentials: Understanding Nanoscience and Nanotechnology; 1st Edition ed.; McGraw-Hill Education: New York, 2007. 7. Muralidharan, V. S.; Subramania, A. Nanoscience and Technology; Ane Books for, 2009. 8. Poole, C. P.; Owens, F. J. Introduction to Nanotechnology; Wiley, 2003.

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2026 Admission Onwards

SYLLABUS			
SIGNATURE COURSE			
Name of the College	Alphonsa College, Pala		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Kochurani George		
Contributors	Dr. Diana Elizabeth Jose, Dr. Sheena Varghese		
Course Name	Nanoscience and Nanotechnology: Synthesis, Characterization, and Toxicology		
Type of Course	DSE		
Specialization title	Nano Chemistry		
Course Code	MG4DSECHEA09		
Course Level	200		
Course Summary	By completing this course, students will gain a basic understanding of nanomaterial synthesis methods, characterization techniques and toxicology of nanomaterials. They will be able to differentiate between various fabrication approaches and utilize appropriate analytical tools to study nanoscale materials.		
Semester	4	**Credits**	4
Course Details			
Pre-requisites, if any			

Learning Approach	Lecture	Total Hours
Credits	4	60

Course Outcomes (CO)

Number of COs		4	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand and apply synthesis methods for nanomaterials (top-down and bottom-up)	K, U	PO1, PO2, PO3
2	Analyze and apply advanced synthesis techniques for novel nanomaterials	K, U, An	PO1, PO2, PO3
3	Characterize nanomaterials using microscopy and spectroscopy techniques	U, An	PO1, PO2, PO3
4	Evaluate toxicity, environmental impact of nanomaterials and ensure safe handling of it	K, U	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	1	2	-	-	-	-	-	-	-
CO 2	1	1	2	-	-	-	-	-	-	-
CO 3	1	2	2	-	-	-	-	-	-	-
CO 4	1	1	1	-	-	1	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Synthesis Methods in Nanoscience: Top-Down and Bottom-Up Approaches			
	1.1	Introduction to Synthesis Methods - Overview of top-down and bottom-up approaches, Importance of synthesis methods in nanoscience and nanotechnology	3	["1"]
	1.2	Top-Down Approaches- Principle, mechanism, and applications of Ball milling, Physical vapor deposition (PVD)- techniques (sputtering, evaporation), Mechano-chemical method, Laser ablation, Arc-discharge method	5	["1"]
	1.3	Bottom-Up Approaches- Principle, mechanism, and applications of Chemical precipitation, Sol-gel method, Reduction technique, Hydrothermal and solvothermal methods	5	["1"]
	1.4	Advantages and limitations of top-down and bottom-up approaches	2	["1"]
2	Advanced Synthesis Techniques in Nanoscience and Nanotechnology			
	2.1	Chemical Approaches - principles and applications of Sol-gel processing, Solvothermal and hydrothermal methods, Precipitation and spray pyrolysis, Electro-spraying and spin coating routes, Self-assembly and self-assembled monolayers (SAMs), Langmuir-Blodgett (LB) films and Micro-emulsion polymerization	6	["2"]
	2.2	Physical Approaches – Principles and applications of: Physical Vapor Deposition (PVD): sputtering, evaporation, Chemical Vapor Deposition (CVD), Molecular Beam Epitaxy (MBE), Atomic Layer Deposition (ALD), Pulsed Laser Deposition (PLD), Magnetron Sputtering Lithography techniques: Principles and applications of: Photolithography, UV Lithography, Electron Beam (EB) Lithography, Focused Ion Beam (FIB) Lithography, Dip Pen Nanolithography Etching Processes - Principles and applications of: Dry Etching, Wet Etching	8	["2"]
	2.3	Applications of chemical and physical approaches in nanoscience and nanotechnology	1	["2"]
3	Fundamental Characterization Techniques			
	3.1	Electron Microscopy techniques: -Principle, Basic instrumental features, comparison and application of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM)	5	["3"]
	3.2	Scanning Probe Microscopy- Principle, Basic instrumental features, comparison and application of Sanning Tunnelling Microscope (STM) and Atomic Force Microscopy (AFM)	5	["3"]
	3.3	Spectroscopy Techniques - Principle, instrumentation, and applications of UV-Visible Spectroscopy, Infrared (IR) Spectroscopy, X-ray Photoelectron Spectroscopy (XPS), X-Ray Diffraction (XRD), Dynamic Light Scattering (DLS), Auger Electron Spectroscopy (AES), Secondary ion mass spectroscopy (SIMS)	5	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Nanotoxicology			
	4.1	Introduction to Toxicology - Definition and principles of nanotoxicology, Importance of nanotoxicology in risk assessment	3	["4"]
	4.2	Physical and Chemical Properties of Nanomaterials -Size, shape, surface area, and charge, Influence on toxicity and environmental fate, Unique properties of nanomaterials (magnetic, optical and thermal)	4	["4"]
	4.3	Toxicity Mechanisms of Nanomaterials-Reactive oxygen species (ROS) and oxidative stress, DNA damage, mutations, and cell death, Case studies: silver, zinc oxide, fullerenes, and carbon nanotubes	4	["4"]
	4.4	Environmental Fate and Exposure- Release, transport, and transformation of nanomaterials, Exposure routes: Inhalation, Ingestion, Dermal, Environmental detection and analysis	4	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, multimedia presentation, group discussion, peer teaching, experimental demonstrations

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments, MCQ, Viva, Involvement in classroom activities, Experiential learning **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Booker, R.; Boysen, E. Nanotechnology, Wiley India Pvt Ltd, 2008. 2. Ngô, C.; Van de Voorde, M. Nanotechnology in a Nutshell: From Simple to Complex Systems;Atlantis Press, 2014. 3. Sengupta, A.; Sarkar, C. K. Introduction to Nano: Basics to Nanoscience and Nanotechnology; Springer Berlin Heidelberg, 2015. 4. Gupta, P. K. (2022). Fundamentals of nanotoxicology: concepts and applications. 5. Sahu, S. C., & Casciano, D. A. (Eds.). (2014). Handbook of nanotoxicology, nanomedicine and stem cell use in toxicology (pp. 75-76). Hoboken, NJ, USA: Wiley. 6. Gupta, P. K. (2023). Nanotoxicology in nanobiomedicine (pp. 37-53). Springer International Publishing. 7. Houdy, P., Lahmani, M., & Marano, F. (Eds.). (2011). Nanoethics and nanotoxicology. Springer Science & Business Media.

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2026 Admission Onwards

SYLLABUS			
SIGNATURE COURSE			
Name of the College	Alphonsa College, Pala		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Kochurani George		
Contributors	Dr. Diana Elizabeth Jose, Dr. Sheena Varghese		
Course Name	Advanced Characterization of nanomaterials		
Type of Course	DSE		
Specialization title	Nano Chemistry		
Course Code	MG5DSECHEA09		
Course Level	300		
Course Summary	The course provides an in-depth understanding of the techniques used to analyze the structural, chemical, and physical properties of nanomaterials. It introduces students to advanced tools such as electron microscopy, spectroscopy, and surface analysis methods. The course emphasizes the interpretation of data to evaluate material performance and functionality at the nanoscale. Additionally, the course highlights safety considerations and best practices in handling and assessing nanomaterials.		
Semester	5	**Credits**	4
Course Details	**Learning Approach** / **Lecture** / **Total Hours** Credits / 4 / 60		
Pre-requisites, if any			

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the principles underlying UV-Visible spectroscopy and Fourier Transform Infrared Spectroscopy (FTIR). Apply these methods for the characterization of nano particles.	U, A	PO1, PO2, PO3, PO9
2	Understand the spectroscopic techniques to analyze nanoparticles using Mass spectroscopy and X-ray Diffraction spectroscopy.	U	PO1, PO2, PO3
3	Understand and analyze the principles of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) and Scanning Probe Techniques	U, An	PO1, PO2, PO3
4	Apply the principles of nano synthesis in synthesizing different nanomaterials	A	PO1, PO2, PO3, PO4, PO7

Number of COs		5	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
5	Analyse the results of different characterization tools for the synthesized Nanomaterials	An	PO1, PO2, PO3, PO5, PO7, PO9

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	1	1	-	-	-	-	-	2	-
CO 2	2	1	1	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-
CO 4	2	1	2	1	-	-	1	-	-	-
CO 5	2	1	3	-	1	-	1	-	3	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Basic Principles of Characterization Techniques			
	1.1	Principles of UV-Visible spectroscopy	3	["1"]
	1.2	Principles of Fourier Transform Infrared Spectroscopy (FTIR)	3	["1"]
	1.3	Principles of Mass spectroscopy and X-ray Diffraction spectroscopy	5	["2"]
	1.4	Analyse UV Spectrum of Nano Materials	4	["2"]
2	Electron microscopic techniques			
	2.1	Introduction and Principles of Electron Microscopic techniques.	4	["3"]
	2.2	Principles of Scanning Electron Microscopy	3	["3"]
	2.3	Instrumentation of SEM	4	["3"]
	2.4	Analyze SEM of Nano Materials	4	["3"]
3	Scanning probe techniques			
	3.1	Principles of Scanning Tunneling Microscopy (STM), Instrumentation of STM	3	["3"]
	3.2	Principles and Instrumentation of Tunnelling Electron Microscopy (TEM), Principle and Application of High-resolution Transmission Electron Microscopy (HRTEM)	4	["3"]
	3.3	Principles of Atomic Force Microscopy (AFM) Principles of Magnetic Force Microscopy (MFM) Principles of Chemical Force Microscopy (CFM)	4	["3"]
	3.4	Characterisation of Gold and Silver Nano Particles	4	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Laboratory Synthesis and Analysis of Nano Materials			
	4.1	Sol gel synthesis of metal oxides, Hydrothermal Synthesis, Plant Extract assisted Synthesis	4	["4"]
	4.2	Analysis of XRD pattern of nanomaterials and particle size calculation	4	["5"]
	4.3	Analysis of UV spectrum of nanomaterials and band gap calculation	4	["5"]
	4.4	Analysis of images obtained by different imaging techniques	3	["5"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, experimental demonstrations and practical training in laboratory

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments, MCQ, Viva, Involvement in classroom activities, Experiential learning **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (10 out of 12) – 10 × 2 = 20 ◦ PART - B ◦ Short Essays - (6 out of 9) – 6 × 5 = 30 ◦ PART - C ◦ Essays - (2 out of 4) – 2 × 10 = 20

References

- 1. T. Pradeep, Nano: The Essentials, McGraw Hill Publishing Company, New Delhi (2007). 2. B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin, Heidelberg, 2012 3. Zhao, Yuliang, Guibin Jiang, and Jun-Jie Zhu. Characterization of Nanomaterials: Advances and Key Technologies. Springer, 2016. 4. Edelstein, A. S., and R. C. Cammarata. Nanomaterials: Synthesis, Properties, and Applications. CRC Press, 2001. 5. Kumar, Narendra, and Yashwant Pathak. Nanotoxicology: Materials, Methodologies, and Assessments. CRC Press, 2017. 6. Sahu, Saura C., and Daniel A. Casciano. Handbook of Nanotoxicology, Nanomedicine and Stem Cell Use in Toxicology. John Wiley & Sons, 2014. 7. Wiesner, Mark R., and Jean-Yves Bottero. Environmental Nanotechnology: Applications and Impacts of Nanomaterials. McGraw-Hill Education, 2007 8. M.S.R Rao and S Singh, “Nanoscience and Nanotechnology: Fundamentals to Frontiers” Wiley India Pvt. Ltd., 2014 9. . K K Chattopadhyay, Arghya Narayan Banerjee, Introduction To Nanoscience AndNanotechnology, PHI Learning, 2009 10. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd.New Delhi, 2009.

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SYLLABUS			
SIGNATURE COURSE			
Name of the College	Alphonsa College, Pala		
Faculty/ Discipline	Chemistry		
Programme	BSc (Hons) Chemistry		
Course Coordinator	Dr. Kochurani George		
Contributors	Dr. Diana Elizabeth Jose, Dr. Sheena Varghese		
Course Name	Advanced Applications of Nanotechnology		
Type of Course	DSE		
Specialization title	Nano Chemistry		
Course Code	MG6DSECHEA09		
Course Level	300		
Course Summary	This course explores the role of nanomaterials in advancing sustainable energy technologies. It covers the synthesis, properties, and applications of nanostructured materials in key areas such as solar energy conversion, energy storage, fuel cells, and hydrogen production. Emphasis is placed on the design principles and mechanisms by which nanomaterials enhance efficiency, reduce costs, and improve environmental compatibility in energy systems.		
Semester	6	**Credits**	4
Course Details			

Learning Approach	Lecture	Total Hours
Credits	4	60

Pre-requisites, if any	

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand Nanomedicine Concepts Analyze Nano-Bio Interactions and Therapeutics	U, An	PO1, PO2, PO3
2	Apply Nanomaterials in Diagnostics and Imaging	A	PO1, PO2, PO3
3	Evaluate Nanotechnology for Sustainable Energy Develop Environmental Remediation Strategies	A, E	PO1, PO2, PO3, PO7
4	Design Smart and Functional Consumer Goods Apply the applications of nano-packaging and nano sensors in improving food safety	A	PO1, PO2, PO3, PO7

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CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	2	-	-	-	-	-	-	-
CO 2	2	1	2	-	-	-	-	-	-	-
CO 3	2	2	2	-	-	-	3	-	-	-
CO 4	2	2	2	-	-	-	2	-	-	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Medical Application I Nanomaterials, Drug Delivery, and Therapeutics			
	1.1	Nanomedicine definition, historical perspective, and size-dependent effects	3	["1"]
	1.2	Bionanomaterials I: Nano-Bio Interactions: Protein corona, and biocompatibility.	3	["1"]
	1.3	Bionanomaterials II: Dendrimers, Inorganic Nanoparticles (Gold, Quantum Dots, Magnetic NPs)	3	["1"]
	1.4	Study of Stimuli-Responsive Release: pH-responsive, temperature-responsive and light-responsive	3	["1"]
	1.5	Nanotechnology in Cancer Therapy: Chemotherapy, Photothermal Therapy (PTT), and Photodynamic Therapy (PDT)	3	["1"]
2	Medical Application II: Imaging, Diagnostics, and Emerging Applications			
	2.1	Nano-Imaging Agents: Nanoparticles as contrast agents.	3	["2"]
	2.2	Nanomaterials in Magnetic Resonance Imaging (MRI)	3	["2"]
	2.3	Point-of-Care (POC) Diagnostics: Nanomaterial-based rapid diagnostic tests (e.g., biosensors)	3	["2"]
	2.4	Nano vaccines and Nano dentistry	3	["2", "4"]
	2.5	Emerging Biomedical Applications: Nanotechnology in Wound Healing (antimicrobial dressings)	3	["4"]
3	Applications in Energy and Environment			
	3.1	Clean Energy Applications I (Energy Conversion) • Photovoltaics (Solar Cells), Fuel Cells: Pt nanoparticles	3	["3"]
	3.2	Supercapacitors/Ultracapacitors: Carbon Nanotubes (CNTs) and Graphene, Hydrogen Storage: Nanomaterials for efficient and safe hydrogen storage.	4	["3"]
	3.3	Water Purification and Environmental Remediation Water Purification: Nano-Adsorbents, Nanofiltration (NF), Nanomaterial-based Disinfection	4	["3"]
	3.4	Air Pollution Control: Nano catalysts for converting harmful gases into benign products. Environmental Monitoring: Nanomaterial-based sensors for detecting trace pollutants.	4	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Nanotechnology in Consumer Products and Textiles			
	4.1	Consumer Products: Cosmetics, scratch-resistant coatings, Lotus Effect: self-cleaning surfaces.	5	["4"]
	4.2	Smart Textiles: Nano coatings for water-repellent, stain-resistant, antimicrobial, and UV-protective fabrics.	5	["4"]
	4.3	Food and Agriculture: Nano-packaging for extended shelf life, nano sensors for food quality, nano-pesticides.	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture involving chalk & board method, multimedia presentation, group discussion, peer teaching, experimental demonstrations

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments, MCQ, Viva, Involvement in classroom activities, Experiential learning **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Theory Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (10 out of 12) – 10 × 2 = 20 ◦ PART - B ◦ Short Essays/Problems - (6 out of 9) – 6 × 5 = 30 ◦ PART - C ◦ Essays - (2 out of 4) – 2 × 10 = 20

References

- 1. "Nanotechnology: Principles and Applications" by Guozhong Cao 2. "Nanobiotechnology: Concepts, Applications and Perspectives" by Christof M. Niemeyer and Chad A. Mirkin 3. "Nanotechnology for Energy and Environmental Applications" by Baldev Raj, Marcel Van de Voorde, and Yashwant Mahajan 4. "Nanotechnology in the Defense Industry: Advances, Innovation, and Practical Applications" by Madhuri Sharon 5. T. Pradeep, Nano: The Essentials, McGraw Hill Publishing Company, New Delhi (2007). 6. B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin, Heidelberg, 2012

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- We, Alphonsa College, Pala and Dr. Kochurani George, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Alphonsa College, Pala, agree to appoint a new course coordinator for the proposed Nano Chemistry in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the

specialization, for as long as the college offers this programme.

- We, Alphonsa College, Pala and Dr. Kochurani George, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.