Anekant Education Society's

Tuljaram Chaturchand College
of Arts, Science and Commerce, Baramati
(Autonomous)

Four Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

CBCS Syllabus

S.Y.B.Sc.(Physics) Semester -III

For

Department of Physics

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2024-2025

Title of the Programme: S.Y.B.Sc. (Physics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students.By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Physics and related subjects, the Board of Studies in Physics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the third semester of S.Y.B.Sc. Physics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.Physics is concerned with the study of the universe from the smallest to the largest scale: it is about unraveling its complexities to discover the way it is and how it works. Discoveries in physics have formed the foundation of countless technological advances and play an important role in many scientific areas. Many techniques used in medical imaging, nanotechnology and quantum computing are derived from physics instrumentation. Even the World Wide

Web was a spin-off from the information processing and communications requirements of high-energy particle physics. The contributions of physics to solving global problems such as energy production, environmental protection, global warming and public health are essential and have an enormous impact on our society.

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

• Programme Specific Outcomes (PSOs)

PSO1: Understand basic mechanics and properties of matter.

PSO2: Illustrate the principles of electricity, magnetism, thermodynamics, optics and spectroscopy.

PSO3: Identify, formulate and analyze complex problems using basic principles of mathematics, physics and statistics.

PSO4: Design, construct and analyze basic electronic and digital circuits.

PSO5: Understand the basics of programming language and apply it to various numerical problems

PSO6: Develop effective communication skills

PSO7: Develop experimental skills and independent work culture through a series of experiments that compliment theories and projects.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Board of Studies (BOS) in Physics

From 2022-23 to 2024-25

Sr.No.	Name	Designation
1.	Prof. (Dr.) A. E. Kalange	Chairman BoS, Vice Principal & HoD
2.	Prof. (Dr.) S. S. Veer	Member, Expert from SPPU, Pune
3.	Prof. (Dr.) K. Y. Rajpure	Member, Expert from Shivaji University, Kolhapur
4.	Prof. (Dr.) K.R. Priolkar	Member, Expert from Goa University
5.	Mr. Subhash Zambare	Representative From Industry, Gaser Metacoat, Pune
6.	Dr. Swapnil Nardekar	Alumni and Research Scholar Jeju National University, South Korea
7.	Dr. R. D. Kale	Member
8.	Dr. R. T. Sapkal	Member
9.	Dr. S. B. Kulkarni	Member
10.	Mr. S. B. Kakade	Member
11.	Dr. V. S. Mohite	Member
12.	Mrs S. E. Bhosale	Member
13.	Mr. S. S. Mhaske	Member
14.	Mr. S. M. Thorat	Member
15.	Dnyneshwari Phadatare, TYBSc	Student Representative
16.	Dhanshree Hole, MSc I	Student Representative
17.	Aditya Sorte, MSc I	Student Representative
18.	Aishwarya Pawar, MSc II	Student Representative

Credit Distribution Structure for S.Y.B.Sc.-2024-2025 (Physics)

Level	Semester	Major		Minor	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	III	PHY-201-MJM: Mathematical methods in Physics PHY-202-MJM: Analog electronics PHY-203-MJM: Basic Optics PHY-204-MJM: Practical –III Credits-2+2+2+2	--	PHY-211-MN Thermometry PHY-212-MN Minor Practical Credits-2+2	PHY-216-OE: Astronomy-III Credit- 2	PHY-221-VSC: Physics Workshop Skills-II Credit- 2	MAR/HIN/SAN-231-AEC: GEN-245-IKS: Credit- 2+2	PHY-235FP CC To be selected from the Basket Credit- 2+2	24	UG Certificate 48
	IV	PHY-251-MJM: Waves and Oscillations PHY-252-MJM – Digital Electronics PHY-253-MJM: Advanced Optics PHY-254-MJM: Practical –IV Credits-2+2+2+2	--	PHY-261-MN Atoms and Molecules PHY-262-MN Minor Practical Credits-2+2	PHY-266-OE: Astronomy-III (Practical) Credit- 2	PHY-276-SEC: Python programming Credit- 2	MAR/HIN/SAN-281-AEC: GEN-245-IKS: Credit- 2+2	PHY-285-CEP CC: To be selected from the Basket Credit- 2+2	24	
	Cum Cr.	**16**	**--**	**8**	**4**	**4**	**8**	**8**	**48**	

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous) S.Y. B.Sc. PHYSICS 2024-25

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
III	Major Mandatory	PHY-201-MJM	Mathematical methods in Physics	Theory	02
	Major Mandatory	PHY-202-MJM	Analog electronics	Theory	02
	Major Mandatory	PHY-203-MJM	Basic Optics	Theory	02
	Major Mandatory	PHY-204-MJM	Practical –III	Practical	02
	Minor	PHY-241-MN	Thermometry	Theory	02
	Minor	PHY-242-MN	Minor Practical	Practical	02
	Open Elective (OE)	PHY-216-OE	Astronomy-III	Theory	02
	Vocational Skill Course (VSC)	PHY-221-VSC	Data Analysis and Graphing Software	Theory	02
	Ability Enhancement Course (AEC)	MAR-231-AEC HIN-231-AEC SAN-231-AEC	भाषिकउपयोजनवलेखनकौशल्ये हिंदीभाषा : सृजनकौशल प्राथमिकसंभाषणकौशल्यम्	Theory	02
	Field Project (FP)	PHY-235-FP		Practical	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-239-CC	To be selected from the Basket	Theory	02
	Generic IKS Course (IKS)	GEN-245-IKS		Theory	02
				Total Credits Semester-III	**24**
IV	Major Mandatory	PHY-251-MJM	Waves and Oscillations	Theory	02
	Major Mandatory	PHY-252-MJM	Digital Electronics	Theory	02
	Major Mandatory	PHY-253-MJM	Advanced Optics	Theory	02
	Major Mandatory	PHY-254-MJM	Practical-IV	Practical	02
	Minor	PHY-261-MN	Atoms and Molecules	Theory	02
	Minor	PHY-262-MN	Practical	Practical	02
	Open Elective (OE)	PHY-266-OE	Astronomy-III	Practical	02
	Skill Enhancement Course (SEC)	PHY-276-SEC	Python Programm	Practical	02
	Ability Enhancement Course (AEC)	MAR-281-AEC HIN-281-AEC SAN-281-AEC	लेखननिर्मितीवपरीक्षणकौशल्ये हिंदीभाषा : संप्रेषणकौशल प्रगतसंभाषणकौशल्यम्	Theory	02
	Community Engagement Project (CEP)	PHY-285-CEP		Practical	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-289-CC	To be selected from the Basket	Theory	02
				Total Credits Semester-IV	**24**
				Cumulative Credits Semester III + Semester IV	**48**

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Theory)

Course Code : PHY-201-MJM

Course Title : Mathematical Methods in Physics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1.To impart knowledge about various mathematical tools employed to study physics problems.

2.To introduce students the methods of mathematical physics.

3.To develop required mathematical skills to solve problems in quantum mechanics, Electrodynamics and other fields of theoretical physics

Course Outcome:

After the completion of this course students will be able to:

CO1: Understand the complex algebra useful in Physics courses.

CO2: Understand the concept of Curl and Divergence.

CO3: Understand the concept of partial differentiation.

CO4: Understand the role of partial differential equations in Physics.

CO5: Understand vector algebra useful in Mathematics and Physics

CO6: Understand the singular points of the differential equation.

CO7: Significance of mathematics formulations for understanding of physics principles

Topics and learning Points

UNIT 1: Complex Numbers (08)

1.1 Introduction to complex numbers.

1.2 Rectangular, polar, and exponential forms of complex numbers.

1.3 Argand diagram, Algebra of complex numbers using Argand diagram.

1.4 De-Moivre's Theorem (statement only)

1.5 Powers, roots and log of complex numbers.

1.6 Trigonometric, hyperbolic, and exponential functions.

1.7 Problems.

UNIT 2: Vector Algebra (12)

2.1 Introduction to scalars, vectors, dot product and cross product.

2.2 Scalar triple product and its geometrical interpretation.

2.3 Vector triple product and its proof.

2.4 Scalar and vector fields.

2.5 Differentiation of vectors with respect to scalar.

2.6 Vector differential operator and Laplacian operator.

2.7 Gradient of scalar field and its physical significance.

2.8 Divergence of scalar field and its physical significance.

2.9 Curl of vector field.

2.10 Vector integrals: Line, surface and volume integral with their examples.

2.11 Statements of Gauss-Divergence theorem and Stoke's theorem.

2.12 Different vector identities.

2.13 Problems.

UNIT 3: Differential Equation (10)

3.1 Definition

3.2 Successive differentiation.

3.3 Total differentiation.

3.4 Exact differential.

3.5 Chain rule.

3.6 Theorems of differentiation.

3.7 Change of variables from Cartesian to polar co-ordinates.

3.8 Implicit and explicit functions.

3.9 Conditions for maxima and minima (without proof).

3.10 Degree, order, linearity and homogeneity of differential equation.

3.11 Concept of Singular points. Example of singular points ($x = 0$, $x = x0$ and $x = \infty$) of differential equation.

3.12 Problems.

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
2. Mathematical Physics by B. D. Gupta
3. Mathematical Physics by Rajput and Gupta
4. Mathematical Methods in Physical Science by Mary and Boas
5. Vector analysis by Spiegel and Murrey
6. Mathematical Methods for Physicists by Arfke and Weber, 5th Edition, Academic Press.
7. Engineering Mathematics by H.K.Dass, S.Chand publication.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Theory)

Course Code : PHY-202-MJM

Course Title : Analog Electronics

No. of Credits : 02

No. of Teaching Hours : 30

Course Outcomes:

On successful completion of this course students will be able to do the following:

CO1. Apply laws of electrical circuits to different circuits.

CO2. Understand the properties and working of transistors.

CO3. Understand the functions of operational amplifiers.

CO4. Design circuits using transistors and operational amplifiers.

CO5. Understand the knowledge of designing of circuits.

CO6. Understand the properties and working of different components.

CO7. Use of knowledge in electronics-based project work for demonstrations.

CO8. Application of logic and electronics for new ideas and societal demands.

Topics and Learning Points

UNIT 1: NETWORK THEOREMS [08]

Kirchhoff's laws (revision), Voltage and Current divider circuits, Thevenin's theorem, Norton's theorem, Super-position theorem, Maximum power transfer theorem, Problems.

UNIT 2: TRANSISTORS [12]

Bipolar junction transistors, n-p-n and p-n-p Transistors, Transistor biasing, CB, CC, CE configurations and their Characteristics- Active, saturation and cut-off regions, Current gains α, β, γ and their relationships, DC operating point and AC and DC Load line, Q-Point, Problems

UNIT 3:OPERATIONAL AMPLIFIERS [10]

Operational Amplifier, Characteristics of an Ideal and Practical Op-Amp (IC 741), Concept of Virtual ground, Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Adder, Subtractor, Differentiator, Integrator, Active filters Problems.

References:

1. Electronics Principles, Malvino, 8th Edition Tata Mc-Graw Hills.
2. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.
3. Op Amp and Linear integrated circuits, RamakantGaikwad, Prentice Hall of India Pub.
4. Integrated Circuts, K.R. Botkar, Khanna Publications, New Delhi
5. Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Theory)

Course Code : PHY-203-MJM

Course Title : Basic Optics

No. of Credits : 02

No. of Teaching Hours : 30

Course Outcomes:

Learning Outcomes: On successful completion of this course the students will be able to do the following:

CO1: Acquire the basic concept of wave optics.

CO2: Explain why a light beam spread out after passing through an aperture.

CO3: Understand the operation of many modern optical devices that utilize wave optics.

CO4: Describe how light can constructively and destructively interfere.

CO5: Summarize the polarization characteristics of electromagnetic wave.

CO6: Understand optical phenomenon such polarization, diffraction, and interference in terms of the wave model.

CO7: Analyze simple example of interference and diffraction.

CO8: Perform optical experiments and do measurements of optical parameters.

Topics and Learning Points

UNIT 1: Geometrical optics [10 L]

Introduction to lenses and sign conventions, Thin lenses: Lens equation for single convex lens, Lens maker formula, Concept of magnification, deviation, and power of a thin lens, Equivalent focal length of two thin lenses, Concept of cardinal points in details, Problems

UNIT 2: Lens aberrations [12 L]

Introduction to Aberration, Types of aberration: Monochromatic and Chromatic Aberration, Types of chromatic aberrations, Achromatism: Lenses in contact and separated by finite distance, Problems.

UNIT 3: Optical Instruments [08 L]

Introduction to optical instruments, Types of optical instruments: Simple Microscope, Compound Microscope, Eyepiece: Ramsden's eye piece, Huygens eye piece, Problems.

Reference Books:

1. Optics - A.R. Ganesan, 4th edition, Pearson Education.
2. A Textbook of Optics - N. Subhramanyam, Brijlal, M.N. Avadhanulu, S. Chand Publication.
3. Physical Optics - A.K. Ghatak, McMillan, New Delhi
4. Fundamental of Optics - F.A. Jenkins, H.E.White, McGraw-Hilll International edition
5. Principles of Optics - D.S. Mathur, Gopal Press, Kanpur.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Practical)

Course Code : PHY-204-MJM

Course Title : Physics Practical-III

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1. To help develop habit of practice in the experimental skill developments.
2. To develop experimental skills in due course of time.
3. To introduce students to different apparatus & instruments, and demonstrate the skill based experiments.
4. To explain association between theoretical ideas and experimental skills.
5. To emphasize the need of practice in the skill developments.
6. To develop experimental skills in due course of time.
7. To help grow confidence while performing the practical individually.

Course Outcome:

After successfully completing this laboratory course, the students will be able to do the following:

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

CO6: Use of experiment to analyse various experimental parameters concerning their application .

CO7: Experimental Models for easy understanding and explanation Physics concepts.

List of Experiments: (Students have to perform Any 10 Experiments)

1. Plotting various trigonometric functions using MS-excel/Origin software: sinx, cosx, tanx, e^{x} , e^{-x} , logx, lnx, x^{n}
2. Equations and Graphs using MS-excel/Origin for the following figures: circle, ellipse, parabola, hyperbola.
3. GONIOMETER-I to find the equivalent focal length
4. GONIOMETER-II to find Cardinal points
5. Refractive index (R.I.) of material of prism using sodium light.
6. Spherical aberration in lens imaging
7. Determining the focal lengths at collecting and dispersing lenses using collimated light
8. Circuit Theorems (Thevenin'sand Norton's theorem)
9. Maximum power transfer theorem
10. Transistor characteristics (CE configuration)
11. OPAMP as inverting and non-inverting amplifier
12. Use of CRO (AC/DC voltage measurement, frequency measurement)
13. Measurement of displacement (linear and angular) using potentiometer/variable inductor
14. OPAMP as an adder and subtractor
15. Integrator and differentiator using IC 741
16. Phase shift Oscillator using IC 741

1. Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)
2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments) / Virtual lab

2 Student Involvement (Any one equivalent to two experiments)

1. Mini Projects

Group of 4 students should carry out mini project with the report.

Students have to perform at least one additional activity out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

OR

3. Industrial Visit /Study Tour / Field Visit

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Open Elective(Theory)

Course Code : PHY-216-OE

Course Title : Astronomy-III (अथांग अंतराळाचा वेध-१)

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

A) अभ्यासक्रमाचीउद्दिष्टे

१.विद्यार्थी पृथ्वी, चंद्र आणि सूर्य यांच्यातील परस्पर संबंधांचे अन्वेषण आणि वर्णन करतील.

२.विद्यार्थी सूर्यमालेतील ग्रहांची तुलना करतील.

३. विद्यार्थी प्रकाश, सूर्य आणि इतर तारे यांच्यातील संबंध ओळखतील.

४. विद्यार्थी ताऱ्याचे जीवनचक्र समजावून सांगतील.

५. विद्यार्थी पल्सारबद्दल माहिती सांगू शकतील.

६. विद्यार्थी धूमकेतू आणि कृष्णविवर (ब्लॅकहोल) बद्दल माहिती सांगू शकतील.

७. विद्यार्थी सौरमंडलातील सर्वात सुंदर ग्रहाबद्दल माहिती सांगू शकतील.

Course Outcomes:

B) अभ्यासक्रमाचीफलिते

CO1. खगोलशास्त्रातील घटकांची माहिती सांगता येईल

CO2. माध्यान्ह वेळ व शून्य सावली कशी काढावी ? याबद्दल माहिती सांगू शकतील.

CO3. धूमकेतूचा जन्म कसा होतो ? त्याचा आवर्तनकाळयाबद्दल सविस्तर माहिती सांगू शकतील.

CO4. कृष्णविवर (ब्लॅकहोल) वउल्कावर्षाव का होतो याबद्दल माहिती सांगू शकतील.

CO5. विद्यार्थ्यांना अज्ञात असलेला सेडना ग्रहयाबद्दल माहिती सांगू शकतील.

CO6. वेगवेगळ्या सॉफ्टवेअर्सचा वापर करून खगोलशास्त्राचा अभ्यास करू शकतील.

CO7. अंतराळात दैनंदिन गोष्टी कशा प्रकारे केल्या जातात ? यामध्ये येणाऱ्या अडचणीयाबद्दल माहिती सांगू शकतील.

Topics and Learning Points

१. ओळख नभांगणाची (10L)

जीवनदाता सूर्य, माध्यान्ह वेळ कशी ठरवाल – माध्यान्ह आणि शून्य सावली, सूर्याचे ऊर्जा उत्सर्जन, वलयांकित शनी, ग्रहांची सांखिकी माहिती, अनाहूत पाहुणे - धूमकेतू, उल्का आणि उल्का वर्षाव, ग्रहांना नियमात बांधणारे केप्लर आणि ब्राहे, पुन्हा एकदा 'ब्लॅकहोल', कालमापन (दिनदर्शिका), विश्वाचे मोजमाप – तारकांची अंतरे, ऊर्जेचा आविष्कार – तापमान (Tempearture).

२. वेध अंतराळाचा (10L)

अंतराळयानांचा अड्डा - चंद्र, व्हायोजरचा दीर्घ प्रवास, जंबोजेट, न्यूट्रॉनतारा (पल्सर), सेडना – एकनवीन ग्रह, अशी बनतात अंतराळयाने, हबलटेलिस्कोपचे भवितव्य, चंद्रावरील खडकापासून ऑक्सिजन, आर्यभट्ट विज्ञानसंशोधन व वेधशाळा, मुक्तिवेग, एका चंद्रावर चमकतात तीन सूर्य.

३. अंतराळातील गमतीजमती (10L)

अंतरिक्ष तंत्रज्ञानाने बदलून टाकले आपले जीवन, रॉकेटमधून अंतरिक्षात प्रवास, अंतरिक्षातील खाणे-पिणे, अंतरिक्षात हॉटेल, अंतरिक्ष युद्धाची तयारी, दुर्लभमृदासाठी चंद्रावर प्रवास, अंतराळात फेरफटका, अंतरिक्षाकडे उड्डाण.

संदर्भसाहित्य

१. आकाशाशी जडले नाते - डॉ .जयंतनारळीकर
२. वेध अंतराळाचा – लीना दामले
३. अंतराळातील गंमतजंमत - रमेश महाले
४. ओळख नभांगणाची - हेमंत माने

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : VSC (Theory)

Course Code : PHY-221-VSC

Course Title : Data Analysis and Graphing Software

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

By the end of this course, students will be able to:

1. Navigate the Origin 8/MS Excel interface with ease
2. Import, manipulate, and organize data sets for analysis
3. Develop critical thinking and problem-solving abilities through Excel tasks.
4. Perform basic and advanced statistical analyses
5. Develop skills to organize and structure data for analysis and reporting.
6. Utilize Origin 8 for their own research projects

Course Outcome:

The students will acquire knowledge about;

CO1: Students will learn the basics of the origin software with a skill to analyze the data

CO2: Understanding and using the data manipulation tools within Origin 8, such as filtering, sorting, and transforming data.

CO3: Creating different types of graphs, including scatter plots, line graphs, bar charts, histograms, box plots, etc.

CO4: Understanding the different graph types and when to use each for presenting data effectively.

CO5: Navigate the Excel interface, including ribbons, menus, and toolbars.

CO6: Apply Excel tools and techniques to solve real-world problems.

CO7: Develop critical thinking in data analysis and interpretation.

Topics and Learning Points

Unit-1.Plotting of Graphs using MS-Excel (11L)

Introduction, use of MS Excel, difference between graph & chart, Types of graphs in MS Excel - Line graph, Column graph, Bar Graphs, Pie Chart, Area Chart, Scatter Plot.Plotting of trignometric function graphs.

Unit-2.Introductionto Origin (14L)

Introduction. Origin Application: Title Bar and Status Bar-Windows-Dynamic menus according to the active child window-Workbook-Graph-Matrix-Toolbars-Toolbar Reference. Project Explorer-Open/Close Project Explorer-Change the Display Properties of Project Explorer-Browse Origin windows in Project Explorer-Add a Sub Folder in Project Explorer-Object Manager-Open/Close Object Manager-Manipulate layers and plots in Object Manager

Unit-3.Case Study (5L)

Advanced Excel Functions and Formulas, Conditional Formatting and Data Validation, Advanced Data Analysis and Visualization with Origin 8, Data Analysis Techniques

Reference Books:

1.Origin 8.6 Lab Manual by John J. Piper
2.Getting Started with OriginLab Origin 8 by John J. Piper
3.Origin 8 for Scientists and Engineers by G.B. Barrow and K.J. Lethbridge
4.Excel 2019 For Dummies by Greg Harvey
5.Excel 2019 Bible by Michael Alexander and Richard Kusleika

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Minor Theory

Course Code : PHY-211-MN

Course Title : Thermometry

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1.Understand the basic principles of temperature measurement.

2.Identify different types of temperature measuring instruments and their applications.

3.Learn calibration methods for temperature measuring instruments.

4.Explore practical applications of thermometry in various fields.

Course Outcome:

CO1: Understand the fundamental principles of temperature measurement,

CO2: To understand thermodynamic concepts and temperature scales.

CO3: Demonstrate proficiency in using various temperature measurement techniques and instruments, such as thermocouples, resistance thermometers, and infrared thermometers.

CO4: Apply knowledge of temperature measurement to select appropriate sensors and instrumentation.

CO5: Apply knowledge for specific applications in industries like manufacturing, pharmaceuticals, and energy.

CO6: Develop skills in calibrating temperature sensors and instrumentation

CO7: Ensure reliable and precise measurements of temperature.

Topics and Learning Points

Chapter 1: Introduction to Thermometry (6 hours)

1.1 Definition of temperature and its significance in different contexts
1.2 Overview of temperature and its measurement
1.3 Historical development of temperature measurement
1.4 Overview of thermometry and its applications
1.5 Temperature scales: Celsius, Fahrenheit, Kelvin
1.6 Thermometric properties of materials

Chapter 2: Thermometer Calibration (8 hours)

2.1 Principles of calibration
2.2 Calibration standards
2.3 Calibration methods
2.4 Calibration procedures for different types of thermometers
2.5 Uncertainty in calibration and measurement

Chapter 3: Temperature Measuring Instruments (8 hours)

3.1 Introduction to temperature sensors
3.2 Thermometric properties of materials: expansion, electrical resistance & thermoelectric effect
3.3 Different types of thermometers
3.4 Liquid-in-glass
3.5 Bimetallic
3.6 Resistance temperature detectors (RTDs)
3.7 Thermocouples: types, principles, applications
3.8 Thermistors: characteristics, applications
3.9 Pyrometers

Chapter 4: Advanced Topics and Applications (8 hours)

4.1 Infrared thermometers: principles, applications
4.2 Thermal imaging: principles and applications
4.3 Temperature measurement in industrial processes
4.4 Temperature measurement in medical applications
4.5 Emerging trends in thermometry

Textbook:

1. Temperature Measurement by Michalasky (John Wiley and Sons)
2. Introduction to Thermometryby John Doe
3. Temperature Measurement by Thomas Smith

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc.Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : III

Course Type : Practical

Course Code : PHY-212-MN

Course Title : Practical (Minor)

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1.To understand temperature measurement techniques;

2.To understand thermodynamic background and temperature scales;

3. To understand calibration techniques

4. To explain association between theoretical ideas and experimental skillsof resistance thermometers, thermocouples, radiation thermometers

5. To emphasize the need of practice in the skill developments.

6. To develop experimental skills in due course of time.

7. To help grow confidence while performing the practical individually.

Any EIGHT experiments and mini project equivalent to TWO experiments.

1. Calibration of Thermometers: Compare readings from different thermometers placed in the same environment to understand their accuracy and reliability.

2. Liquid-in-Glass Thermometer Comparison: Compare the readings of a liquid-in-glass thermometer with those of a digital thermometer in various conditions to assess their differences.

3. Thermal Expansion of Liquids: Measure the expansion of a liquid (such as alcohol or mercury) in a glass tube as the temperature changes. Plot a graph of volume against temperature.

4. Thermocouple Calibration: Use a known temperature source (like boiling water or an ice bath) to calibrate a thermocouple thermometer and check its accuracy.

5. Resistance Temperature Detector (RTD) Experiment: Measure the resistance of an RTD sensor at different temperatures and analyse the relationship between resistance and temperature.

6. Thermistor Characterization: Investigate the resistance-temperature relationship (PTC/NTC) of a thermistor by immersing it in water baths of different temperatures and recording its resistance at each temperature.

7. Infrared Thermometer: Use an infrared thermometer to measure the temperature of various objects and surfaces at different distances to understand its accuracy and limitations.

8. Thermal Imaging Experiment: Use a thermal imaging camera to visualize temperature variations on different surfaces and objects and correlate them with actual temperature measurements.

9. Temperature Data Logger Study: Deploy temperature data loggers in various environments (indoors, outdoors, near heat sources, etc.) and analyse the recorded data to understand temperature fluctuations over time.

10. Temperature Measurement in Different Media: Measure the temperature of solids, liquids, and gases using different types of thermometers (e.g., contact thermometers, non-contact infrared thermometers) to understand their suitability for different applications and environments.