

 <p>Estd. 1962 "A++" Accredited by NAAC(2021) With CGPA 3.52</p>	<p align="center"><b>SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA</b> PHONE : EPABX – 2609000, www.unishivaji.ac.in, <b>bos@unishivaji.ac.in</b> <b>शिवाजी विद्यापीठ, लिहापूर - ४१६००४, महाराष्ट्र</b> दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दूरध्वनी विभाग २३१-२६०९०९३/९४</p>	
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SU/BOS/Science/ 41

Date: 17/ 10/ 2022

To,  
The Principal,  
All Affiliated Concerned Science Colleges/Institutions  
Shivaji University, Kolhapur.

**Subject :- Regarding syllabi of M. Sc. & B.Sc. Part- I (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 .**

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 syllabi and Nature of question paper of **M. Sc. & B.Sc. Part- I Information Technology** under the Faculty of Science and Technology as per National Education Policy 2020 .

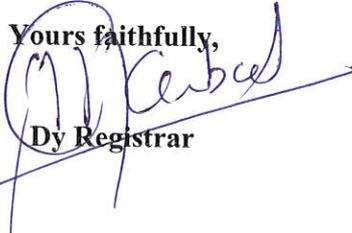
Sr.No.	Faculty of Science and Technology	Programme/ Course
1	Physics	<b>B.Sc. - M. Sc. Part- I . Nanoscience and Technology ( 5 Years Integrated )</b> <b>B.Sc. Part- I. Nanoscience and Technology</b>

This syllabi and nature of question paper shall be implemented from the Academic Year **2022-2023** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in) (students Online Syllabus)

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	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre ( I.T.)
4	B.Sc. Exam	10	Affiliation Section ( U.G.)
5	Eligibility Section	11	Affiliation Section ( P.G.)
6	O.E. I Section	12	P.G.Admission Section

# Shivaji University, Kolhapur



Accredited by NAAC with 'A++' Grade

**NATIONAL EDUCATION POLICY (NEP-2020)**  
**Syllabus for**  
**B. Sc. Nanotechnology**

Syllabus to be implemented from the academic year 2022-23  
(August, 2022) onwards

### Program Structure for B. Sc. (Nanotechnology)

B. Sc. ( Nanotechnology) NEP 2020				
Part – I ( Semester – I and II)				
	Sr. No.	Course Code	Course Title	Credits
CGPA	1	DSC-37A	Introduction to Nanoscience and Nanotechnology	2
	2	DSC-38A	Physico-Chemical aspects of Nanoscience and Nanotechnology	2
	3	DSC-37B	Techniques for the synthesis of Nanomaterials	2
	4	DSC-38B	Basic Characterization Techniques for Nanomaterials	2
	5	1. Practical DSC-37A and DSC-38A 2. Practical DSC-37B and DSC-38B	Laboratory Course-I  Laboratory Course-I	2
Non-CGPA	6	AECC-1 AECC-2	As per NEP- 2020 Science structure	As per NEP-2020 Science structure
Non-CGPA	7	SEC	As per NEP- 2020 Science structure	As per NEP-2020 Science structure

**(B. Sc. Nanotechnology)**  
**F. Y. B. Sc., Sem. I**  
**Syllabus**  
**Paper I**

**Title of Paper: Introduction to Nanoscience and Nanotechnology**

**Subject Code: DSC-37A**

**Unit I: Fundamentals of Nanoscience and Nanotechnology** **10 L**

Definitions, Relationship and Differences. Nano and Nature: Nanoscopic Colours (Butterfly Wings), Bioluminescence (Fireflies), Tribiology (Geckos sticky feet, lotus leaf effect). Introduction to hydrophilic and hydrophobic materials. Nanotechnology timeline, Pre-18<sup>th</sup> Century, 19<sup>th</sup> Century, 20<sup>th</sup> Century and 21<sup>st</sup> Century. Future perspectives of nanoscience and nanotechnology.

**Unit II: Nanoscale Science** **9L**

Interconversion of Units. Introduction to surface area to volume ratio and aspect ratio. Difference between surface area to volume ratio of bulk materials and nanomaterials (sphere, hollow sphere, rods, hollow rods, cubes and hollow cubes) and related numerical problems. Difference in aspect ratio of bulk wire and nanowire and related numerical problems. Nanomaterials and wavelength of light.

**Unit III: Classification of Nanomaterials** **10L**

Introduction to dimensional growth process. Classification of nanomaterials into 0D, 1D, 2D and 3D. Relationship between dimension and shape of nanomaterials (Quantum dots, Quantum wires, Carbon nanotubes, Bucky balls, Fullerenes). Introduction to size effect on electronic and optical properties (Quantum confinement).

**Unit IV: Introduction to Self-assembled Biological Nanomaterials in Nature** **8L**

Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus).

**References:**

1. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
2. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.

**(B. Sc. Nanotechnology)**

**F. Y. B. Sc., Sem. I**

**Syllabus**

**Paper II**

**Title of Paper: Physico-Chemical, Biological aspects of Nanoscience and Nanotechnology**

**Subject Code: DSC-38A**

**Unit I: Fundamentals of Atomic Structure and Bonding** **11 L**

Bohr's atomic structure, Bohr's atomic radii, comparative size of nanomaterials and atomic size, electronic configuration, energy levels of shells and related numerical problems on excitation of electrons from lower to higher energy level. Concept of quantization of energy. Arrangement of atoms in solids (two-dimension crystal structures and three-dimension crystal structure). Bonding in solids (MOT), bonding and antibonding states. Electronic structures of solids.

**Unit II: Crystal Structure** **9 L**

Lattices, basis of crystallographic planes and direction. Simple Cubic (SC), BCC, and FCC crystal structures.

**Unit III: Types of Solid and Phase Diagram** **10 L**

Single Phase alloys, Semiconductors, insulators and oxide materials. Basic terms involved in phase diagram: system, surrounding, component, co-ordinates, phase equilibrium, phase diagram. Lever rule, Gibb's phase rule, phase diagram of Pb-Sn system.

**Unit IV: Terminology and Techniques in Nanobiotechnology** **8 L**

Definitions, Scopes and applications of Biotechnology, Nanobiotechnology, Biomolecular Nanotechnology, Biomedical Nanotechnology, Green Nanotechnology. Fundamentals and introduction to techniques such as mechanical extraction, physical methods of homogenization, centrifugation, dialysis, electrophoresis and chromatography techniques for purification of biomolecules and microscopy.

References:

1. Materials Science and Engineering –V. raghavan
2. Elements of Material Science and Engineering-H. Vanvlach (4<sup>th</sup> Edition)
3. Nanotechnology-S. K. Kulkarni (3<sup>rd</sup> Edition)

**(B. Sc. Nanotechnology)**

**F. Y. B. Sc., Sem. II**

**Syllabus**

**Paper I**

**Title of Paper: Techniques for the synthesis of Nanomaterials**

**Subject Code: DSC-37B**

**Unit I : Basics of Fabrication Methods**

**10L**

Top-Down fabrication methods –Types of Top-Down fabrication methods (mechanosynthesis, thermal, high energy, chemical fabrication and lithography-concepts with examples only). Bottom-Up fabrication methods-Types of Bottom-Up fabrication methods (gaseous-phase, liquid phase, solid-phase, template synthesis-concepts with examples only). Nano perspective of the fabrication methods.

**Unit II: Chemical Synthesis-I**

**8 L**

i) Combustion: Chemical etching of silicon ii) Basic concepts of Chemical-Mechanical polishing.  
iii) Anodization and Electropolishing: Chemical reactions of electrodeposition of aluminum.

**Unit III: Chemical Synthesis-II**

**11 L**

Introduction to molecular self-assembly (MSA), Template synthesis, Sol-gel methods, metal reduction, emulsion polymerization, block copolymerization, electrodeposition with examples and reactions involved.

**Unit IV: Biological Synthesis**

**8 L**

Biological synthesis of Nanoparticles, Concept of reducing and capping agents, introduction to biomolecules as reducing and capping agents, Bacteria, fungi and plants as sources of reducing and capping agents and for biogenic synthesis of nanomaterials. Advantages and applications of biologically synthesized nanomaterials. Introduction to biological nanomaterials.

Biom mineralization, Magnetosomes, DNA based Nano structures, Protein based Nano structures

**References:**

1. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
2. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.
3. Nanotechnology-S. K. Kulkarni (3<sup>rd</sup> Edition)

**(B. Sc. Nanotechnology)**

**F. Y. B. Sc., Sem. II**

**Syllabus**

**Paper II**

**Title of Paper: Basic Characterization Techniques for Nanomaterials**

**Subject Code: DSC-38B**

**Unit I: Introduction to Nanotools**

**10L**

Types of characterization methods: Electron probe methods, Scanning Probe methods, Spectroscopic methods and Nonradiative and Nonelectron methods (classification and concepts only). Optics and resolution (formula and calculations).

**Unit II: Fundamentals of Spectroscopy I**

**10L**

Electromagnetic radiation and range (problems on interconversion of wavelength to frequency and energy). Relationship between electromagnetic radiation range and spectroscopy. Fundamentals and working principle of UV-Visible spectroscopy, difference between absorbance and surface plasmon resonance (SPR), principle of Fourier-Transformation, fundamentals and working principle of FT-IR, application in functional group determination of organic compounds (-OH, -COOH, -NH<sub>2</sub>, -NH-, -O-).

**Unit III: Fundamentals of Spectroscopy II**

**10 L**

Emission spectroscopy: Fundamentals and working principle of spectrofluorometer, concept of singlet and triplet electronic state, definition of fluorescence and phosphorescence through Jablonski diagram. Distinction between radiative and nonradiative emissions. Definition of luminescence and basic types (chemiluminescence).

**Unit IV: Tools in Nanobiotechnology**

**8L**

Fundamentals of Microscopy, types of microscopes, light microscope, compound microscope, bright field and dark phase microscopy, inverted microscope, Confocal microscopy. Applications of microscopy in nanobiotechnology.

**References:**

1. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
2. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.
3. Nanotechnology-S. K. Kulkarni (3<sup>rd</sup> Edition)
4. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash (4<sup>th</sup> Edition), Tata McGraw-Hill Publishing Company Ltd., New Delhi.

**Title: Laboratory Course**

**List of Experiments for B.Sc. Nanotechnology**

**F. Y. B. Sc. (Sem I &II)**

Sr. No.	Name of the Experiments
1.	Reduction of $\text{Ag}^+$ by glucose (Tollen's Test for reducing sugar).
2.	Reduction of $\text{Cu}^{2+}$ by aldehydes (Fehling's Test).
3.	Synthesis of Ag nanoparticles using sodium borohydride (Creighton's method).
4.	Synthesis of Au nanoparticles using citric acid (Lee –Meisel method )
5.	Determination of density of colloidal Ag/Au nanoparticles using specific gravity bottle (5 ml).
6.	Measurements of conductivity of KCl solution at different concentration.
7.	Volumetric acid base titration using pH meter.(Strong acid vs Strong base , Weak acid vs Strong base )
8.	Determination of viscosity of polymer by using viscometer.
9.	Diffraction grating by LASER.
10.	Determination of surface tension of a liquid by drop weight method.
11.	Error analysis.
12.	I-V characteristics of solar cells.
13.	Demonstration of nano $\text{TiO}_2$ dye sensitized solar cell. – NVIS kit
14.	Demonstration of nanotechnology. – NVIS kit
15.	Use of multimeter to measure resistance/Inductance/diode/transistor.
16.	Validation of Lambert's-Beer's law using $\text{CuSO}_4$ solution.
17.	Calculation of total number of atom's and surface atom's present in a nanoparticle of a given size. (Theoretical)
18.	Calculation of surface area to volume ratio of 1D solid and hollow nanostructure. (Theoretical).
19.	Calculate the ballistic I-V characteristics for conventional MOSFETs, Nanowires MOSFETs and Carbon Nanotube MOSFETs (FETToy)

20.	Introduction to Nanobiotechnology lab equipments- Calorimeter, pH meter, Weighing balance, Hot Air Oven, Water Bath, Autoclave, Laminar Air Flow, -20 <sup>0</sup> C deep freezer, Thermal cyclor machine (PCR machine), Gel Electrophoresis system, PAGE system, power supply/unit, Centrifuge, water distillation unit etc
21.	Preparation of stock solutions and Buffer Solution, Stock Solution, such as Acetate Buffer pH 4.8, phosphate buffer pH 9.6, Phosphate Buffer saline pH 7.2, Saline solution pH 7.0
22.	Preparation of Plant extract (Organic and aqueous), Crushing, grinding, maceration, homogenization, Filtration, Centrifugation, cold percolation extraction, hot extraction, using Soxhlet apparatus