



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. II Nanoscience and Technology**

**Under
Faculty of Science and Technology
(As per NEP 2.0)**

With effect from Academic Year 2025-2026

Syllabus for Bachelor of Science (B.Sc.) Part –II

Nanoscience and Technology

PREAMBLE:

The B.Sc. Nanoscience and Technology course under the autonomy framework will be introduced in the academic year 2025-2026. It has been designed to meet the specific needs of B.Sc. Nanoscience and Technology students in accordance with the NEP 2020 guidelines. The curriculum has been developed to reflect the expanding scope of physical, chemical and life sciences. The focus is on equipping students with up-to-date knowledge while maintaining a strong foundation in Nanotechnology. This approach will enable students to understand and appreciate contemporary interdisciplinary methods in Nanoscience and their contributions to societal development. The course also includes new practical exercises, providing students with hands-on experience with the latest techniques currently in use. Additionally, the course is intended to inspire students to pursue higher studies in nanoscience, become entrepreneurs, and seek employment in nanotechnology-based industries.

GENERAL OBJECTIVES OF THE COURSE:

1. To provide students with a solid foundation in Nanoscience and Technology.
2. To foster a scientific mindset, encouraging students to be open-minded, critical, and curious.
3. To develop practical skills in conducting experiments and working with laboratory materials.
4. To help students understand scientific terms, concepts, facts, phenomena, and their inter relationships.

PROGRAMME OUTCOMES

After completing the B.Sc. program, graduates will:

1. Possess a strong foundation of knowledge in their chosen field of study.
2. Develop a scientific mindset, becoming open-minded, critical, and curious, which will support their entry into research and innovation.
3. Be skilled in practical work, experiments, and the use of laboratory materials.
4. Be eligible to pursue higher studies in their field, both in India and abroad.

PROGRAMME SPECIFIC OUTCOMES

After completing the B.Sc. Nanoscience and Technology program, students will:

1. Be able to explain, describe, discuss, and ask questions about various aspects of Nanoscience.
2. Design and conduct experiments related to Nanotechnology.
3. Critically analyze the interactions between living and non-living entities in their surroundings.

4. Apply knowledge of Nanoscience related techniques to develop sustainable solutions for both society and industry.

1. TITLE: **Nanoscience and Technology**

2. YEAR OF IMPLEMENTATION: **2025-2026**

3. DURATION: **01 year**

4. PATTERN: **Semester Examination**

5. MEDIUM OF INSTRUCTION: **English**

6. STRUCTURE OF COURSE:

As per NEP-2020 (2.0)

Semester (Level)	Courses		OE	VSC/SEC	AEC/VEC/IKS	OJT/FP /CEP/ CC/RP	Total Credits
	Course I	Course II					
Sem III (5.0)	DSC XIII (2)	DSC XV (2)	OE III (2)	VSC I (2) (P)	AEC I (2)	-	22
	DSC XIV (2)	DSC XVI (2)		SEC I (2) (P)	IKS II (2)		
	DSC P (2)	DSC P (2)					
Sem IV (5.0)	DSC XVII (2)	DSC XIX (2)	OE IV (2)	VSC II (2) (P)	AEC II (2)	-	22
	DSC XVIII (2)	DSC XX (2)		SEC II (2) (P)	VEC II (2)		
	DSC P (2)	DSC P (2)					
Credits	12	12	04	08	08	-	44

7. COURSE TITLE

1) Third Semester

Sr. No.	Course	Course Code	Course Title	Credits
1.	DSC XIII	BNTT 231	Basic Characterization Techniques for Nanomaterials	02
2.	DSC XIV	BNTT 232	Advanced Characterization Techniques for Nanomaterials	02
3.	DSC P	BNTP 233	Practical VII	02
4.	DSC XV	BNTT 234	Physics for Nanoscience III	02
5.	DSC XVI	BNTT 235	Sensors and Transducers	02
6.	DSCP	BNTP 236	Practical VIII	02
7.	VSC I	BNTPVSC 1	Thin Film Coating Techniques I	02
8.	SEC I	BNTPSEC 1	IR Spectrophotometry Techniques	02
9.	AEC I	BNTTAEC 1	English for Communication I	02
10.	IKS II	BNTTIKS 2	Indian Knowledge System for Nanoscience and Technology	02
11.	OE III	BNTTOE 3	Agricultural Economics	02

2) Fourth Semester

Sr. No.	Course	Course Code	Course Title	Credits
1.	DSC XVII	BNTT 241	Nanobiotechnology	02
2.	DSC XVIII	BNTT 242	Physics for Nanoscience IV	02
3.	DSC P	BNTP 243	Practical IX	02
4.	DSC XIX	BNTT 244	Chemistry for Nanoscience III	02
5.	DSC XX	BNTT 245	Chemistry for Nanoscience IV	02
6.	DSC P	BNTP 246	Practical X	02
7.	VSC II	BNTPVSC 2	Thin Film Coating Techniques II	02
8.	SEC II	BNTPSEC 2	Sensor Technology	02
9.	AEC II	BNTTAEC 2	English for Communication II	02
10.	VEC II	BNTTVEC 2	Role of Nanotechnology in Environmental Science	02
11.	OE IV	BNTPOE 4	Instrumentation & Measurement Studies	02

8. EVALUATION STRUCTURE:

Semester III (5.0)

Course	Course Category	Course Code	Internal Evaluation (Best of Two)			ESE	Total Marks	Credits
			CCE-I (10)	CCE- II (10)	CCE-III (10)			
DSC	T	BNTT 231	10	10	10	30	50	02
	T	BNTT 232	10	10	10	30	50	02
	P	BNTP 233	--	20	--	30	50	02
DSC	T	BNTT 234	10	10	10	30	50	02
	T	BNTT 235	10	10	10	30	50	02
	P	BNTP 236	--	20	--	30	50	02
OE III	T	BNTTOE 3 (For Humanities)	10	10	10	30	50	02
VSC I	P	BNTPVSC I	--	20	--	30	50	02
SEC I	P	BNTPSEC I Practical	--	20	--	30	50	02
AEC I	T	BNTTAEC I	10	10	10	30	50	02
IKS II	T	BNTTIKS II	10	10	10	30	50	02
Total							550	22

Semester IV

Course	Course Category	Course Code	Internal Evaluation (Best of Two)			ESE	Total Marks	Credits
			CCE-I (10)	CCE- II (10)	CCE-III (10)			
DSC	T	BNTT 241	10	10	10	30	50	02
	T	BNTT 242	10	10	10	30	50	02
	P	BNTP 243	--	20	--	30	50	02
DSC	T	BNTT 244	10	10	10	30	50	02
	T	BNTT 245	10	10	10	30	50	02
	P	BNTP 246	--	20	--	30	50	02
OE IV	P	BNTPOE 4 (For Humanities)	--	20	--	30	50	02
VSC II	P	BNTPVSC II	--	20	--	30	50	02
SEC II	P	BNTPSEC II Practical	--	20	--	30	50	02
AEC II	T	BNTTAEC II	10	10	10	30	50	02
VEC II	T	BNTTVEC II	10	10	10	30	50	02
Total							550	22

9. OTHER FEATURES:

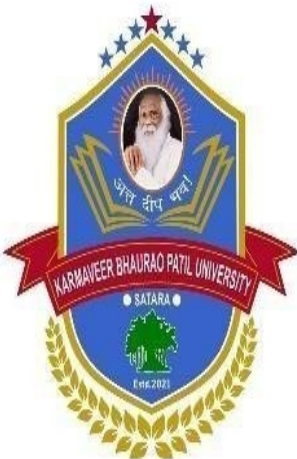
A) LIBRARY: Reference books, Textbooks, journals and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENTS:

a) Computer, LCD projector, Visualizer, smart board

b) Laboratory Equipments:

- | | |
|-----------------------------|-----------------|
| 1. Microscope | 2. Hot Air Oven |
| 3. Digital weighing balance | 4. Incubator |
| 5. PH meter | 6. Refrigerator |
| 7. Conductometer | 8. Autoclave |
| 9. UV-Vis Spectrophotometer | 10. Centrifuge |

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: Major Paper I	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTT 231-Basic Characterization Techniques for Nanomaterials	
Course Objectives: Students will be able to ... 1. study characterization techniques. 2. learn about absorbance and transmittance of materials by using UV-Visible Spectroscopy. 3. gain knowledge of theories behind data analysis. 4. remember the concept of luminescence spectroscopy.		
Course Outcomes: Students should be able to... 1. explain the principle, working and application of basic characterization techniques of nanomaterials. 2. evaluate the-terms involved in characterization techniques. 3. interpret the how to calculate absorbance and transmittance of UV-Visible spectroscopy. 4. analysis the types of different spectroscopy.		
Module	Title and Contents	Hrs
Module-1:	Basics of Spectroscopy 1.1 Introduction to Spectroscopy 1.2 Electromagnetic Radiation, Nature and Properties of Electromagnetic Radiation 1.3 Electromagnetic spectrum 1.4 Application of Spectroscopy in various fields.	08
Module-2:	UV-Visible Spectroscopy 2.1 Instrumentation 2.2 Working, Principle and Sample Preparation 2.3 Electromagnetic Spectrum of UV- Visible Spectrum 2.4 Advantages, Disadvantages and Application of UV-Visible Spectroscopy	07
Module-3:	Raman Spectroscopy 3.1 Introduction of Raman Spectroscopy, Raman Effect 3.2 Why Raman is different from IR 3.3 Selection Rules, Raman Spectrum 3.4 Advantages, Disadvantages and Application of Raman Spectroscopy	07

Module-4:	Luminescence Spectroscopy 4.1 Definition and Principles of Luminescence Spectroscopy 4.2 Types of Luminescence (Fluorescence, Phosphorescence, Chemiluminescence, Bioluminescence) 4.3 Mechanism of Luminescence 4.4 Jablonski Diagram and Energy Level Transitions.	08
Reference Books:- 1. Prisham M. J., Instrumental Analysis Lab Manual, CHM 311, 2018. 2. Yao N., Wang Z. L. Handbook of Microscopy for Nanotechnology, Springer New York, 2005. 3. Chaugule R. S., Ramanujan R. V., Textbook: Nanoparticles: Synthesis Characterization and applications, American Academic Publisher 2010. 4. Benemekki M., Textbook: An Introduction to Nanoparticles and Nanotechnology, 2nd Edition, 2014.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: Major Paper II	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTT 232-Advanced Characterization Techniques for Nanomaterials	

Course Objectives: Students will be able to...

1. study the characterization techniques.
2. learn about crystalline size of materials by using X-Ray Diffraction.
3. understand principle of SEM, TEM and STM Microscopy.
4. analysis of the materials by using characterization techniques.

Course Outcomes: Students should be able to...

1. explain principle of XRD, construction and working of XRD
2. demonstrate the instrument of scanning electron microscopy.
3. interpretation data of scanning electron microscopy with EDS.
4. describe the principle and working of TEM.

Module	Title and Contents	Hrs
Module-1:	X-Ray Diffraction (XRD) 1.1 Introduction, Theory of XRD 1.2 Production of X-rays and X- ray spectra, Bragg's Law, and applications 1.3 Powder Method, Principle of the Powder Method, Key Characteristics and Application 1.4 Instrumental units: sources, X –ray tube, Crystal Monochromators, Detectors for Measurement of X- ray Radiation.	08
Module-2:	Scanning Electron Microscopy 2.1 Introduction, History and development of SEM 2.2 Instrumentation of SEM, Principles and Advantages of SEM 2.3 Fundamentals of SEM, Electron Beam Generation and control 2.4 Scanning and imaging system, Detector system and Sample preparation	07
Module-3:	Transmission Electron Microscopy 3.1 Introduction, Instrumentation of TEM 3.2 Sample Preparation Techniques, Electron Beam Generation 3.3 Image formation and contrast mechanisms, Electron diffraction and crystallography	08

	3.4 Application of TEM in various fields.	
Module-4:	Scanning Tunneling Microscopy 4.1 Introduction of Scanning Tunneling Microscopy 4.2 Construction, Principle and working of STM 4.3 Application of STM in various fields.	07
Reference Books:- 1. Cullity D., Elements of X-Ray Diffraction Second Edition. ISBN 0-201-01174-Elsevier,2003. 2. Cohen, Samuel H., and Marcia L. Light body, eds. <i>Atomic force microscopy/scanning tunneling microscopy</i> Springer Science & Business Media, 2007. 3. Van L., Tom A. J., <i>Analytical atomic absorption spectroscopy: selected methods</i>. Elsevier, 2012. 4. Thomas E. W., and Gidley J. A. F., <i>Atomic-Absorption Spectrophotometry: International Series of Monographs in Analytical Chemistry</i>. Vol. 6. Elsevier, 2013. 5. Severin A., Dyck D. V., Van J. L., and Tendeloo G. V., eds. <i>Electron microscopy: principles and fundamentals</i>. John Wiley & Sons, 2008.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Marks • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)		End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B. Sc

Semester- III

Type: Major Practical

Marks: 50

Credits: 2

From: 2025-26

Name of the Course: BNTP 233: Practical VII

Course Objectives: Students will be able to...

1. gain knowledge in characterization techniques.
2. study analysis of materials by using characterization techniques.
3. analyze morphology of materials.
4. learn spectral analysis of UV, Raman, XRD, SEM, TEM, STM etc.

Course Outcomes: Students should be able to...

1. calculate the absorbance and transmittance of materials by using UV-Visible spectroscopy.
2. remaimber the composition of materials by using EDS.
3. remember the characterization techniques.
4. evaluate crystal structure of materials by using XRD.

Sr. No.	Name of the Experiments	Hrs
1.	Use of Origin software for Data Interpretation and Plotting.	60
2.	To Verify Lamberts Beers Law.	
3.	To verify Lamberts Beers Law variation of absorbance spectra with respect to concentration.	
4.	To verify Lamberts Beers Law variation of absorbance spectra with thickness of film.	
5.	Synthesis of ZnO Nanoparticles and interpretation of Absorbance data by using Origin Software.	
6.	Synthesis of NiO Nanoparticles and interpretation of Transmittance data by using Origin Software.	
7.	Calculate the Band Gap of Material by using Tauc-Plot Method.	
8.	Average Particle Size from SEM images by Image J software.	
9.	Matching of XRD data with standard JCPDS cards by using Xpert High Score Software.	
10.	Measurement of FWHM of given XRD data by Xpert High Score Software.	
11.	Determination of Crystalline Size using Debye Scherrer equation.	

12.	Analysis of Crystal Structure and Crystallite Size Using XRD.
13.	Data Interpretation and plotting XRD Graph by Origin software.
14.	Interpretation of X-ray powder pattern of a given crystalline compound of a Nanomaterial.
15.	To determine the size of Metal Nanoparticle by plotting the frequency distribution from the given SEM image
Reference Books:-	
1. Prisham M. J., Instrumental Analysis Lab Manual, La Salle University CHM 311,2018. 2. Yao, Nan, and Wang Z. L., eds. <i>Handbook of microscopy for nanotechnology</i> . Boston, MA, USA: Kluwer academic publishers, 2005. 3. Chaugule R. S., Ramanujan R. V., Textbook: Nanoparticles: Synthesis Characterization and applications, American Academic Publisher 2010. 4. Thomas E. W., and Gidley J. A. F., <i>Atomic-Absorption Spectrophotometry: International Series of Monographs in Analytical Chemistry</i> . Vol. 6. Elsevier, 2013.	
Practical Evaluation Pattern: 60:40	
Total Marks: 50	
Internal Continuous Evaluation: 20 Marks • Internal Work – 1: 20 Marks	End Semester Examination: 30 Marks • Question-1: 30 Marks

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	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: Minor Paper I	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTT 234: Physics for Nanoscience III	
Course Objectives: Students will be able to... 1. get an awareness of present energy pattern. 2. know the concepts of renewable energy systems. 3. outline utilization of renewable energy sources for both domestic and industrial applications. 4. understand role of nanotechnology in the energy studies.		
Course Outcomes: Students should be able to... 1. explain the different forms of energy and their interconversion. 2. analyze the principles of wind power generation and wind farm planning. 3. describe the solar energy spectrum and its significance in energy applications. 4. assess the role of renewable energy sources in reducing dependency on fossil fuels.		
Module	Title and Contents	Hrs
Module-1:	Energy and Wind Energy 1.1 Energy, Forms of energy, Energy chains 1.2 Classification of energy resources, Energy demands 1.3 Age of renewable and alternatives, Wind energy, Wind energy chains, Wind energy quantum 1.4 Wind power density, Efficiency factor of wind turbine, Power of wind turbine for a given incoming wind velocity.	08
Module-2:	Solar Energy 2.1 Solar energy, Solar energy spectrum (UV-Visible and IR) 2.2 Utilization of solar energy-thermal route, photovoltaic route 2.3 Solar constant, Solar photovoltaic systems, Merits and limitations of solar PV systems 2.4 Prospects of solar PV systems, Power of a solar cell and solar PV panel	07
Module-3:	Biomass Energy 3.1 Origin of biomass, Biomass energy resources 3.2 Biomass from Cultivated crops, Biomass from Waste Organic Matter 3.3 Biomass conversion process (biochemical conversion-anaerobic digestion and fermentation)	07

Module-4:	Geothermal and Wave Energy 4.1 Geothermal energy, Types, Systems and Applications 4.2 Ocean thermal energy, systems and applications 4.3 Wave energy systems and applications 4.4 Tidal energy - systems and applications.	08
Reference Books:- 1. Jenkins, Nick, and Janaka Ekanayake. <i>Renewable Energy Engineering</i>. 2nd ed. Cambridge: Cambridge University Press, 2024. 2. Goyal, Rahul, Satyanarayan Patel, and Abhishek Sharma, eds. <i>Renewable Energy: Accelerating the Energy Transition</i>. Singapore: Springer, 2024. 3. Peddapelli, Satish Kumar, and Peter Virtic, eds. <i>Wind and Solar Energy Applications: Technological Challenges and Advances</i>. Boca Raton, FL: CRC Press, 2023. 4. Thapar, Sapan. <i>Renewable Energy: Policies, Project Management and Economics: Wind and Solar Power (India)</i>. Singapore: Springer, 2024.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Marks • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

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	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: Minor Paper II	Marks: 50
	Credits: 2	From: 2025-26
Name of the Course: BNTT 235: Sensors and Transducers		
Course Objectives: Students will be able to... 1. understand the working of sensors and transducers 2. learn error analysis by statistical method 3. perform configuration of ac and dc bridge circuits for electrical measurement. 4. evaluate the data converter and acquisition techniques		
Course Outcomes: Students should be able to... 1. study error analysis by statistical methods. 2. know the basic principles of sensors and transducers. 3. measure electrical quantities by means of ac and dc bridge. 4. apply data converters and data acquisition systems.		
Module	Title and contents	Hrs
Module-1:	Measurement and error 1.1 Static types of static error, dynamic response of an instrument 1.2 Significant figure and rounding off the and dynamic characteristics of an instrument 1.3 Error in the measurements and numbers 1.4 Statistical analysis.	08
Module-2:	Sensors and Transducers 2.1 Classification of transducer, selecting of transducer 2.2 Electrical Transducers and their parameters 2.3 Types of Transducers: Electro acoustic transducers (microphone and speaker), Temperature Transducers (Thermistor, Thermocouple and RTD) 2.4 Fiber Optical sensors, Smart sensors.	07
Module-3:	Measurement techniques 3.1 Impendence measurement: Introduction, resistance measurement- Voltmeter Ammeter method and Whetstone Bridge method, measurement of low resistance: Kelvin's bridge method 3.2 Inductance measurement: Maxwell's bridge 3.3 Inductance measurement: Maxwell's bridge 3.4 Frequency measurement: Wien bridge	07

Module-4:	Data Converter and Data Acquisition System 4.1 Data converter: D/A converter: Weighted resistor network and R-2R network. 4.2 A/D Converter: A/D Converter circuit: parallel comparator, successive approximation, and dual slope ADC 4.3 Data Acquisition System: Block diagram of DAS, objective of DAS, single channel and multi-channel Data. 4.4 Acquisition System, computer-based data acquisition system and data loggers.	08
Reference Books:- - Cooper W. D. and Helfrick A. D., Electronic Instrumentation and Measurement Techniques, Prentice- Hall 2005. - Nakra B. C., Chaudry K., Instrumentation Measurement and analysis: - Doebelin E. O., Measurement Systems: Application and Design, McGraw Hill Book -fifth Edition, 2003. - Carr J. J., Elements of Electronic Instrumentation and Measurement, Pearson Education 2005. - Bell D. A., Electronic Instrumentation and Measurements, Prentice Hall 2013. - Oliver and Cage, “Electronic Measurements and Instrumentation”, TMH 2009.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Marks - Internal Work-1: CCE- I: 10 Mark - Internal Work-2: CCE- II :10 Mark - Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks - Question-1: 2 Mark x 5= 10 Mark - Question-2: 10 Mark x 2= 20 Mark - Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

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	Programme: B. Sc	Semester- III
	Type: Minor Practical	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTP 236: Practical VIII	

Course Objectives: Students will be able to...

1. learn concepts of renewable energy systems.
2. understand role of nanotechnology in the energy studies.
3. study the characteristics of various types of transducers.
4. designing of AC and DC bridge for measurement.

Course Outcomes: Students should be able to...

1. analyze the properties of energy conversion system.
2. explain the characteristics of various types of transducers.
3. aware about present energy conversion system.
4. design and analyze DC bridges such as Wheatstone and Kelvin bridges for resistance measurement.

Sr. No.	Name of the Experiments	Hrs
1.	Absolute capacity of condenser.	60
2.	I-V characteristics of Solar Cell.	
3.	Band gap energy of semiconductor using p-n junction diode.	
4.	Determination of Plank's constant by using LED.	
5.	Performance analysis of Solar PV panel.	
6.	Study of Uncertainty & Errors.	
7.	Study of Instrumentation Amplifier.	
8.	Study of Load Cell.	
9.	Study of LVDT.	
10.	Study of Strain Gauge.	
11.	Study of Thermistors.	
12.	Study of LDR.	
13.	Study of Photodiode.	
14.	Study of Phototransistor.	

15.	Study of Analog to Digital Converter.
16.	Study of Digital to Analog Converter.
17.	Study of Fiber optic sensor.
18.	Study of Wien bridge.
19.	Study of Whetstone Bridge for Resistance Measurement.
20.	Study of Schering Bridge for Capacitance Measurement.
Reference Books:-	
1. Flint B. L., & Worsnop H. T., Advanced Practical Physics for Students, Asia Publishing House, 1971 2. Kalsi H. S., Electronic Instrumentation, TMH 2006. 3. Cooper W. D. and Helfrick A. D., Electronic Instrumentation and Measurement Techniques, Prentice-Hall 2005. 4. Singh C., Solanki, Solar photovoltaics: fundamentals, Technologies and Applications. Phi learning Pvt. Ltd., 2015.	
Practical Evaluation Pattern: 60:40	
Total Marks: 50	
Internal Continuous Evaluation: 20 Marks	End Semester Examination: 30 Marks
• Internal Work – 1 : 20 Marks	• Question-1: 30 Marks

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	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: VSC Practical	Marks:50
	Credits: 2	From: 2025-26
	Name of the Course: BNTPVSC 1: Thin Film Coating Techniques I	

Course Objectives: Students will be able to... 1. understand synthesis of thin film coating by various methods. 2. study properties of different thin film. 3. explore various optical properties of thin film. 4. execute various types of material synthesis.		
Course Outcomes: Students should be able to... 1. develop skill for measuring physical, optical and electrical properties of materials. 2. know the principle and working of various synthesis methods. 3. have an idea about the growth mechanism of nanoparticles. 4. use different nanoparticles synthesis methods.		

Sr. No.	Name of the Experiments	Hrs
1.	Synthesis of Fe ₂ O ₃ Thin film by using CBD Method	60
2.	Synthesis of TiO ₂ Thin film by using CBD Method	
3.	Synthesis of Ferrite Nanoparticles by CBD Method	
4.	Synthesis of ZnO Thin film by using CBD Method	
5.	Synthesis of CdS Thin film by using CBD Method	
6.	Synthesis of SnO ₂ Thin film by using CBD Method	
7.	Synthesis of Polyaniline Nano fibers by CBD Method	
8.	Preparation of Superhydrophobic Nanocoatings by Spin Coating Method.	
9.	Synthesis of CdS Nanoparticles by SILAR method	
10.	Synthesis of SnO ₂ Thin film by SILAR Method.	
11.	Synthesis of CdS Nanoparticles by SILAR Method.	
12.	Synthesis of TiO ₂ Nanoparticles by SILAR Method.	
13.	Electrodeposition and Anodization of Thin film.	
14.	Preparation and Characterization of Thin Films by the Doctor Blade Method.	

15.	Preparation and Characterization of Thin Films by Microwave-Assisted Synthesis.	
16.	To Study and Sample preparation of Tin dioxide by Spray Pyrolysis method.	
17.	Preparation of CuO Thin film by Spray Pyrolysis method.	
18.	Preparation of ZnO nanoparticles by Spray pyrolysis method.	
19.	Analysis of Optical Properties (Transmittance) and Band Gap of Thin Film.	
20.	Analysis of Optical Properties (Absorbance) and Band Gap of Thin Film.	

Reference Books:-

1. Dr. Gerrard E. J. P., A Laboratory Course in Nanoscience and Nanotechnology; CRC Press, Taylor and Francis Group, 2015.
2. Hoffman, Handbook of vacuum science and technology, Academic Press, 1998.
4. Prushan M. J, Instrumental Analysis Lab manual, CHM 311, 2018.
5. Charles P. Poole Jr. and Franks. J. Qwens, Introduction to Nanotechnology, John Wiley and Sons. 2003.
6. Bharat B., Springer Handbook of Nanotechnology, Springer Verlag. 2007

Practical Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: 20 Marks

- Internal Work – 1: 20 Marks

End Semester Examination: 30 Marks

- Question-1: 30 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: SEC Practical	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTPSEC 1: IR Spectrophotometry Techniques	

Course Objectives: Students will be able to... 1. study the advantages of IR spectrophotometer. 2. learn the concept interpretation of IR spectrophotometer. 3. use of IR spectrophotometer in various areas. 4. determine the technique to handling the instruments.		
Course Outcomes: Students should be able to... 1. understand theoretical knowledge of infrared spectrophotometer. 2. know various types of functional groups. 3. execute plotting of IR spectra. 4. identify different functional groups by using IR spectrophotometer.		

Sr. No.	Name of the Experiments	Hrs
1.	Study of Infrared Spectroscopic Techniques for Material Characterization.	60
2.	Analysis of Molecular Vibrations (Stretching and Bending) Using IR Spectroscopy	
3.	Preparation of Solid, Liquid, and Thin Film Samples for IR Spectral Analysis.	
4.	Interpretation and Evaluation of Infrared (IR) Spectra of Samples.	
5.	Practical Applications of FTIR Spectroscopy in Various Research Fields.	
6.	Processing and Plotting of FTIR Spectral Data Using Origin Software.	
7.	Functional Group Analysis of Sample I Using Infrared (IR) Spectroscopy.	
8.	Interpretation of IR Spectra : Hydroxyl O-H Stretch and Amine N-H Stretch.	
9.	Interpretation of IR Spectra : Carbonyl C=O Stretch.	
10.	Interpretation of IR Spectra : Alkyne and Nitrile Stretches.	
11.	Interpretation of IR Spectra : Alkene and Aromatic C=C Stretch.	
12.	Interpretation of IR Spectra : C-H Stretching and Bending.	
13.	Interpretation of IR Spectra : C-O Stretch.	

14.	To study IR spectra for common organic solvent: Acetone.	
15.	To study IR spectra for common organic solvent: Acetonitril.	
16.	To study IR spectra for common organic solvent: 1- Butanol.	
17.	To study IR spectra for common organic solvent: Cyclohexane.	
18.	To study IR spectra for common organic solvent: Chloroform.	
19.	To study IR spectra for common organic solvent: Nitromethane.	

Reference Books:-

1. Barbara H. Stuart, Infrared Spectroscopy: Fundamentals and Applications, First Published 25 June 2004.
2. Itrić, K.; Vukoje, M.; Banić, D. FT-IR Spectroscopy as a Discrimination Method for Establishing Authenticity of Euro Banknotes. *Acta Graph.* 2018.
3. Barbara A., Infrared Spectroscopy: Fundamentals and Applications, John Wiley & Sons, Ltd., 2004.
4. Thomas E. W., and Gidley J. A. F., *Atomic-Absorption Spectrophotometry: International Series of Monographs in Analytical Chemistry*. Vol. 6. Elsevier, 2013

Practical Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: 20 Marks

- Internal Work – 1 : 20 Marks

End Semester Examination: 30 Marks

- Question-1: 30 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Physics		
	Programme: B. Sc		Semester- III
	Type: IKS		Marks:50
	Credits: 2		From: 2025-26
	Name of the Course: BNTTIKS 2: Indian Knowledge System for Nanoscience and Technology		
Course Objectives: Students will be able to.... 1. understand historical and philosophical foundation of indian knowledge systems in the context of materials science and nanotechnology. 2. explore traditional indian approaches to materials, including ayurvedic, metallurgical, and alchemical knowledge, and their relevance to modern nanotechnology. 3. study ancient techniques and methods related to nanoscale materials and their impact on contemporary research. 4. analyze the interdisciplinary potential of iks for sustainable and advanced nanomaterials.			
Course Outcomes: Students should be able to..... 1. gain an understanding of india historical contributions to nanoscience and materials technology. 2. relate traditional indian metallurgical and medicinal practices to modern nanotechnology. 3. analyze ancient alchemical and philosophical concepts in light of contemporary scientific advancements. 4. develop an awareness of sustainable and green nanotechnology approaches derived from iks.			
Module	Title and Contents		Hrs
Module-1:	Foundations of Indian Knowledge System and Materials Science 1.1 Introduction to Indian Knowledge Systems (IKS) and its scientific basis 1.2 Ancient Indian contributions to materials science and technology 1.3 Metallurgy in ancient India: Wootz steel, zinc extraction, and rust-resistant iron 1.4 Philosophical concepts of matter, atoms (Anu and Parmanu) in Vaisheshika and Nyaya schools.		08
Module-2:	Nanotechnology in Ayurveda and Traditional Indian Medicine 2.1 Ayurvedic concepts of Bhasma (metallic and herbal nanoparticles) 2.2 Preparation methods and physicochemical properties of Ayurvedic Bhasma 2.3 Bioavailability and therapeutic applications of nano-formulated Ayurvedic medicines 2.4 Modern scientific validation of traditional nanoscale formulations		07

Module-3:	Ancient Indian Alchemy and Nanomaterials 3.1 Rasa Shastra: Ancient Indian alchemical traditions and nanostructured materials 3.2 Techniques of material purification and transformation in alchemical texts 3.3 Nanostructures in temple architecture and artistic applications 3.4 Role of organic-inorganic hybrid materials in traditional Indian sciences.	07
Module-4:	Contemporary Applications and Sustainable Nanotechnology 4.1 Application of IKS in green nanotechnology and eco-friendly material synthesis 4.2 Lessons from traditional practices for sustainable material development 4.3 Integration of IKS with modern nanoscience: Case studies 4.4 Ethical and philosophical perspectives on science and technology from Indian traditions.	08

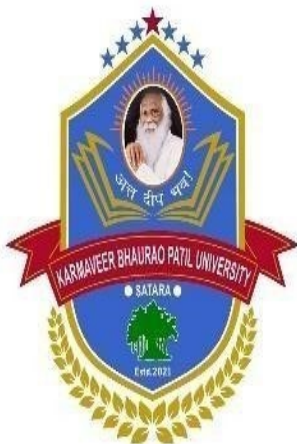
Reference Books:-

1. Subbarayappa, B. V. Science in India: Past and Present. New Delhi: Project of History of Indian Science, Philosophy, and Culture, 2004.
2. Bag, A. K. History of Technology in India. New Delhi: Indian National Science Academy, 1997.
3. Rao, K. N., and S. R. Sarma Alchemy and Metallic Medicines in Ayurveda. Varanasi: Chaukhambha Orientalia, 2000.
4. Krishnan, R. Ancient Indian Metallurgy and Materials Science. Bangalore: National Institute of Advanced Studies, 2012.

Evaluation Pattern: 60:40

Total Marks :50

Internal Continuous Evaluation: 20 Marks • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE-III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Interdisciplinary Studies	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- III
	Type: Open Elective Course	Marks:50
	Credits: 2	From: 2025-26
	Name of the Course: BNTTOE 3: Agricultural Economics	
Course Objectives: Students will be able to.... 1. understand the basic concepts, nature, scope, and significance of Agricultural Economics and the characteristics of agriculture. 2. explain the role of agriculture in the Indian economy, rural development, and different farming systems. 3. analyze the contribution of agriculture to economic development, including agricultural policies, land reforms, and land utilization. 4. develop an understanding of agricultural reforms, food security programs, and major agricultural development initiatives in India.		
Course Outcomes: Students should be able to..... 1. explain the fundamental concepts, scope, and importance of Agricultural Economics. 2. assess the role of agriculture in the Indian economy and compare different farming systems. 3. evaluate agricultural policies, land reforms, and changing cropping patterns in the context of economic development. 4. analyze the impact of agricultural reforms, food security measures, and development programmes on the agricultural sector in India		
Module	Title and Contents	Hrs
Module-1:	Introduction of Agricultural Economics 1.1 Introduction of Agricultural Economics: Definition, Nature and Scope for the separate study of agricultural economics 1.2 Utility of agricultural economics 1.3 Nature of uncertainty in agriculture 1.4 Characteristics of agriculture	08
Module-2:	Indian Agriculture 2.1 Role of Agriculture in Indian Economy 2.2 Place of agriculture in rural Economy 2.3 Difference between agriculture and industry Systems of Cultivation- Peasant, Co-operative 2.4 State Farming, Corporate, Contract, Precision and Organic Farming, Farmers Club	07

Module-3:	Agriculture and Economic Development 3.1 Role of agriculture in economic development 3.2 Agricultural Policy During Plan Period and Recent National Agricultural Policy 3.3 Land Reforms in India 3.4 Land Utilization in India – Change in Cropping Pattern.	07
Module-4:	Agriculture Reforms 4.1 Food security - Buffer Stock and Public Distribution System (PDS) 4.2 Green Revolution, White Revolution, Blue Revolution, Yellow Revolution 4.3 Waste Land Development Programmes 4.4 National Commission on farmers and Agriculture	08
Reference Books:- - Gardner, Bruce L., and Gordon C. Rausser, eds. Handbook of Agricultural Economics. Vol. 1. Elsevier, 2001. - Knutson, Ronald D., James L. Outlaw, and H. L. “Drew” Anderson. Agricultural Economics: Concepts, Issues, and Policy. Wiley, 2011. - Singh, K. R. Indian Agriculture: A Sectoral Analysis. ICFAI University Press, 2007. - Sharma, Ramesh Chand, and P. K. Joshi. Indian Agriculture: Performance and Policies. Academic Foundation, 2007. - Dantwala, M. L., and P. R. Brahmananda. Agricultural Development in India Since Independence. Oxford University Press, 1996.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation (20 Marks): - CCE - I: 10 Marks: Assignment/Class Tests, - CCE - II: 10 Marks: Case study/ Seminar/ Field Work - CCE – III: 10 Marks: Multiple Choice questions (The Best of two will be considered for the final mark entry)		End Semester Examination (30 Marks): - Q.1) Solve the following questions. [5=10] - Q.2) Attempt any two questions. [2X10=20] - Q.3) Attempt any four questions. [4X5=20] - Note: Conversion of 50 marks of ESE evaluation to 30 marks.

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: Major Paper I	Marks: 50
	Credits: 2	From: 2025-26
Name of the Course: BNTT 241: Nanobiotechnology		
Course Objectives: Students will be able to... 1. understand structure and functions of important biomolecules. 2. study nutrient media for bacterial isolation. 3. learn different culture techniques for isolation of bacteria. 4. explore different culture techniques.		
Course Outcomes: Students should be able to... 1. know structures of different carbohydrates, classification of carbohydrates. 2. classify lipids, structures of different lipids, functions of lipid in biological system. 3. understand classification of microorganisms based on their nutrient media, carbon and energy source. 4. learn the method of isolation.		
Module	Title and Contents	Hrs
Module-1:	Carbohydrates 1.1 Introduction to Structural Polysaccharides 1.2 Storage Polysaccharides 1.3 Complex Polysaccharides 1.4 Nanoligno cellulosic material.	07
Module-2:	Lipids 2.1 Introduction to Lipids 2.2 Triacylglycerols, Glycerophospholipids, Sphingolipids, Cholesterol 2.3 Storage Lipids, Lipids as Signals, Cofactors, and Pigments 2.4 Applications of Nano-capsules: Nano-capsule for Efficient Delivery of Pesticides, Fertilizers and other Agrochemicals 2.5 Liposomal Nano- capsules in Food Science and Agriculture	08
Module-3:	Microbial Nutrients 3.1 Culture media: Synthetic or defined media, Complex media 3.2 Types of media, Selective media, Differential media 3.3 Common nutrient requirements, Requirements for Carbon, Hydrogen, Oxygen 3.4 Types of Microorganisms based on Nutritional Requirements.	07

Module-4:	Pure Culture Techniques 4.1 Isolation of Pure Cultures 4.2 Spread Plate, Streak Plate, Pour plate method 4.3 Colony Morphology and Growth. Cultivation and Maintenance of Microorganisms 4.4 Nutritional categories of Microorganisms, Methods of Isolation, Purification and Preservation.	08
Reference Books:- 1. D. L. Nelson and M. M. Cox, Lehninger's- Principles of Biochemistry, CBS Publications, 7th edition, United Kingdom, 2017. 2. Stanier, A. I., General Microbiology, 4th Edition, The Macmillan Press Ltd, Hong Kong, 1976. 3. Verma and Agarwal, Cell biology, genetics, molecular biology, evolution and ecology, 4th Edi. S. Chand and company, New Delhi, 2006. 4. Freeman W. H. & Company, Molecular Cell Biology, Lodish et al., 5th ed - New York, United states, 2006.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Mark • Internal Work-1: CCE- I: 05 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE- III: 05 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: Major Paper II	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTT 242: Physics for Nanoscience IV	
Course Objectives: Students will be able to... 1. learn the vector algebra and basic vector calculus and difference between scalars and vectors. 2. study different types of differential equations. 3. explain newton's laws of motion, conservation laws for single and system of particles and their applications and correlate linear and angular motions 4. know the concept of rotational motion and moment of inertia of various bodies.		
Course Outcomes: Students should be able to... 1. define scalar, vector and their products and perform the basic algebra operations of scalars and vectors. 2. examine the order, degree, linearity of differential equation, solve 1st and 2nd order homogenous differential equation and distinguish between ordinary and partial differential equations as well as exact and inexact differential equations 3. state newton's laws of motion, law of conservation of linear momentum, angular momentum and energy for single and system of particles. 4. describe rotational kinematical variables, relate them to their linear counterparts and calculate the moment of inertia of a spherical shell and solid cylinder about axis of rotation and analyze their rolling motion.		
Module	Title and Contents	Hrs
Module-1:	Vector Algebra and Elementary Calculus 1.1 Vector algebra 1.2 Elementary Calculus 1.2 Scalar and Vector Products 1.3 Derivatives of a Vector with respect to Parameters (Velocity and Acceleration)	07
Module-2:	Ordinary Differential Equations 2.1 Differential equations; Degree, Order, Linearity and Homogeneity of Differential Equation 2.2 Ordinary and Partial Differential Equations, Exact Differentials 2.3 1 st Order Homogeneous Differential equations 2.4 2 nd Order Homogeneous Differential equation with constant coefficients, Problems.	08
Module-3:	Dynamics of a System of Particles 3.1 Frames of reference, Newton's Laws of Motion 3.2 Conservation of Linear and Angular Momentum, Work and Energy Theorem 3.3 Conservation of Energy (Single Particle), Centre of Mass 3.4 Motion of Rocket (Qualitative Treatments only), Problems	07

Module-4:	Rotational Motion 4.1 Angular Velocity and Angular Momentum 4.2 Torque, Analogy between Translational and Rotational Motion 4.3 Relation between Torque and Angular Momentum, Kinetic Energy of Rotation and Moment of Inertia 4.4 Moment of Inertia of Spherical shell; Solid Cylinder (only about the axis of symmetry), Motion of Spherical shell and Solid Cylinder Rolling down an Inclined Plane, Problems	08
Reference Books:- - Walker, Halliday and Resnick, Fundamentals of Physics Hoboken, New Jersey: John Wiley & Sons, 11th Edition, 2018. - Verma H. C., Concepts of Physics –Part–I, Bharati Bhawan Publishers, Revised Edition, 2018. - Charles K., Knight, Ruderman et al., Mechanics, New York: Berkeley Physics Course, Vol.1, Tata McGraw Hill Publications, 2nd Edition, 2017. - Das H. K., Dr. Verma R., Mathematical Physics, New Delhi: S. Chand Publication, 7th Edition, 2014. - Gupta B. D., Mathematical Physics Mumbai: Vikas Publication House, 4th Edition, 2010. - Mathur D. S., Mechanics, New Delhi: S. Chand and Company Ltd., 2007. - Riley K. F., Hobson M. P., Bence S. J., Mathematical Methods for Physics and Engineering, Cambridge: Cambridge University Press, 3rd Edition, 2006		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Mark - Internal Work-1: CCE- I:105 Mark - Internal Work-2: CCE- II :10 Mark - Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks - Question-1: 2 Mark x 5= 10 Mark - Question-2: 10 Mark x 2= 20 Mark - Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: Major Practical	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTP 243: Practical IX	
Course Objectives: Students will be able to... 1. study different staining techniques of bacteria. 2. learn the biochemical isolation of bacteria and characterization of bacteria. 3. develop fundamental experimental skills to perform an experiment and learn the experimental setup and procedure to perform given experiment. 4. develop skills in taking readings/observations obtained from these instruments and learn how to analyze and interpret experimental data, including error analysis, graphical representation.		
Course Outcomes: Students should be able to... 1. understand isolation and characterization of bacteria. 2. calculate qualitative estimation of biomolecules. 3. demonstrate basic experimental skills by setting up laboratory equipment/ experiment set up safely and efficiently, instruments calibration, carry out experimental procedure, data. 4. collection, analysis and report it in a written sheet manner.		
Sr. No.	Name of the Experiments	Hrs
1.	Preparation of Cultural Media	60
2.	Sterilization Methods of Cultural Media	
3.	Method of Isolation of Bacteria from Different Sources	
4.	Staining Methods: Simple staining, Gram Staining, Negative staining, and Hanging Drop.	
5.	Isolation and Enumeration of Bacteria using Streak Plate Technique	
6.	Isolation and Enumeration of Bacteria using Spread Plate Technique	
7.	Isolation and Enumeration of Bacteria using Pour plate Technique	
8.	Determination of Bacterial Cell Size by Micrometry	
9.	Enumeration of Microorganism - Total & Viable Count. Separation of Amino acids by Paper Chromatography. Qualitative tests for Carbohydrates, Lipids and Proteins	
10.	Determination of Total Amino acid Concentration by Ninhydrin Method	

11.	Measurements of Length/Diameter using Vernier Caliper, Screw Gauge and Travelling Microscope.	
12.	To determine the Moment of Inertia of a Flywheel.	
13.	To determine Moment of Inertia of a Disc using Auxiliary annular Ring.	
14.	To determine 'g' by Bar Pendulum.	
15.	To determine 'g' by Kater's Pendulum (Fixed Knife Edges).	
16.	To determine 'g' by Kater's Pendulum (Movable Knife Edges).	
17.	To study the Motion of a Spring and Calculate (a) Spring Constant (b) value of 'g'.	
18.	To use a Multimeter for measuring (a) Resistance, (b) AC and DC voltages, (c) DC current, and (d) checking electrical fuses.	
19.	Input, output and transfer characteristics of common Emitter (CE) Transistor.	
20.	To verify Kirchhoff 's Laws.	
Reference Books:- 1. Practical Biochemistry: An Introductory Course, England Publisher: London, 1972. 2. Jayaraman S., A Textbook of Practical Biochemistry, APC; 2018. 3. Gupta S.L. and Kumar V., <i>Practical physics</i>. Meerut: Pragati Prakashan, 29th Edition. 2017. 4. Chattopadhyay D. and Rakshit P. C., <i>An advanced course in practical physics</i> Calcutta: New Central Book, 8th Edition, 2013. 5. Prakash and Ramakrishna, <i>A Textbook of Practical Physics</i>, Kitab Mahal, 11th Edition, 2011. 6. Singh H. Harnam and Hemne P. S., B.Sc. Practical Physics, New Delhi, S. Chand & Co. Ltd., 17th Edition, 2011		
Practical Evaluation Pattern: 60:40		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks		End Semester Examination: 30 Marks
• Internal Work – 1 : 20 Marks		• Question-1: 30 Marks



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B. Sc

Semester- IV

Type: Minor Paper I

Marks: 50

Credits: 2

From: 2025-26

Name of the Course: BNTT 244: Chemistry for Nanoscience III

Course Objectives: Students will be able to...

1. define physiochemical principles of analytical chemistry.
2. gain knowledge of theories behind study of periodic table.
3. know the technical idea of separation of components from their mixtures by chromatography.
4. remember the concept of catalysis and its application.

Course Outcomes: Students should be able to...

1. explain the physico-chemical principles of basic chemical analysis.
2. analyze characterizes of d-block elements.
3. difference between chromatographic techniques.
4. understand types of catalysis and characteristics of catalytic reactions.

Module	Title and Contents	Hrs
Module-1:	Introduction, Basic Principle of Physicochemical Analysis 1.1 Equivalent and Molar Conductivity and their Variation with Dilute and Strong Electrolytes 1.2 Determination of degree of ionization of Weak electrolytes 1.3 Concept of EMF of cell, Reversible and Irreversible cells, Nernst Equation and its importance 1.4 Electrochemical Synthesis, Deposition of Nanomaterials, Solved Problems.	08
Module-2:	Principles of Chromatography 2.1 Introduction, Basic Principles of Chromatography 2.2 Classification of Chromatography- Paper and TLC Chromatography 2.3 Types of Paper and treatments, Sample Loading, Determination of R _f Value 2.4 Application, Advantages and Disadvantages, Solved Problems	07
Module-3:	Chemistry of elements of first Transition Series 3.1 Position of elements in periodic table: Characteristics of d-block elements 3.2 Electronic Configuration 3.3 Oxidation states 3.4 Magnetic Character, Coloured Ions, Complex Formation.	08

Module-4:	Catalysis 4.1 Introduction, Classification of Catalytic Reactions 4.2 Homogeneous and Heterogeneous, Types of Catalysis 4.3 Characteristics of Catalytic Reactions 4.4 Mechanism of Catalysis i) Intermediate Compound Formation ii) Adsorption Theory	07
Reference Books:- 1. Lee J. D., Concise Inorganic Chemistry, Wiley India Editor 5th edition 2008. 2. Schubert U. and Hoesling N., Synthesis of Inorganic Materials, Wiley VCH, 2000. 3. Hill A. F., Organotransition Metal Chemistry, Royal Society of Chemistry, Tutorial Chemistry Text, 2002. 4. Shriver and Atkins, Inorganic Chemistry: UK: Oxford 4th edition, 2003.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Marks • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II:10 Mark • Internal Work-3: CCE-III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: Minor Paper II	Marks: 50
	Credits: 2	From: 2025-26
Name of the Course: BNTT 245: Chemistry for Nanoscience IV		
Course Objectives: Students will be able to... 1. study different types of conductometric titrations. 2. gain knowledge of theories behind study of periodic table. 3. explain the sample preparation of fertilizers. 4. gain knowledge of theories behind study of f-block elements.		
Course Outcomes: Students should be able to... 1. analyze the conductometric titrations. 2. study characteristics of f-block elements. 3. evaluate the gibbs phase rule and its thermodynamic derivation. 4. understand the preparation of fertilizers.		
Module	Title and Contents	Hrs
Module-1:	Electroanalytical Methods 1.1 Classification of Electroanalytical methods 1.2 Basic principle of PH meter, Potentiometric and Conductometric Titrations 1.3 Techniques used for the determination of Equivalence Points. 1.4 Solved Problems.	08
Module-2:	Phase Equilibria 2.1 Introduction, Gibbs Phase Rule 2.2 Phase diagram 2.3 One Component System 2.4 Two Component System	07
Module-3:	Analysis of Fertilizers 3.1 Introduction 3.2 Sampling and Sample Preparation 3.3 Analysis of Nitrogen, Phosphorous and Potassium 3.4 Analysis of NPK values of different fertilizers.	07

Module-4:	Study of f-block Elements 4.1 Lanthanides: Introduction of f-block elements 4.2 Position of lanthanide in the periodic table 4.3 Electronic Configuration, Oxidation state, Magnetic properties 4.4 Actinides: Position in the periodic table, Electronic Configuration and Oxidation States.	08
Reference Books:- 1. Clayden J., Greeves N., Stuart Warren, Organic Chemistry, 2nd edition, Oxford publisher, 2014. 2. Hill A. F., Organo transition Metal Chemistry, Royal Society of Chemistry, Tutorial Chemistry Text, 2002. 3. Sony P. L., Dharmarha O. P., Das U. N., Textbook of Physical Chemistry, by Sultan Chand and S. Publication, 2003. 4. Sharma B. K., Industrial Chemistry, Goel Publishing Housing, 1st edition, 2011. 5. Atkins P. W., Physical Chemistry, Oxford University Press, 8th edition, 2006. 6. Khopkar, S. M, Basic Concepts of Analytical Chemistry, New Age, International Publisher, 2009.		
Evaluation Pattern: 60:40		
Total Marks :50		
Internal Continuous Evaluation: 20 Mark • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE-III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: Minor Practical	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTP 246: Practical X	

Course Objectives: Students will be able to... 1. understand concept of cell constant. 2. study potentiometric titrations. 3. learn organic estimation and preparation methods. 4. study basic principles of chromatography.		
Course Outcomes: Students should be able to... 1. explain the titrimetric analysis. 2. remember the lambert beer’s law and use of colorimeter. 3. analysis characteristics of fertilizers. 4. calculate the relative strength of acids.		

Sr. No.	Name of the Experiments	Hrs
1.	Determination of Cell Constant.	60
2.	Conductometric Titrations-Strong Acid vs. Strong Base	
3.	Potentiometric Titrations- Strong Acid vs. Strong Base	
4.	Potentiometric Titrations- Weak Acid vs. Strong Base	
5.	Preparation of Sodium Cuprous Thiosulphate.	
6.	To Estimate the Amount of acetic acid in Commercial Vinegar sample by Titrimetric Method.	
7.	To Study the specific Reaction rate of Hydrolysis of Methyl Acetate in presence of N/2 HCl.	
8.	To Study Reaction between Potassium per Sulphate and Potassium Iodide in Solution with Equal Concentration of the Reactant.	
9.	To Study the Effect of Acid Strength on Hydrolysis of an Ester by using 0.5 M HCl and 0.25 M HCl.	
10.	Preparation of Ferrous Ammonium Sulphate.	
11.	Preparation of Tetra amino copper Sulphate.	
12.	Thin Layer Chromatography.	

13.	Estimation of Total Hardness of water by Complexometric Titrations.
14.	Gravimetric Estimation of Iron.
15.	Gravimetric Estimation of Barium.
16.	Fertilizer Analysis
17.	Organic Estimation of Acetone
18.	Organic Estimation of Aspirin
19.	Preparation of P-Nitro acetanilide
20.	Determination of Amount of acetic acid in Commercial Vinegar.
Reference Books:- 1. Beran J. A., Laboratory Manual for Principles of General Chemistry, John Wiley and Sons, 6th edition, 2000. 2. Svehla, G. Vogel's, Qualitative Inorganic Analysis, 2012, Pearson Education. 3. D. Garg V. C. and Gulati R. Chand, A Senior Practical Physical Chemistry, New Delhi, 2011. 4. Mendham, J., R. C. Denney, J. D. Barnes, and M. J. K. Thomas. Vogel's Textbook of Quantitative Chemical Analysis. 6th ed. Harlow, UK: Prentice Hall, 2000. 5. Sharma, B. K. Instrumental Methods of Chemical Analysis. 24th ed. Meerut, India: Goel Publishing House, 2010.	
Practical Evaluation Pattern: 60:40	
Total Marks: 50	
Internal Continuous Evaluation: 20 Marks • Internal Work – 1 : 20 Marks	End Semester Examination: 30 Marks • Question-1: 30 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B. Sc	Semester- IV
	Type: VSC Practical	Marks: 50
	Credits: 2	From: 2025-26
	Name of the Course: BNTPVSC 2: Thin Film Coating Techniques II	
Course Objectives: Students will be able to... 1. study of fabrication of thin layers. 2. learn thin film coating technique. 3. understand the physical vapour deposition method. 4. determine the spray pyrolysis technique.		
Course Outcomes: Students should be able to... 1. understand of fabrication of thin layers. 2. learn thin film coating technique. 3. use of physical vapor deposition method. 4. optimize preparative parameters for the spray pyrolysis technique.		
Sr. No.	Name of the Experiments	Hrs
1.	Techniques of FTO Substrate Cleaning	60
2.	To Synthesis of MnO ₂ Thin Film by Hydrothermal Method	
3.	To Synthesis of Nickel hydroxide Thin Film by Hydrothermal Method	
4.	To Synthesis of CdS Thin Film by CBD Method	
5.	To Synthesis of Polyaniline by Electrodeposition Method	
6.	Deposition of SnO ₂ Thin film by Electrodeposition	
7.	To Synthesis of Al doped ZnO thin film by Spray Pyrolysis method	
8.	To Synthesis of TiO ₂ - NiO Composite Thin Film.	
9.	To Synthesis of TiO ₂ Thin Film by Sol Gel Method	
10.	To Synthesis of Cu Thin Film by PVD Method	
11.	To Synthesis of Al Thin Film by PVD Method	
12.	To Synthesis of ZnO Thin Film by PVD Method	
13.	To Synthesis of MoO ₃ by Hydrothermal Method	
14.	To Synthesis of TiO ₂ Thin Film by Dr Blade Method	
15.	To Synthesis of Ferrite Thin Film by Spray Pyrolysis Method	

16.	To Synthesis of Nickel Oxide Thin Film by Spray Pyrolysis Method
17.	To Synthesis of Iron Oxide Thin Film by Spray Pyrolysis Method
18.	To Synthesis of ZnO Thin Film by Electrodeposition
19.	To Synthesis of Ferrite Thin Film by Spray Pyrolysis Method
20.	To Synthesis of CuO Thin Film by Electrodeposition
Reference Books:- 1. Ohring, Milton. Materials Science of Thin Films: Deposition and Structure. 2nd ed. San Diego: Academic Press, 2002. 2. Chopra, K. L., and Das S. R, Thin Film Solar Cells. New York: Springer, 1983. 3. Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed. Hoboken, NJ: Wiley, 2001. 4. Jagannathan, R., and Mariappan M., Handbook of Sol-Gel Science and Technology: Processing, Characterization and Applications. Cham, Switzerland: Springer, 2016. 5. Mittal, K. L., ed. Physico-Chemical Aspects of Polymer Surfaces. New York: Plenum Press, 1983.	
Practical Evaluation Pattern: 60:40	
Total Marks: 50	
Internal Continuous Evaluation: 20 Marks • Internal Work – 1: 20 Marks	End Semester Examination: 30 Marks • Question-1: 30 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Physics		
	Programme: B. Sc		Semester- IV
	Type: SEC Practical		Marks: 25
	Credits: 2		From: 2025-26
	Name of the Course: BNTPSEC 2: Sensor Technology (Practical Based Course)		
Course Objectives: Students will be able to... 1. understand the basic principles and types of sensors and transducers. 2. study sensor materials and their properties for different applications. 3. analyze the characteristics of various sensors and thin-film sensors. 4. understand sensor calibration and performance evaluation techniques.			
Course Outcomes: Students should be able to... 1. explain the working principles and classification of sensors and transducers. 2. performance parameters of different types of sensors. 3. evaluate the structural, optical, and sensing properties of sensor materials. 4. apply calibration and characterization techniques to assess sensor performance.			
Sr. No.	Name of the Experiments		Hrs
1.	To study the Basics of sensors and transducers		60
2.	Introduction to sensors		
3.	To study Materials for Sensors		
4.	To understand the Multidisciplinary Aspects of sensors		
5.	Introduction to sensor parameters		
6.	Analysis of sensor parameters I		
7.	Analysis of sensor parameters II		
8.	To study properties Capacitive Sensors		
9.	To study properties of thermal Sensor		
10.	To study properties of Chemical Sensor		
11.	To study properties optical sensor		
12.	To study properties magnetic sensor		
13.	Introduction of MEMS sensors		
14.	Synthesis of thin film for sensor application: Case Study		

15.	To study the structural properties of sensor material	
16.	To study the optical properties of sensor material	
17.	Parameter analysis of thin film sensor I	
18.	Parameter analysis of thin film sensor II	
19.	Performance analysis of thin film sensor I	
20.	To study the Calibration of sensor	
Reference Books:-		
1. Fraden, Jacob. Handbook of Modern Sensors: Physics, Designs, and Applications. 5th ed. Cham, Switzerland: Springer, 2016. 2. Wilson, John S. Sensor Technology Handbook. Amsterdam: Elsevier, 2005. 3. Gardner, Julian W., and Philip N. Bartlett. <i>Electronic Noses: Principles and Applications</i>. Oxford: Oxford University Press, 1999. 4. Jones, D. S. Capacitive Sensors: Design and Applications. New York: Wiley, 1998. 5. Liu, Zhao, and Xueji Zhang. <i>Thin-Film-Based Sensors: Fabrication, Characterization, and Applications</i>. Singapore: Springer, 2021.		
Practical Evaluation Pattern: 60:40		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks Internal Work – 1: 20 Marks		End Semester Examination: 30 Marks Question-1: 30 Marks



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B. Sc

Semester- IV

Type: VEC

Marks: 50

Credits: 2

From: 2025-26

Name of the Course: BNTTVEC 2: Role of Nanotechnology in Environmental Science

Course Objectives: Students will be able to...

1. study about environmental pollution.
2. gain knowledge about various acts for water and air pollution.
3. evaluate concept of toxic ions.
4. use application of nanoparticles for treatment of environmental pollutions.

Course Outcomes: Students should be able to...

1. know the acts of water pollution.
2. role of different sources of air pollution.
3. understand applied nanotechnology.
4. learn types of environmental sensor.

Module	Title and Contents	Hrs
Module-1:	Water Pollution 1.1 Water Pollution, Sources and Measurement of Water Pollution 1.2 Need for Water Management, Effect and Control of Water pollution 1.3 The Environmental Protection Act:1986 1.4 Nanotechnology used in Waste Water Treatment	08
Module-2:	Air Pollution 2.1 Air Pollution, Sources of Air Pollution 2.2 Need for Air Pollution Management, Air Pollution Control Act 1981 2.3 Air Purifiers using Nanomaterials 2.4 Application of Nanotechnology in Air Purifiers.	07
Module-3:	Applied Nanotechnology 3.1 Environmental Contaminants 3.2 Types of Environmental Sensor 3.3 Sensing of Chemical Pollutants (Gas Sensor)	07
Module-4:	Application of Nanoparticles for Adsorption of Toxic ions 4.1 Introduction, Environmentally Toxic ions 4.2 Hierarchy of Solid structure and Adsorption	08

4.3 Various Types of Nanoparticles for Degradation of Toxic ions	
Reference Books:- 1. Peavy, Howard S., Donald R. Rowe, and George Tchobanoglous. Environmental Engineering. New York: McGraw-Hill, 1985. 2. Qu, Xiaolei, Pedro J. J. Alvarez, and Qilin Li. "Applications of Nanotechnology in Water and Wastewater Treatment." Water Research 47, 2013. 3. Seinfeld, John H., and Spyros N. Pandis. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. 3rd ed. Hoboken, NJ: Wiley, 2016. 4. Kalantar - zadeh, Kourosh, and Benjamin Fry. Nanotechnology-Enabled Sensors. Berlin: Springer, 2008. 5. Sharma R., and Arora V. K., Nanomaterials for Environmental Applications and Their Fascinating Attributes. Berlin: Springer, 2021.	
Evaluation Pattern: 60:40	
Total Marks :50	
Internal Continuous Evaluation: 20 Mark • Internal Work-1: CCE- I: 10 Mark • Internal Work-2: CCE- II :10 Mark • Internal Work-3: CCE- III: 10 Mark (Best of Two CCE)	End Semester Examination: 30 Marks • Question-1: 2 Mark x 5= 10 Mark • Question-2: 10 Mark x 2= 20 Mark • Question-3: 5 Mark x 4= 20 Mark (50 Marks converted into 30 Marks)



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Interdisciplinary studies

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B. Sc.

Semester : IV

Type: OE

Marks: 50

Credits: 2

From: 2025-26

Name of the Course: BNTPOE 4: Instrumentation and Measurement Studies

Course Objectives: Students will be able to...

1. learn familiarize students with the basic principles of instrumentation and their applications.
2. understand practical knowledge on the operation, maintenance, and troubleshooting of common laboratory instruments.
3. know the ability to select and use appropriate instrumentation for specific experimental procedures.
4. to inculcate the importance of laboratory safety and good laboratory practices while handling instruments.

Course Outcomes: Students should be able to...

1. evaluate the fundamental principles of various instruments and their role in experimental design.
2. demonstrate proficiency in operating, calibrating, and maintaining common laboratory instruments.
3. analyze experimental data obtained using different instruments and interpret the results effectively.
4. graduates will have a deep understanding of fundamental instrumentation concepts and their practical applications in various fields.

Sr. No.	Title and Contents	Hrs
1.	Identification of Basic Components.	60
2.	Study of working principle of pH meter.	
3.	Study of Electrical conductivity of different materials.	
4.	To find the refractive index of solution by using refractometry.	
5.	Test different components by using multimeter.	
6.	Measurement of intensity of various lamps using lux meter Lux meter.	
7.	Study of different types of errors in instruments.	
8.	Study the different parts of Incubator.	
9.	Study the working principle of incubator.	
10.	Conversion of units in MKS system.	
11.	Calibration of 3D Printer Bed and Nozzle.	

12.	Troubleshooting Common 3D Printing Issues.
13.	Introduction to DSO – Function, Controls, and Operation
14.	Measurement of AC and DC Signal Waveforms Using DSO
15.	Testing Function Generator Output Using DSO
16.	Analysis of Noisy Signals Using DSO.
17.	Use of CRO for Testing Electronic Circuits.
18.	Observation of Different Waveforms (Sine, Square, Triangular).
19.	Calibration of 3D Printer Bed and Nozzle.
20.	Troubleshooting Common 3D Printing Issues.
Reference Books:- 1. Skoog, Douglas A., F. James Holler, and Stanley R. Crouch. Principles of Instrumental Analysis. 7th ed. Boston: Cengage Learning, 2017. 2. Harisha, S. Biotechnology Procedures and Experiments Handbook. Boca Raton: CRC Press, 2007. 3. Taylor, D.C. Biotechnology Laboratory Manual. New York: John Wiley & Sons, 1997. 4. Hill, Robert H., and David C. Finster. Laboratory Safety for Chemistry Students. 2nd ed. Hoboken: John Wiley & Sons, 2016. 5. Glasel, Jay A., and Murray P. Deutscher, eds. Introduction to Biophysical Methods for Protein and Nucleic Acid Research. San Diego: Academic Press, 1995.	
Practical Evaluation Pattern: 60:40	
Total Marks: 50	
Internal Continuous Evaluation: 20 Marks • Internal Work – 1:20 Marks	End Semester Examination: 30 Marks • Question-1: 30 Marks