Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA

PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in

शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

SU/BOS/Science/880 **Date: 28/12/2023**

To,

The Head of Department Nanoscience & Technology,
Shivaji University, Kolhapur.

Subject: Regarding syllabi of **B.Sc.-M.Sc. Nanoscience & Technology** degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of question paper and equivalence of **B.Sc.-M.Sc. Nanoscience & Technology** under the Faculty of Science and Technology.

	Course Name
1.	**B.Sc.-M.Sc. Part III Nanoscience and Technology (5Years Integrated) (NEP 1.0)**
2.	**B.Sc.-M.Sc. Part II Nanoscience and Technology (5Years Integrated) (NEP 2.0)**
3.	**M.Sc. Part II Nanoscience and Technology (NEP 2.0)**

This syllabi and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020(Online Syllabus)

The question papers on the pre-revised syllabi of above mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	P.G.Seminar Section
2	Director, Board of Examinations and Evaluation	8	Computer Centre
3	The Chairman, Respective Board of Studies	9	Affiliation Section (U.G.)
4	B.Sc. Exam	10	Affiliation Section (P.G.)
5	Eligibility Section	11	P.G.Admission Section
6	Appointment Section		

Shivaji University, Kolhapur

Accredited by NAAC with 'A++' Grade

NATIONAL EDUCATION POLICY (NEP-2020)

Syllabus for

M. Sc. in Nanoscience and Technology, Part II

Syllabus to be implemented from the academic year 2024-25 (July 2024) onwards.

School of Nanoscience and Biotechnology,

Shivaji University, Kolhapur

Programme: M.Sc. in Nanoscience and Technology, Part-II under NEP -2020 structure (AY 2024-25)

Course code Abbreviations

Sr. No.	Name	Short form
1	Major Mandatory	MM
2	Major Elective	ME
3	Research Methodology	RM
4	On Job Training	OJT/OJ
5	Field Projects	FP
6	Research Project	RP

M. Sc. in Nanoscience and Technology, Part- II

List of course with the codes

Sr. No.	Name of the Course	Course Code
1	Physics	01
2	Chemistry	02
3	Nanobiotechnology	03
4	Nanoscience and Technology	04

M. Sc. in Nanoscience and Technology, Part-II,

SEM-III and SEM-IV

Sr. No.	Paper Code	Title of the Paper
		SEM III
1	MSCU0325MML604I1	SWYAM / MOOCS / NPTEL (Online Course with exam) 4 Credit Or Tools and Techniques in Nanomaterial's Synthesis
2	MSCU0325PML604I1	Research Methodology
	MSCU0325RPP604I1	Research Project – I (Research Project or Internship Phase-I)
		SEM IV
9	MSCU0325MML604J1	SWYAM / MOOCS / NPTEL (Online Course with exam) 4 Credit Or Tools and Techniques in Nanomaterial Characterization
10	MSCU0325RPP604J1	Research Project – II (Research Project or Internship Phase-II)

The following shall be the courses of the studies under the NEP-2020 pattern

M. Sc. in Nanoscience and Technology, Part-II, SEM-III and SEM-IV

NEP-2020 PATTERN (2024-25)

SEMESTER-I (Duration – 6 Months)																			
Sr. No.	Course Title	**Teaching Scheme**						**Examination Scheme**											
								Theory								Practical			
		Theory			Practical			Theory			Internal			Total		Total			
		No. of lectures	Hours	Credits	No. of Lectures	Hours	Credits	Max.	Min.	Hours	Max.	Min.	Hours	Max.	Min.	Max.	Min.	Hours
1	# SWYAM / MOOCS / NPTEL (Online Course with exam) 4 Credit Or Tools and Techniques in Nanomaterial's Synthesis	4	4	4	-	-	-	80	28	3	20	7	1	100	35	-	-	-
2	Research Methodology	4	4	4	-	-	-	80	28	3	20	7	1	100	35	-	-	-
3	Research Project – I (Research Project or Internship Phase-I)	-	-	-	6	36	4	-	-	-	-	-	-	-	-	100	35	4
	Total	**8**	**8**	**8**	**6**	**36**	**4**	**-**	**-**	**-**	**-**	**-**	**-**	**200**	**-**	**100**	**-**	**-**

	SEMESTER-II (Duration 6 months)																	
Sr. No.	Course Title	Teaching Scheme						Examination Scheme										
								Theory								Practical		
		Theory			Practical			Theory			Internal			Total		Total		
1	# SWYAM / MOOCS / NPTEL (Online Course with exam) 4 Credit Or Tools and Techniques in Nanomaterial Characterization	4	4	4	-	-	-	80	28	3	20	7	1	100	35	-	-	-
2	Research Project – II (Research Project or Internship Phase-II)	-	-	-	6	42	6	-	-	-	-	-	-	-	-	200	70	4
	Total	**4**	**4**	**4**	**6**	**42**	**6**	**-**			**-**	**-**	**-**	**100**		**200**		**-**
	Grand Total	**12**	**12**	**12**	**12**	**88**	**10**							**300**		**300**		

Note:

For each semester**, students** can choose one Online course [From online platforms like SWYAM / MOOCS / NPTEL with a minimum of 4 Credit] **Or**

Students can enroll in a subject that is offered by the University (the Mode of teaching is Online Mode) and the exam will be conducted by the University.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Biotechnology
M.Sc. in Nanoscience and Technology Part – II, Semester-III

Tools and Techniques in Nanomaterial's Synthesis
Lectures: 60

Course learning outcomes

After completion of this course, the student will be able to

- Understand the fundamental concept of different nanomaterial synthesis routes
- Understand the background of the physical synthesis techniques
- The concept of chemical synthesis with various methods and their pros and cons.
- Handle the microbial cultures and nanomaterials synthesized by biological route.

Unit	Title	Lectures
1	**Introduction to synthesis of nanomaterials:** Top down, and Bottom up approach Different method used for nanomaterial synthesis-Physical, chemical and biological. Applications of nanomaterial in various field , Catalysis, Energy harvesting, energy storage and biomedical application, industrial application	15
2	**Physical methods** Ultra Sonication, Irradiation, Evaporation-Condensation, Arc-Discharge, Laser ablation, Phase separation, Nano-imprinting, electro spraying, Sputtering, Milling, Inert gas condensation, Grinding system.	15
3	**Chemical Synthesis** Micro-emulsion process, sol-gel process, polyol process, solvothermal and hydrothermal methods, precipitation methods, Chemical reductions Soft and hard templating methods, Reverse micelle methods, spin and dip coating. Sonochemical, microwave synthesis Advantages and disadvantages of chemical synthesis method.	15
4	**Biological Synthesis-** Nanoparticle synthesis using bacteria, mechanism, types, examples and advantages Nanoparticle synthesis using fungi- mechanism, types, examples and advantages Nanoparticle synthesis using plant (green synthesis)-mechanism, examples and advantages Nanoparticles synthesis using purified enzymes, proteins, biomolecules.	15

	Isolation and purification of bioinspired nanomaterials-biopolymers, Liposomes, lipoproteins, magnetosomes, exosomes,etc .	

Reference:

1. Synthesis and Applications of Nanoparticles, Atul Thakur, Preeti Thakur, S.M. Paul Khurana, 2022 springer publication
2. Synthesis of nanoparticles and nanomaterial's, (Zhypargul abdullaeva) 2017 springer publication
3. The Chemistry of Nanomaterials C. N. R. Rao, Achim Müller, A. K. Cheetham 2004 Wiley-VCH Verlag GmbH & Co. KGaA.
4. Handbook of Metal Physics, Chemical Methods for Preparation of Nanoparticles in Solution, C.-H. Yu, Kin Tam, Edman S.C. Tsang, 2008 Elsevier publication
5. Nanomaterials Synthesis Design, Fabrication and Applications A volume in Micro and Nano Technologies, 2019 Elsevier publication.
6. Nanobiotechnology: Concepts and Applications in Health, Agriculture, and Environment Rajesh Singh Tomar, Anurag Jyoti, Shuchi Kaushik CRC Press
7. Nanobiotechnology: Concepts, Applications and Perspectives Christof M. Niemeyer, Chad A. Mirkin Wiley,
8. Colloids for Nanobiotechnology, Synthesis, Characterization and Potential Applications,Wolfgang Parak, Neus Feliu
9. Robert A. Freitas Jr (2003) Nanomedicine, Vol. I: Basic Capabilities.
10. Neelina H. Malsch (2005) Biomedical Nanotechnology. Taylor and Francis. CRC press.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Biotechnology
M.Sc. in Nanoscience and Technology Part – II, Semester-III

Research Methodology
Lectures: 60

Course outcomes:
CO1: Understand the basics of research methodology, significance and design of research problem.
CO2: Develop competence on understanding of Literature Survey and Communication of Research Findings.
CO3: Understand the Ethical aspects of the research work.
CO4: Understand process of fundamentals of Data Analysis.

Unit	Title	Lectures
1	**Research Methodology**: Research: objectives and motivation, types of research, research approaches, significance of research, importance of knowing how research is done, research progress, criteria of good research. Research design: meaning of research design, features of good design, important concepts of relating research design, different basic designs.	18
2	**Literature Searching and Communicating of Research Findings** Introduction of Literature Searching, Database: SciFinder, Web of Science, Pub Med, Scopus, Science Direct, Quality measures of research: Citation Index, Impact Factor, H-index and i-10 index. Writing scientific report: Structure and components of research report, revision, writing project proposal, Paper writing for International Journals, submitting to editors, conference presentation, preparation of effective slides, pictures, graphs, and citation styles. Reference Management Tools: END note, Reference manager and Mendeley, Criteria for evaluation of research report, Thesis writing.	18
3	**Ethical aspects of the research work.** Scientific ethics, axiology and ethical values of science, ethics of the researcher, personal code of conduct, internal code of conduct, conduct guidelines, ethical standards of publication, scientific fraud and malpractice; study of historical and contemporary cases. Plagiarism awareness and detection tools.	12

4	**Fundamentals of Data Analysis** Statistical tools in Data analysis, Data acquisition methods and software, Data Processing and Analysis and interpretation using MS excel, Origin, MATLAB, Python, Mathematica, Introduction to AI language.	12

Reference Books

1. Fundamentals of computers, Morley & Parkar, Cengage Learning Pvt. Ltd. New Delhi,
2. Research Methodology – Methods and Techniques, C. R. Kothari, Wiley Easter Ltd, New Delhi 1985.
3. Writing your thesis, Paul Oliver, Vistaar Publication, New Delhi
4. Research Methodology: A Step-by-Step Guide for Beginners Fifth Edition Ranjit Kumar - University of Western Australia, Australia.
5. Fernanda S. Oda, James K. Luiselli, Derek D. Reed, Chapter 10 - Ethically Communicating Research Findings, Editor(s): David J. Cox, Noor Y. Syed, Matthew T. Brodhead, Shawn P. Quigley, Research Ethics in Behavior Analysis, Academic Press, 2023, Pages 215-236, ISBN 9780323909693
6. https://pubmed.ncbi.nlm.nih.gov/
7. https://www.scopus.com/search/form.uri?display=basic#basic
8. Ali Z, Bhaskar SB. Basic statistical tools in research and data analysis. Indian J Anaesth. 2016 Sep;60(9):662-669. doi: 10.4103/0019-5049.190623.
9. Yip C, Han NR, Sng BL. Legal and ethical issues in research. Indian J Anaesth. 2016 Sep;60(9):684-688. doi: 10.4103/0019-5049.190627.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Biotechnology
M.Sc. in Nanoscience and Technology Part – II, Semester-IV

Tools and Techniques in Nanomaterial Characterization
Lectures: 60

Course learning outcomes

After completion of this course, the student will be able to

- Understand the fundamental concept of different nanomaterial characterization techniques.
- Understand the background of imaging techniques.
- Understand the background of Separation techniques
- Basic skills for the measurement of optical, physical, chemical and biological properties of Nanomaterials.

Unit I: Imaging, electron probe methods and others (15 Lectures)

Scanning Probe Microscopy Methods Atomic Force Microscopy (AFM): The Force in AFM, Resolution, and Operation. Electron microscopy techniques such as, Scanning electron microscopy (SEM), Field-emission scanning electron microscopy (FE-SEM), Transmission electron microscopy (TEM), High-resolution transmission electron microscopy (HR-TEM), X-ray photoelectron spectroscopy (XPS), X-Ray Methods: X-Ray Diffraction.

Unit II: Separation techniques in nanobiotechnology (15 Lectures)

Electrophoresis: Fundamentals applications and types. Zone Electrophoresis: Paper, gel, thin layer, cellulose acetate electrophoresis. Moving boundary electrophoresis: Capillary, Isotacho, Isoelectric focussing, Immuno- electrophoresis. Chromatography: Fundamentals applications and types. Centrifugation: Fundamentals applications and types.

Unit III: Particle sizing, thermal analysis, porosity (15 Lectures)

Particle Size Determination: Dynamic Light Scattering (DLS) Photon correlation spectroscopy based size determination. Porosimtery, Surface Area and Porosity: Brunauer-Emmett-Teller (BET) pore shapes and size and pore size distribution, Research tools & Techniques: Static and dynamic Contact angle measurements, Thermal analysis: Thermogravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC).

Unit IV: Spectroscopy and analysis techniques (15 Lectures)

Spectroscopic Methods UV-Visible Absorption and Emission Spectroscopy, Infrared and Raman Spectroscopy principle, Operation, Qualitative and quantitative analysis using these spectroscopic techniques. Photoluminescence. Most probable number (MPN) test, Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Total organic carbon (TOC), Dissolved oxygen (DO), Turbidity, Hardness, Chlorides.

References:

1. Fundamentals of molecular spectroscopy: C. N. Banwell Mcgraw Hill London, third edition.
2. Thomas, Sabu, et al., eds. Thermal and rheological measurement techniques for nanomaterials characterization. Vol. 3. Elsevier, 2017.
3. Cullity, Bernard Dennis. Elements of X-ray Diffraction. Addison-Wesley Publishing, 1956.
4. Willard, Hobart Hurd, et al. "Instrumental methods of analysis." (1988).
5. Sivasankar, B. "Instrumental methods of analysis." (No Title) (2012).
6. Kuo, John, ed. Electron microscopy: methods and protocols. Vol. 369. Springer Science & Business Media, 2008.
7. Haugstad, Greg. Atomic force microscopy: understanding basic modes and advanced applications. John Wiley & Sons, 2012.
8. Smith, Ivor. Chromatographic and electrophoretic techniques. Vol. 2. Heinemann, 1960.
9. Centrifugation: A Practical Approach David Rickwood, IRL Press, 1984
10. De Anil, Kumar. Environmental chemistry. New Age International, 2003.

NATURE OF QUESTION PAPER

M. Sc. in Nanoscience and Technology

All Questions are compulsory

Time duration (3 hours) **Total Marks: 80**

Q. 1. Select the correct answers: MCQ **1 x 8 = 8**

i) ii)

iii) iv)

v) vi)

vii) viii)

Q. 2. Write short notes on: **2 x 4 = 8**

a) b)

c) d)

Q. 3. Answer any six of the following: **4 x 6 = 24**

a)

b)

c)

d)

e)

f)

g)

h)

Q.4. Answer any five of the following: **8 x 5 = 40**

a)
b)
c)
d)
e)
f)