Anekant Education Society's

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

Three/Four Year Honours/ Honours with Research B.Sc. Degree

Program in Physics

(Faculty of Science)

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

(2024 Pattern)

(As Per NEP- 2020)

To be implemented from Academic Year 2025-2026

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, 2024 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 first 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 third year/fourth year honours 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

It refers to the ability of students to understand the fundamental concepts of mechanics and the properties of matter, such as force, motion, energy, elasticity, viscosity and surface tension. This knowledge helps in analyzing physical phenomena and solving practical problems in science and engineering.

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

It focuses on understanding and applying the fundamental principles of electricity, magnetism, thermodynamics, optics and spectroscopy to explain various natural phenomena and technological applications, enabling students to solve problems and innovate in science and engineering.

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

It emphasizes the ability to identify, formulate, and analyze complex problems in science and engineering by applying fundamental principles of mathematics, physics, and statistics, enabling students to develop effective solutions.

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

This outcome focuses on developing the ability to design, construct, and analyze basic electronic and digital circuits using fundamental principles of electronics. It helps

students to understand the working of various electronic components and systems, enabling them to apply their knowledge in practical applications.

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

This outcome aims to develop a basic understanding of programming languages to solve various numerical and scientific problems. It helps students to apply computational methods and algorithms for problem-solving in physics and related fields. This skill enhances their analytical thinking and technical abilities, preparing them for research and practical applications.

PSO6: Develop effective communication skills

This outcome focuses on enhancing students' communication skills to effectively express their ideas, concepts, and research findings. It helps them to communicate clearly and confidently in both written and verbal forms, which is essential in academic and professional settings. Strong communication skills also improve their ability to collaborate, present, and share knowledge in scientific and technical fields.

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

This outcome aims to enhance students' experimental skills by conducting practical experiments that support and strengthen theoretical knowledge. It also encourages students to work independently, fostering a self-reliant and research-oriented work culture. Through hands-on experiments and projects, students gain practical experience, enabling them to apply scientific concepts effectively in real-world scenarios.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Physics

From 2025-26 to 2027-28

Sr. No.	Name	Designation
1	**Dr. Kalange Ashok Eknath** Head & Professor, Department of Physics, T. C. College, Baramati.	Chairperson
2	**Dr. Pathan H.M.** Associate Professor, Department of Physics, Savitribai Phule Pune University, Pune	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
3	**Prof. Dr. Patil Vikas Baburao** Professor & Head, Department of Physics Punyashlok Ahilyadevi Holkar Solapur University, Solapur	Subject Expert from Outside the Parent University
4	**Dr. Patil Umakant Mahadev** Associate Professor, D.Y. Patil University, Kolhapur	Subject Expert from Outside the Parent University
5	**Mr. Bhabale Amar Ramesh** Head - Production Planning at Piaggio Vehicles Pvt. Ltd , Pune	Representative from industry/corporate sector/allied areas
6	**Mr. Mahanavar Balbhim Sahebrao** Assistant Professor, Department of Physics, Dada Patil Mahavidyalaya, Karjat	Member of the College Alumni
7	**Dr. Kale Rajendra Devidas** Associate Professor, Department of Physics, T. C. College, Baramati	Member
8	**Dr. Sapkal Ramchandra Tukaram** Associate Professor, Department of Physics, T. C. College, Baramati	Member
9	**Dr. Kulkarni Sachin Babasaheb** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
10	**Mr. Kakade Sandip Bhimrao** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
11	**Dr. Mohite Vijay Sampat** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
12	**Mrs. Bhosale Shubhangi Eknath** Assistant Professor, Department of Physics, T. C. College, Baramati	Member

13	**Mr. Thorat Sopan Muralidhar** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
14	**Mr. Lalge Vikrant Prakash** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
15	**Miss. Pawar Aishwarya Chandrakant** Assistant Professor, Department of Physics, T. C. College, Baramati	Member
16	**Miss. Jadhav Sai Vikas**	UG Student
17	**Miss. Phadtare Dnyaneshwari Rajendra**	PG Student

Department of Physics **S.Y.B.Sc. Semester-III**

Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme
With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP-2020)

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with176 credits														

T = Theory **P** = Practical **DSC** = Discipline Specific Course **OE** = Open Elective **SEC** = Skill Enhancement Course
IKS = Indian Knowledge System **AEC** = Ability Enhancement Course **VEC** = Value Education Course **CC** = Co-curricular Course **VSC**= Vocational Skill Course
OJT= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Course Structure for F.Y.B.Sc. (2024 Pattern) as per NEP-2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
I (4.5)	DSC-I (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	PHY-101-GEN	Mechanics & Properties of Matter	T	02
		PHY-102-GEN	Physics Practical-I	P	02
	Open Elective (OE)	PHY-103-OE	Indian Astronomy-I	T	02
	Skill Enhancement Course (SEC)	PHY-104-SEC	Applications of Internet of Things-I	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	Functional English-I	T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knoweldge System (GIKS)	GEN-106-IKS		T	02
	Total Credits Semester-I				**22**
II (4.5)	DSC-I (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	PHY-151-GEN	Heat and Thermodynamics	T	02
		PHY-152-GEN	Physics Practical –II	P	02
	Open Elective (OE)	PHY-153-OE	Indian Astronomy -II	P	02
	Skill Enhancement Course (SEC)	PHY-154-AEC	Applications of Internet of Things-II	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC	Functional English-II	T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (SS)	YOG/PES/CUL/ NSS/NCC-156-CC	To be selected from the CC Basket	T	02
	Total Credits Semester-II				**22**
	Cumulative Credits Semester-I + Semester-II				**44**

Course Structure for S.Y.B.Sc. (2024 Pattern) as per NEP-2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III (5.0)	Major Mandatory	PHY-201-MRM	Mathematical Methods in Physics	Theory	02
	Major Mandatory	PHY-202-MRM (A)/ PHY-202-MRM (B)	Analog Electronics/ Instrumentation-I	Theory	02
	Major Mandatory	PHY-203-MRM	Major Physics Practical–I	Practical	02
	Vocational Skill Course (VSC)	PHY-204-VSC	Python Programming in Physics	Practical	02
	Field Project (FP)	PHY-205-FP	Field Project	Practical	02
	Minor	PHY-206-MN	Basic Physics	Theory	02
	Minor	PHY-207-MN	Minor Physics Practical - I	Practical	02
	Open Elective (OE)	PHY-208-OE	Astronomy-I	Theory	02
	Subject Specific Indian Knowledge System (IKS)	PHY-209-IKS	Knowledge System of Bharata	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC/ HIN-210-AEC/ SAN-210-AEC	मराठी भाषेची कौशल्ये -१ हिंदी भाषा : सृजन कौशल Prathamik Sambhashan Kaushalyam	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-211-CC	To be continued from the Semester - II		02
				Total Credits Semester - III	**22**
IV (5.0)	Major Mandatory	PHY-251- MRM	Waves and Oscillations	Theory	02
	Major Mandatory	PHY-252- MRM (A)/ PHY-252- MRM (B)	Digital Electronics/ Instrumentation-II	Theory	02
	Major Mandatory	PHY-253- MRM	Major Physics Practical–I	Practical	02
	Vocational Skill Course (VSC)	PHY-254-VSC	Python Programming in Physics	Theory	02
	Community Engagement Project (CEP)	PHY-255-CEP	Community Engagement Project	Practical	02
	Minor	PHY-256-MN	Thermometry	Theory	02
	Minor	PHY-257-MN	Minor Physics Practical - I	Practical	02
	Open Elective (OE)	PHY-258-OE	Astronomy-II	Practical	02
	Skill Enhancement Course (SEC)	PHY-259-SEC	Practical on Data Software and Graphing Software	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC/ HIN-260-AEC/ SAN-260-AEC	मराठी भाषेची कौशल्ये -२ हिंदी भाषा : संप्रेषण कौशल Prathamik Sambhashan Kaushalyam	Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-261-CC	To be continued from the Semester - III		02
				Total Credits Semester - IV	**22**
				Total Credits Semester – III + IV	**44**

• Programme Outcomes (POs)

PO 1.Comprehensive Knowledge and Understanding

Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.

PO 2. Practical, Professional, and Procedural Knowledge

Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.

PO 3. Entrepreneurial Mindset and Knowledge

Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.

PO 4. Specialized Skills and Competencies

Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.

PO 5. Capacity for Application, Problem-Solving and Analytical Reasoning

Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

PO 6. Communication Skills and Collaboration

Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.

PO 7. Research-related Skills

Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.

PO 8. Learning How to Learn Skills

Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.

PO 9. Digital and Technological Skills

Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.

PO 10. Multicultural Competence, Inclusive Spirit, and Empathy

Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.

PO 11. Value Inculcation and Environmental Awareness

Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.

PO 12. Autonomy, Responsibility, and Accountability

Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.

PO 13. Community Engagement and Service

Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 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-MRM
Course Title : Mathematical Methods in Physics-I
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
4. To equip students with the essential mathematical tools needed to solve problems in theoretical physics.
5. Students will learn and apply core mathematical techniques like vector calculus, special functions
6. The course aims to enhance students' ability to apply mathematical concepts to solve physics problems, including those in areas like electromagnetism and statistical mechanics.
7. Students will gain a deeper understanding of the mathematical principles underlying various physics theories, preparing them for more advanced studies in theoretical physics.

Course Outcomes:

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 (8L)

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 (12L)

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 (10L)

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.

References:

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.

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Mathematical Methods in Physics-I **Course Code**: PHY-201-MRM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 2	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 3	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 4	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 5	3	2	1	3	3	2	1	2	2	1	1	2	1
CO 6	3	2	1	3	3	3	1	2	2	1	1	2	1
CO7	3	2	1	3	3	2	2	2	2	1	1	2	1

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs are built on foundational mathematical concepts crucial for physics. Students gain deep theoretical understanding, contributing to multidisciplinary contexts (math-physics interface).

PO2: Practical, Professional, and Procedural Knowledge – Moderate (2)

While the COs are theoretical, they have strong applications in modeling real-world physical systems and engineering problems, aligning with practical and procedural aspects.

PO3: Entrepreneurial Mindset and Knowledge – Weak (1)

Minimal direct connection. However, mathematical modeling might marginally support innovation and opportunity recognition in technical ventures.

PO4: Specialized Skills and Competencies – Moderate/Strong (2–3)

The COs support analytical and problem-solving abilities in a specialized domain. Vector algebra and differential equations (CO5–CO7) directly support technical skill development.

PO5: Application, Problem-Solving and Analytical Reasoning – Strong (3)

Mathematical concepts like vector algebra, differential equations, and partial differentiation are core tools for solving physical problems.

PO6: Communication Skills and Collaboration – Moderate (2)

Understanding and expressing complex mathematical ideas demands clear communication. While collaboration is not a direct focus, mathematical discourse often involves teamwork in higher education and research.

PO7: Research-related Skills – Weak/Moderate (1–2)

Mathematics forms the base for research formulation and analysis, especially in theoretical physics.

PO8: Learning How to Learn – Moderate (2)

Mastery of abstract concepts helps students develop habits of self-directed learning and problem engagement, especially when solving non-standard problems.

PO9: Digital and Technological Skills – Moderate (2)

Mathematics supports computation and simulation, often implemented using software tools. Though not taught directly here, the COs provide foundational knowledge needed for technical tool use.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – Weak (1)

Mathematics is a universal language, but these COs do not directly engage with multicultural or empathy-related goals.

PO11: Value Inculcation and Environmental Awareness – Weak (1)

No direct connection to ethical or environmental issues, though the application of these skills in broader contexts may encourage responsible practice.

PO12: Autonomy, Responsibility, and Accountability – Moderate (2)

Solving complex mathematical problems requires independent learning and discipline, reinforcing personal responsibility in academic and professional contexts.

PO13: Community Engagement and Service – Weak (1)

Mathematics has indirect relevance to community service unless applied in outreach or educational activities, which these COs do not explicitly cover.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 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-MRM (A)
Course Title : Analog Electronics
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1.To expose the students semiconductor device, performance characteristics and their application.
2. To expose different signal processing technique and characteristics
3. To develop a foundational understanding of passive and active components such as resistors, capacitors, inductors, diodes, and transistors.
4. To apply the principles of circuit analysis (Ohm's Law, Kirchhoff's Laws, etc.) to complex analog circuits.
5. To explore the operation of operational amplifiers and their use in analog circuits such as amplifiers, oscillators, filters, and comparators.
6. To understand the characteristics and design of different types of amplifiers (e.g., common-emitter, common-collector, common-base, differential amplifiers).
7. To study signal processing techniques such as filtering, modulation, and demodulation and how they are applied in analog systems.

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.

Topics and Learning Points

UNIT 1: NETWORK THEOREMS (8L)

1.1 Kirchhoff's laws (revision)

1.2 Voltage and Current divider circuits

1.3 Thevenin's theorem

1.4 Norton's theorem

1.5 Super-position theorem

1.6 Maximum power transfer theorem

1.7 Problems

UNIT 2: TRANSISTORS (12L)

2.1 Bipolar junction transistors

2.2 n-p-n and p-n-p Transistors

2.3 Transistor biasing

2.4 CB, CC, CE configurations and their Characteristics- Active, saturation and cut-off regions

2.5 Current gains α, β, γ and their relationships

2.6 DC operating point

2.7 Q-Point

2.8 Problems

UNIT 3: OPERATIONAL AMPLIFIERS (10L)

3.1 Operational Amplifier

3.2 Characteristics of an Ideal and Practical Op-Amp (IC 741)

3.3 Concept of Virtual ground

3.4 Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Adder, Subtractor, Integrator, Differentiator

3.5 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, Ramakant Gaikwad, 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

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Analog Electronics **Course Code**: PHY-202- MRM (A)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	3	1	3	3	2	1	2	2	1	1	2	1
CO 2	3	3	1	3	3	2	1	2	2	1	1	2	1
CO 3	3	3	1	3	3	2	1	2	3	1	1	2	1
CO 4	3	3	2	3	3	2	2	2	3	1	1	3	2
CO 5	3	3	2	3	3	2	2	2	3	1	1	3	2
CO 6	3	3	1	3	3	2	1	2	2	1	1	2	1
CO7	3	3	2	3	3	3	2	3	3	2	2	3	3

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs develop foundational and advanced understanding of electronics, components, and circuits, aligning directly with theoretical mastery in the discipline.

PO2: Practical, Professional, and Procedural Knowledge – Strong (3)

Hands-on circuit design (CO4–CO5) and real-world component understanding (CO1–CO3, CO6) support application of theoretical knowledge in practical scenarios and align with industry-relevant procedures.

PO3: Entrepreneurial Mindset and Knowledge – Weak to Moderate (1–2)

While not explicitly entrepreneurial, designing and applying electronic systems (CO4–CO7) fosters innovation and can feed into product development and prototyping, hence a **moderate link for CO4–CO5 and CO7**.

PO4: Specialized Skills and Competencies – Strong (3)

COs demand and build proficiency in electronic design, problem-solving, and analysis, especially in design-based outcomes (CO4, CO5, CO7), satisfying this PO strongly.

PO5: Application, Problem-Solving and Analytical Reasoning – Strong (3)

All COs emphasize analytical reasoning (e.g., interpreting circuits), practical application of concepts, and solving real-life electronics problems, making this PO strongly linked.

PO6: Communication Skills and Collaboration – Moderate (2)

Though not directly addressed, projects (CO7) involve demonstrations and may require teamwork and presentation, supporting moderate collaboration and communication skills.

PO7: Research-related Skills – Weak to Moderate (1–2)

Design and project work (CO4, CO5, CO7) require experimentation and observation, aligning with basic research skills, especially in circuit optimization or testing.

PO8: Learning How to Learn Skills – Moderate (2)

COs like CO5 and CO7 require students to engage in self-directed exploration and iterative learning, supporting this PO moderately.

PO9: Digital and Technological Skills – Moderate to Strong (2–3)

Work with operational amplifiers and electronic components involves simulations, measurement tools, and software (especially in CO3–CO5, CO7), making this a strong or moderate match.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – Weak (1)

No direct linkage; minimal influence from electronics theory or design to this PO unless within collaborative, diverse teams during projects (slight case in CO7).

PO11: Value Inculcation and Environmental Awareness – Weak (1)

Unless sustainability in electronics is addressed (e.g., energy-efficient circuits), there's little direct alignment.

PO12: Autonomy, Responsibility, and Accountability – Moderate to Strong (2–3)

Design tasks and project work (CO4, CO5, CO7) require students to take ownership and manage tasks independently or in groups, linking strongly to responsibility and autonomy.

PO13: Community Engagement and Service – Weak to Moderate (1–2)

CO7 supports this PO when projects are used in real-life demonstrations, exhibitions, or local technology outreach, enabling some societal impact and engagement.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 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-MRM **(**B**)**
Course Title : Instrumentation
No. of Credits : 02
No. of Teaching Hours : 30

(This Course is for the students who have offered Electronics at F. Y. B. Sc.)

Course Objectives:

1. Explain basic concepts and definitions in measurement.
2. Describe the bridge configurations and their applications.
3. To introduce students to the fundamental concepts of instrumentation, including measurement principles, transducers, sensors, and actuators.
4. To familiarize students with different measurement techniques, standards, and error analysis.
5. To explore the working principles and applications of different types of sensors and transducers, such as thermocouples, strain gauges, capacitive sensors, and optical sensors.
6. To understand the role of signal conditioning in instrumentation systems and learn how to design circuits that modify the output of sensors to make them suitable for processing.
7. To understand the integration of instrumentation with control systems, including feedback loops and control strategies like PID.

Course Outcomes:

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

CO1. Explain the fundamental concepts of measurement systems.

CO2. Analyze static and dynamic characteristics of measurement systems.

CO3. Understand and differentiate between the dynamic characteristics

CO4. Apply knowledge of transducer principles to measure displacement, force, and temperature.

CO5. Demonstrate the ability to select appropriate transducers for force and temperature measurement

CO6. Evaluate different types of pressure measurement techniques.

CO7. Understand the principles of load cells and cantilever beams

Topics and Learning Points

UNIT 1: FUNDAMENTALS OF MEASUREMENT (14L)

1.1 Aims of measurement

1.2 Functional elements of typical measurement system (block diagram and its Explanation)

1.3 Standard measurements and types of calibration methods

1.4 Static characteristics

1.5 Dynamic characteristics: concepts of zero, first and second order systems, examples of first-order resistance thermometer and thermal element, examples of second order: U- tube manometer

1.6 Errors in measurement. (Definition and types)

1.7 Problems.

UNIT 2: TRANSDUCERS (16L)

2.1 Measurement of displacement: variable resistance, inductance and capacitance Methods, variable capacitance transducer

2.2 Measurement of force: Load cell, cantilever beam

2.3 Measurement of temperature:

I) Scales of temperature (Kelvin, Celsius, Fahrenheit etc.)

II) Methods of temperature measurement:

a. Non-electrical method – liquid filled thermometer, bimetallic thermometer.
b. Electrical method – Platinum resistance thermometer
c. Thermistor – PTC and NTC with characteristics
d. Radiation Method- Pyrometers

2.4 Unit of pressure, concept of vacuum, absolute gauge, and differential pressure

2.5 Elastic transducer – diaphragm, corrugated diaphragm, bellows, Bourdon tube

2.6 Electric type - LVDT, strain gauge

2.7 Problems.

References:

1. A course in Electrical and Electronic Instrumentation - A. K. Sawhney (Dhanpat Rai & Co. Pvt. Ltd., New Delhi)
2. Instrumentation devices and systems- Rangan, Sarma, Mani [Tata McGraw Hill]
3. Instrumentation Measurement and Analysis – Nakra, Choudhari [Tata McGraw Hill]
4. Electronics Instrumentation – H. S. Kalsi [Tata McGraw Hill]
5. Sensor and Transducers – Patrabnis [PHI]
6. Fundamental of Industrial Instrumentation- Alok Barua [Wiley India]
7. Instrumentation, measurement and systems-Nakra and Chaudhary.

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Instrumentation-I **Course Code**: PHY-202-MRM **(B)**

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 2	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 3	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 4	3	3	2	3	3	2	2	2	3	1	1	3	2
CO 5	3	3	2	3	3	2	2	2	3	1	1	3	2
CO 6	3	3	2	3	3	2	2	2	3	1	1	3	2
CO7	3	3	2	3	3	2	2	2	2	1	1	3	2

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs emphasize foundational and theoretical knowledge in measurement systems and transducers, forming a strong alignment with core understanding of engineering principles.

PO2: Practical, Professional, and Procedural Knowledge – Moderate to Strong (2–3)

CO4–CO7 focus on applying principles to real-world measuring instruments and systems, reflecting strong professional and procedural knowledge, particularly in selecting and using transducers.

PO3: Entrepreneurial Mindset and Knowledge – Weak to Moderate (1–2)

While not directly linked to business principles, COs involving selection and application of transducers (CO4–CO6) encourage decision-making and innovation in system design, giving a **moderate** link for these COs.

PO4: Specialized Skills and Competencies – Moderate to Strong (2–3)

CO4 to CO7 build specialized skills in instrumentation and measurement, including analytical evaluation of system behaviors—skills that are essential in engineering practice.

PO5: Capacity for Application, Problem-Solving and Analytical Reasoning – Strong (3)

All COs involve real-world problem-solving using measurement principles, system characteristics, and instrumentation, which aligns directly with analytical reasoning and practical application.

PO6: Communication Skills and Collaboration – Moderate (2)

Understanding system characteristics and presenting evaluation results fosters technical communication. While team collaboration is not explicit, CO7 involving project/demonstration has collaborative potential.

PO7: Research-related Skills – Weak to Moderate (1–2)

COs involving analysis (CO2–CO3) and evaluation (CO6–CO7) reflect observation, inference, and data-driven reasoning—aligning partially with research-related skills.

PO8: Learning How to Learn – Moderate (2)

Students must engage in conceptual learning and technical updating (especially for sensor technologies), which develops independent learning skills.

PO9: Digital and Technological Skills – Moderate to Strong (2–3)

COs like CO4–CO6 often require digital instrumentation, simulation software, or data acquisition tools, indicating a **strong** link to technological competency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – Weak (1)

This PO is not directly addressed by the course, though teamwork in lab or project environments may offer minimal indirect exposure.

PO11: Value Inculcation and Environmental Awareness – Weak (1)

Measurement system knowledge doesn't inherently promote ethical or environmental awareness unless integrated into sustainability-focused projects.

PO12: Autonomy, Responsibility, and Accountability – Moderate to Strong (2–3)

Design and evaluation tasks (CO4–CO7) require independent thinking, responsible experimentation, and systematic application of knowledge, directly supporting this PO.

PO13: Community Engagement and Service – Weak to Moderate (1–2)

Indirectly supported through demonstrations or applied project work (CO7), especially if measurement systems are used in real-world problem-solving or outreach settings.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 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-203-MRM
Course Title : Major Physics Practical-I
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 Outcomes:

After successful completion of the course student will be able to

CO1. Classify and analyze solids (crystalline, amorphous, polycrystalline) and their lattice structures, including Miller indices, interplanar distances, and atomic packing factors for various crystal types.

CO2. Understand free electron theory, its limitations, and apply concepts like energy levels, Fermi energy, the Hall effect and distinguish between metals, semiconductors and insulators.

CO3. Study semiconductor behaviour, focusing on intrinsic and extrinsic properties, carrier concentrations, diffusion, and the p-n junction as a diode.

CO4. Learn about different types of magnetism (diamagnetism, paramagnetism, ferromagnetism, superconductivity) and their phenomena like hysteresis, the Meissner

effect, and Curie/Neel temperatures.

CO5. Solve problems related to free electron theory, semiconductors, and magnetism to understand practical applications in solid-state physics.

CO6. Understand the relationship between atomic structure and material properties in crystalline solids, semiconductors, and magnetic materials.

CO7. Apply solid-state physics knowledge to solve problems in modern materials science, electronics, and device technology.

List of Experiments: (Students have to perform Any 8 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. Circuit Theorems (Thevenin's and Norton's theorem)
4. Maximum power transfer theorem
5. Study and Use of CRO (AC/DC voltage measurement, frequency measurement)
6. Measurement of displacement using LVDT
7. Transistor characteristics (CE configuration)
8. OP-AMP as inverting and non-inverting amplifier
9. OP-AMP as an Adder
10. OP-AMP as a Subtractor
11. Integrator and differentiator using IC-741
12. Phase shift Oscillator using IC-741

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

2. Industrial Visit /Study Tour / Field Visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Major Physics Practical–I **Course Code**: PHY-203-MRM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 2	3	2	1	2	3	2	2	2	2	1	1	2	1
CO 3	3	2	1	2	3	2	2	2	2	1	1	2	1
CO 4	3	2	1	2	3	2	2	2	2	1	1	2	1
CO 5	3	2	1	3	3	2	2	2	2	1	1	3	1
CO 6	3	2	1	2	3	2	2	2	2	1	1	2	1
CO7	3	3	2	3	3	2	3	3	3	1	1	3	2

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs build solid theoretical knowledge in solid-state physics, including lattice structures, energy bands, and material behavior, providing a deep foundation in the subject.

PO2: Practical, Professional, and Procedural Knowledge – Moderate to Strong (2–3)

CO7 directly addresses the application of solid-state physics in real-world materials science and electronics, aligning strongly. Others (CO1–CO6) support practical understanding through theory-to-application bridging.

PO3: Entrepreneurial Mindset and Knowledge – Weak to Moderate (1–2)

While not directly tied to business or markets, CO7 touches on innovation through materials and device technology, which has entrepreneurial relevance (hence **moderate = 2** for CO7).

PO4: Specialized Skills and Competencies – Moderate to Strong (2–3)

Students gain analytical skills for material classification, electronic behavior, and solving problems using theoretical models, especially in CO5 and CO7.

PO5: Capacity for Application, Problem-Solving and Analytical Reasoning – Strong (3)

Problem-solving (CO5) and real-world application (CO7) are core focuses. All COs enhance analytical thinking and reasoning using physics models.

PO6: Communication Skills and Collaboration – Moderate (2)

Though not central, students may present and discuss material behavior and problem-solving approaches. Projects (if included in CO7) support teamwork and technical discussion.

PO7: Research-related Skills – Weak to Moderate (1–2)

CO2, CO3, and CO7 involve critical inquiry into models and behaviors. CO7 aligns best with research-related skills by applying concepts in modern science and technology.

PO8: Learning How to Learn – Moderate (2–3)

Independent engagement with abstract concepts and model-based reasoning in solid-state physics promotes continuous learning, especially in CO7.

PO9: Digital and Technological Skills – Moderate to Strong (2–3)

While not software-heavy, CO7 involves technology and electronics applications, and theoretical modeling may use simulation tools, linking well with digital skills.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – Weak (1)

Solid-state physics doesn't inherently cover multicultural or empathy components unless part of broader team or social projects (minimal role here).

PO11: Value Inculcation and Environmental Awareness – Weak (1)

Unless sustainability in materials is explicitly integrated, the course content doesn't inherently promote environmental or ethical discussions.

PO12: Autonomy, Responsibility, and Accountability – Moderate to Strong (2–3)

Solving advanced problems and applying knowledge (particularly in CO5 and CO7) requires independent study and responsibility.

PO13: Community Engagement and Service – Weak to Moderate (1–2)

If project work (CO7) is used for outreach or societal benefits (e.g., energy-efficient material design), this can relate modestly to community service.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : S.Y.B.Sc.
Semester : III
Course Type : VSC (Practical)
Course Code : PHY-204-VSC
Course Title : Python Programming in Physics
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives:

1. It aims to equip students with the skills to solve physics problems using Python, including understanding algorithms, implementing them in code, and visualizing/analyzing results.
2. To provide students with a strong foundation in Python programming, including variables, data types, loops, conditionals, functions, and classes.
3. To help students develop the ability to approach and solve physics problems using Python programming techniques.
4. o introduce Python libraries such as NumPy, SciPy, and SymPy that are commonly used for numerical computations, symbolic algebra, and mathematical operations.
5. To teach students how to use Python to simulate and model physical systems such as motion, waves, electrical circuits, and thermodynamic processes.
6. To provide an understanding of numerical methods used in physics, such as solving ordinary differential equations (ODEs), partial differential equations (PDEs), and integration methods.
7. To develop students' skills in simulating key physical phenomena such as projectile motion, gravitational interactions, wave propagation, and the behavior of gases.

Course Outcomes:

On successful completion of this course students will be able to do the following:
CO1.Develop Python programs to solve basic mathematical problems
CO2. Apply concepts of arithmetic operators in Python to perform mathematical operations efficiently.

CO3. Create simple line charts to analyze and visualize numerical trends over time.

CO4. Construct scatter plots to demonstrate the relationship between two numerical variables.

CO5. Generate and visualize trigonometric functions such as sine and cosine over a given range.

CO6. Apply knowledge of plotting techniques to simulate and analyze the motion of a mass-spring system with friction.

CO7. Develop and simulate the motion of a simple pendulum using Python and visualize the results graphically.

List of Experiments: (Students have to perform Any 8 Experiments)

1. Write a Python program that calculates the factorial of a number using a for loop.
2. Write a Python program that prints the first 10 numbers of the Fibonacci sequence using a for loop.
3. Write a Python program that prints all prime numbers between 1 and 50.
4. Draw a simple line chart showing the trend of a numerical variable over time.
5. Draw a scatter plot to show the relationship between two numerical variables.
6. Plot sine and cosine over the range $\{-\pi, \pi\}$.
7. Write simple Python program using Arithmetic operators
8. Program to plot the motion of a mass and spring on a horizontal surface with friction.
9. Program to plot the motion of a simple pendulum.
10. Program to plot the wave motion.

Additional Activities

Additional Activity (Any one Activity equivalent to two experiments)

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

1. Simulation/Demonstration/Mini Project.
2. Industrial Visit / Study Tour / Field visit.

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Python Programming in Physics **Course Code**: PHY-204-VSC

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	2	1	2	3	1	1	2	1
CO 2	3	2	1	2	3	2	1	2	3	1	1	2	1
CO 3	2	2	1	2	3	2	2	2	3	1	1	2	1
CO 4	2	2	1	2	3	2	2	2	3	1	1	2	1
CO 5	3	2	1	2	3	2	2	2	3	1	1	2	1
CO 6	3	3	1	3	3	2	3	3	3	1	1	3	1
CO7	3	3	1	3	3	2	3	3	3	1	1	3	2

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs build a foundation in Python programming with applications in physics and math, particularly CO1, CO5, CO6, and CO7, which integrate computational thinking with physical concepts.

PO2: Practical, Professional, and Procedural Knowledge – Moderate to Strong (2–3)

Through simulation and visualization (CO6, CO7), students apply programming to real-world physics problems, aligning well with professional and procedural knowledge development.

PO3: Entrepreneurial Mindset and Knowledge – Weak (1)

While innovation in simulations and visualizations might encourage creativity, there's little direct connection to business or entrepreneurial skills in these COs.

PO4: Specialized Skills and Competencies – Moderate to Strong (2–3)

Students develop specialized computational skills in visualization, data representation, and numerical simulation, especially in CO6 and CO7.

PO5: Application, Problem-Solving and Analytical Reasoning – Strong (3)

All COs demand logical reasoning and problem-solving using programming constructs, simulations, and visual analysis of physical systems.

PO6: Communication Skills and Collaboration – Moderate (2)

Visualizations and simulations support communication of technical concepts. If collaborative programming is used (e.g., pair programming or team-based projects), it enhances this further.

PO7: Research-related Skills – Weak to Strong (1–3)

CO6 and CO7 involve designing simulations, requiring observational and data analysis skills akin to research. Other COs involve less exploration but still build foundational data-handling skills.

PO8: Learning How to Learn – Moderate to Strong (2–3)

Python encourages self-directed learning through problem-solving, debugging, and adapting code—especially in CO6 and CO7, where creativity and iteration are needed.

PO9: Digital and Technological Skills – Strong (3)

All COs directly enhance students' proficiency in Python and data visualization—core components of digital literacy.

PO10: Multicultural Competence and Empathy – Weak (1)

This course doesn't inherently address diversity or empathy unless contextualized within broader team dynamics or global applications of simulation.

PO11: Value Inculcation and Environmental Awareness – Weak (1)

Unless simulations involve environmental modeling (not specified), the course lacks direct links to ethics or environmental awareness.

PO12: Autonomy, Responsibility, and Accountability – Moderate to Strong (2–3)

CO6 and CO7 encourage independent and responsible work on coding and problem-solving—key elements in professional conduct.

PO13: Community Engagement and Service – Weak to Moderate (1–2)

If students share simulation projects or apply them to social/educational platforms, there's a possible, though limited, link to this PO (especially in CO7).

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : S.Y.B.Sc.
Semester : III
Course Type : Field Project (Practical)
Course Code : PHY-205-FP
Course Title : Field Project
No. of Credits : 02
No. of Teaching Hours : 60

Guidelines for Field Project (FP)

In NEP 2020 (2024 Pattern) we are offering to UG (Second Year-Third Semester) students **Field Project (FP)** for **TWO (2)** credits i.e. **50 Marks**. The total time allocation for the student to carry out field project is **60 hours**. The actual field work should be carried out after college hours or on holidays.

To carry out the field project work following guidelines should be used:

1. Field-based learning: Students should participate in field-based learning/projects under the supervision of faculty.
2. A minimum of **30 hours of learning per credit** in a semester is required.
3. Assignment of project topics to individual student or groups of students (2 or 3 students in one group/ Commerce faculty can have 5 students per group) and one faculty member from the department will act as GUIDE for the student or group of students.
4. If the project is related to survey type work, then prepare questionnaire (20 -30 questions or more) related to their project topic (in Marathi or English). If the project is related to work that does not involve SURVEY work, then the questionnaire part can be replaced accordingly.
5. The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative. If the project is related to other type work (e.g. Data collection, sample collection etc.), then the guide should discuss with student and finalise the methodology for the same.

6. Students should go to their chosen field with the questionnaire and collect the information regarding the questions asked to the concerned people. Collect as much information as possible by collecting 25 or more questionnaires or enough number of samples or reasonable amount of data. The more the data, the better it will be for analysis.
7. The student should compile all the relevant data and carry out its analysis.
8. Write a project report in the standard format (2 Copies): Index, Chapter-1, Chapter-2, ….. Conclusion, References etc. The report should mention the clear **OUTPUT** drawn from the study. The typed project report should have minimum 25 pages(excluding title, Certificate, index and acknowledgement pages etc.), in Times New Roman with font size 12, and line spacing of 1.5.
9. Submit the project report with the Guide's signature to the department.
10. The Oral presentation for all the projects in the department should be arranged in the department. To evaluate the project, TWO examiners should be appointed by HoD (The details about appointment of examiners, weightage to internal and external marks etc. will be provided by examination section).
11. The total project work including preparation of questionnaire or sample/data collection to oral presentation should be evaluated for 2 credits (50 Marks).The details about the allocation of time, marks and scheme of examination for field project is given in Table. The departmental FP coordinator/HoD should submit the marks as per regular procedure to the examination section.
12. Since it is a compulsory subject in our syllabus, passing students in this **field project** is **MUST** to complete their degree.

Typical Time and marks allocation for the different stages of the field project is:

Step of Project	**Individual students work in hours**	**Marks**
Topic Selection/ Study Design	05	05
Survey preparation / Fieldwork	25	20
Analysis	10	05
Report writing	20	10
Oral Presentation		10
Total	60	50

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 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-206-MN
Course Title : Basic Physics
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

The student will :

1. Understand Atomic Structure
2. Interpret absorption and emission spectra of atoms and molecules.
3. Describe the physical principles behind stimulated emission, population inversion, and optical amplification.
4. Understand Einstein coefficients and their role in laser physics.
5. Perform or analyze basic experiments related to atomic/molecular spectra and laser systems.
6. Discuss applications of lasers in science, technology, and medicine.
7. Solve quantitative problems involving atomic and molecular systems.

Course Outcomes:

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

CO1. To understand the general structure of atom, spectrum of hydrogen atom.
CO2. To understand the atomic excitation and LASER principles.
CO3. To understand the bonding mechanism and its different types.
CO4. To demonstrate an understanding of electromagnetic waves and its spectrum.
CO5. Demonstrate quantitative problem-solving skills in all the topics covered.
CO6. Understand the types and sources of electromagnetic waves and applications.
CO7. To demonstrate quantitative problem solving skills in all the topics covered.

Topics and Learning Points

UNIT 1: Physics of Atoms **(08L)**

1.1 Introduction to Atom (Atomic Models: Thomson, Rutherford, Bohr)

1.2 Introduction to Atomic Spectrum

1.3 The Bohr Theory of the Hydrogen Atom

1.4 Energy levels of Hydrogen Emission Spectrum

1.5 Problems

UNIT 2: LASERS and Its Applications **(07L)**

2.1 Introduction to LASERS

2.2 Basic Principle of Lasers: Three Processes

2.3 Characteristics of Lasers: Brief Explanation

2.4 Population Inversion and Pumping

2.5 Types of Lasers

2.6 Applications of Lasers

2.7 Problems

UNIT 3: Physics of Molecules **(08L)**

3.1 Introduction to Bonding Mechanisms

3.2 Forces between Atoms

3.3 Types of Bonding:

3.3.1 Ionic Bonds

3.3.2 Covalent Bonds

3.3.3 van der Waal's Bonds

3.3.4 Hydrogen Bond

3.3.5 Metallic Bond

3.4 Problems

UNIT 4: Sources of Electromagnetic Waves **(08L)**

4.1 Introduction to Electromagnetic Waves: Historical Perspective

4.2 General properties of Electromagnetic radiations

4.3 Electromagnetic spectrums and its sources

4.4 Production of electromagnetic waves: Hertz experiment

4.5 Plank's hypothesis of Photons (Concept only)

4.6 Applications of Electromagnetic Waves

4.7 Problems

References:

1. Concepts of Modern Physics: A Beiser (6^{th} ed., McGraw Hill, 2003
2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11^{th} Ed. Pearson Education)
4. LASERS: M. N. Avdhanulu, S. Chand Publications.

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Basic Physics **Course Code**: PHY-206-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 2	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 3	3	2	1	2	3	2	1	2	2	1	1	2	1
CO 4	2	2	1	2	2	2	1	2	2	1	1	2	1
CO 5	3	2	1	3	3	2	2	2	2	1	1	3	1
CO 6	3	2	1	3	3	2	2	2	2	1	1	3	1
CO7	3	2	1	3	3	2	2	2	2	1	1	3	1

Justification

PO1: Comprehensive Knowledge and Understanding – Strong (3)

All COs directly enhance understanding of physical laws and principles in classical mechanics and fluid properties, foundational to the field of physics.

PO2: Practical, Professional, and Procedural Knowledge – Moderate (2)

The course applies theoretical knowledge to solve real-world problems (e.g., Bernoulli's principle), enhancing procedural thinking useful in labs or industry.

PO3: Entrepreneurial Mindset and Knowledge – Weak (1)

Although physics underpins many innovations, direct application to business or entrepreneurship is minimal in this course.

PO4: Specialized Skills and Competencies – Moderate to Strong (2–3)

Problem-solving using Newtonian mechanics and fluid dynamics (especially CO5–CO7) builds essential analytical and technical skills for future scientific or engineering roles.

PO5: Application, Problem-Solving and Analytical Reasoning – Strong (3)

A core strength of all COs, especially CO5, CO6, and CO7, is fostering analytical skills, logical reasoning, and quantitative application of physical laws.

PO6: Communication Skills and Collaboration – Moderate (2)

Students may explain solutions and discuss physical phenomena, which supports written and verbal communication, especially in lab or group contexts.

PO7: Research-related Skills – Weak to Moderate (1–2)

Although not a research-focused course, CO5–CO7 involve data-based reasoning and application of empirical models, which underpin future research skills.

PO8: Learning How to Learn – Moderate (2)

Problem-solving and applying principles independently (especially CO5–CO7) require adaptive learning and self-correction—hallmarks of lifelong learning.

PO9: Digital and Technological Skills – Moderate (2)

If supported by simulation tools, graphing, or motion-tracking software in lab exercises, these COs can enhance digital proficiency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy – Weak (1)

Not directly relevant in this course unless collaborative or diverse team-based labs are incorporated.

PO11: Value Inculcation and Environmental Awareness – Weak (1)

While physics is fundamental to sustainable engineering, no specific ethical or environmental content is embedded in these outcomes.

PO12: Autonomy, Responsibility, and Accountability – Moderate to Strong (2–3)

Students must demonstrate consistent effort, self-direction, and accountability when solving physics problems (especially CO5–CO7).

PO13: Community Engagement and Service – Weak (1)

No explicit connection unless course activities are linked to outreach or applied science demonstrations for the public.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : S.Y.B.Sc.
Semester : III
Course Type : Minor (Practical)
Course Code : PHY-207-MN
Course Title : Minor Physics Practical-I
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 Outcomes:

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. To correlate their physics theory concepts through practical

CO7. Students will understand the concept of the moment of inertia (I), which is the rotational equivalent of mass and depends on both the mass of the object and how that mass is distributed relative to the axis of rotation.

List of Experiments: (Students have to perform Any 8 Experiments)

1. Plotting of various trigonometric functions using MS-excel: sinx, cosx, tanx, e^{x}, e^{-x},logx, lnx, x_n
2. Equations and Graphs using MS-excel for the following figures: circle, ellipse, parabola, hyperbola.
3. Plotting of graphs using origin 8 software
4. Determination of band gap energy using origin 8 software
5. Measurement of displacement using LVDT
6. Determination of wavelenth of LASER light using plane diffration grating
7. Study of Logic Gates
8. Varification of De-Morgan's Theorems
9. Determination of Plank's constant
10. Verification of inverse square law of radiation

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

2. Industrial Visit /Study Tour / Field Visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Minor Physics Practical - I **Course Code**: PHY-207-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	2	3	1	3	2	1	1	2	2	1	1	2	1
CO 2	2	3	1	3	3	2	3	2	2	1	1	2	1
CO 3	3	3	1	2	2	1	2	2	2	1	2	2	1
CO 4	3	2	1	2	3	1	2	2	1	1	1	2	1
CO 5	1	2	2	2	2	3	1	1	1	2	1	2	1
CO 6	3	2	1	2	3	2	2	2	2	1	1	2	1
CO7	2	2	1	3	3	1	2	2	2	1	1	2	1

Justification

PO1: Comprehensive Knowledge and Understanding

- **CO3, CO4, CO6 (3):** Deeply reinforces understanding through real-life application.
- **CO2, CO7 (2):** Concepts like inertia and experimental methods relate to theoretical understanding.
- **CO1, CO5 (1-2):** Moderate to weak theoretical knowledge development via practice.

PO2: Practical, Professional, and Procedural Knowledge

- **CO1, CO2, CO3 (3):** Strong emphasis on lab procedures, handling, and data gathering.
- **CO4, CO5, CO6, CO7 (2):** Partial contribution via applied learning.

PO3: Entrepreneurial Mindset and Knowledge

- **CO5 (2):** Team collaboration fosters interpersonal and initiative-driven skills.
- Others (1): Minimal impact on business or innovation contexts.

PO4: Specialized Skills and Competencies

- **CO1, CO2, CO7 (3):** Technical manipulation and analysis are core competencies.
- **CO3, CO4, CO5, CO6 (2):** Problem-solving and adaptability through lab practice.

PO5: Application, Problem-Solving, Analytical Reasoning

- **CO2, CO4, CO6, CO7 (3):** Clear application of theory to solve problems and analyze data.
- **CO1, CO3, CO5 (2):** Procedural work supports applied reasoning.

PO6: Communication Skills and Collaboration

- **CO5 (3):** Teamwork in labs directly develops collaboration.
- **CO2, CO6 (2):** Involves data interpretation and group interaction.
- Others (1): Limited influence.

PO7: Research-related Skills

- **CO2 (3):** Observation and data gathering are core to research skills.
- **CO3, CO4, CO6, CO7 (2):** Help build experimental design and inquiry.
- **CO1, CO5 (1):** Indirect support.

PO8: Learning How to Learn Skills

- **CO1–CO7 (2):** All contribute moderately to self-learning through hands-on activity and reflection.

PO9: Digital and Technological Skills

- **CO1, CO2, CO3, CO6, CO7 (2):** Use of instruments and data analysis tools.
- **CO4, CO5 (1):** Limited direct tech involvement.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

- **CO5 (2):** Working in lab groups encourages inclusivity and empathy.
- Others (1): Limited scope for cultural engagement.

PO11: Value Inculcation and Environmental Awareness

- **CO3 (2):** Lab safety and ethics contribute to responsible behavior.
- Others (1): Not focused on environmental or moral values.

PO12: Autonomy, Responsibility, and Accountability

- **CO1–CO7 (2):** Lab work fosters individual responsibility and independent task handling.

PO13: Community Engagement and Service

- **CO1–CO7 (1):** Minimal relevance to direct community service.

Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : S.Y.B.Sc
Semester : III
Course Type : OE Theory
Course Code : PHY-208-OE
Course Title : Astronomy I
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

A) अभ्यासक्रमाची उद्दिष्टे

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 जीवन चक्र समजावून सांगतील.

५. विद्यार्थी पल्सार बद्दल माहिती सांगू शकतील.

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

७. विद्यार्थी सौरमंडलातील सर्वात सुंदर ग्रहाबद्दल माहिती सांगू शकतील.

Course Outcomes:

B) अभ्यासक्रमाची फलिते

CO1. खगोलशास्त्रातील घटकांची माहिती सांगता येईल

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

CO3. धूमकेतूचा जन्म कसा होतो ? त्याचा आवर्तन काळ याबद्दल सविस्तर माहिती सांगू शकतील.

CO4. कृष्णविवर (ब्लॅक होल) व उल्का वर्षाव का होतो याबद्दल माहिती सांगू शकतील.

CO5. विद्यार्थ्यांना अज्ञात असलेला सेडना ग्रह याबद्दल माहिती सांगू शकतील.

CO6. वेगवेगळ्या सॉफ्टवेअर्सचा वापर करून खगोलशास्त्राचा अभ्यास करू शकतील.

CO7. अंतराळात दैनंदिन गोष्टी कशा प्रकारे केल्या जातात ? यामध्ये येणाऱ्या अडचणी याबद्दल 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',विश्वाचे मोजमाप - तारकांची अंतरे, ऊर्जेचा आविष्कार – तापमान (Tempearture).

२. वेध अंतराळाचा (10L)

अंतराळयानांचा अड्डा - चंद्र, व्हायोजरचा दीर्घ प्रवास, न्यूट्रॉन तारा (पल्सर), सेडना - एक नवीन ग्रह, अशी बनतात अंतराळयाने, हबल टेलिस्कोपचे भवितव्य, चंद्रावरील खडकापासून ऑक्सिजन, आर्यभट्ट विज्ञान संशोधन व वेधशाळा, मुक्तिवेग, एका चंद्रावर चमकतात तीन सूर्य, ताऱ्यांचे जीवनचक्र.

३. अंतराळातील गमती जमती (10L)

दुर्बिणीच्या जगात, अंतरिक्ष तंत्रज्ञानाने बदलून टाकले आपले जीवन, रॉकेट मधून अंतरिक्षात प्रवास, अंतरिक्षातील खाणे-पिणे, अंतरिक्षात हॉटेल, अंतरिक्ष युद्धाची तयारी, दुर्लभ मृदासाठी चंद्रावर प्रवास, अंतराळात फेरफटका, अंतरिक्षाकडे उड्डाण.

References:

संदर्भसाहित्य

१. आकाशाशी जडले नाते - डॉ . जयंत नारळीकर
२. वेध अंतराळाचा - लीना दामले
३. अंतराळातील गंमत जंमत - रमेश के महाले
४. ओळख नभांगणाची - हेमंत माने

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Astronomy-I **Course Code**: PHY-208-OE

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	1	2	2	2	2	2	1	1	1	2	1
CO 2	3	3	1	2	3	2	3	3	2	1	2	2	2
CO 3	3	2	1	2	2	2	3	2	2	1	1	2	2
CO 4	3	2	1	2	2	2	3	2	2	1	1	2	2
CO 5	3	2	1	2	2	2	2	2	2	1	1	2	1
CO 6	2	3	2	3	3	2	3	3	3	1	2	3	2
CO7	3	3	2	3	3	2	2	3	2	1	2	3	2

Justification

PO1: Comprehensive Knowledge and Understanding

- **CO1–CO5, CO7 (3):** All involve in-depth knowledge of astronomical phenomena and principles.
- **CO6 (2):** Learning through software connects to foundational methods and digital tools.

PO2: Practical, Professional, and Procedural Knowledge

- **CO2, CO6, CO7 (3):** Use of software and practical astronomical calculations like zero shadow time reflect professional application.
- **Others (2):** Provide contextual understanding useful for academic or outreach purposes.

PO3: Entrepreneurial Mindset and Knowledge

- **CO6, CO7 (2):** Innovation in using technology or addressing space challenges may support entrepreneurship.
- **Others (1):** Primarily content knowledge, limited link to entrepreneurship.

PO4: Specialized Skills and Competencies

- **CO6, CO7 (3):** Technical use of software and knowledge of space tasks enhances specific competencies.
- **Others (2):** Enhance domain-specific understanding and communication.

PO5: Capacity for Application, Problem-Solving and Analytical Reasoning

- **CO2, CO6, CO7 (3):** Solving practical or computational problems is central.
- **Others (2):** Require analytical thinking to explain or teach complex topics.

PO6: Communication Skills and Collaboration

- **All COs (2):** Require clear expression of scientific concepts; potentially collaborative during software or observation-based tasks.

PO7: Research-related Skills

- **CO2–CO4, CO6 (3):** Involve analysis, data interpretation, and scientific reasoning.
- **CO1, CO5, CO7 (2):** Support observational inquiry and discussion of scientific topics.

PO8: Learning How to Learn

- **CO2, CO6, CO7 (3):** Independent software use and solving novel problems promote self-learning.
- **Others (2):** Encourage ongoing interest in scientific discovery.

PO9: Digital and Technological Skills

- **CO6 (3):** Central to this PO through use of astronomy software.
- **Others (1–2):** Limited direct tech use but can involve digital resources.

PO10: Multicultural Competence and Empathy

- **All COs (1):** Minimal connection; possible indirect link through group discussions or community engagement.

PO11: Value Inculcation and Environmental Awareness

- **CO2, CO6, CO7 (2):** May touch on sustainability in space or ethical implications.
- **Others (1):** Largely informational with minimal moral content.

PO12: Autonomy, Responsibility, and Accountability

- **CO6, CO7 (3):** Independent tasks using software and solving space-related problems.
- **Others (2):** Require initiative in understanding and explaining.

PO13: Community Engagement and Service

- **CO2–CO4, CO6, CO7 (2):** Could be shared in outreach programs or science communication activities.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2024 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : S.Y.B.Sc.
Semester : III
Course Type : IKS (Theory)
Course Code : PHY-209-IKS
Course Title : Knowledge System of Bharata
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1. Creating awareness amongst the youths about the true history and rich culture of the Country
2. Understanding the scientific value of the tradition and culture of the Bhārata
3. Promoting the youths to do research in the various fields of Bhāratīya knowledge Tradition
4. Converting the Bhāratīya wisdom into the applied aspect of the modern scientific Paradigm
5. Adding career, professional and business opportunities to the youths.
6. Reasons of ideas occurrence in the ancient society, and connection with the concept of material world, and religious, social, and cultural beliefs.
7. The course is designed to provide a broad-spectrum of the Bhāratīya knowledge system

Course Outcomes:

At the end of this course, students will be able to

CO1. The knowledge system was developed during the Vedic period, the Saraswatī Sindhu Civilization, the Middle ages and practiced knowingly or unknowingly till date

CO2. In Bhārata, a special attention was given to the reasons of ideas occurrence, and connection with the concept of material world, and religious, social, and cultural beliefs

CO3. Bhārata was quite advanced in arts, literature, music, dance, drama, and all other spheres of life including aeronautics, science, astronomy, mathematics, life science, medical science, and architecture.

CO4. Awareness amongst the youths about the true history and rich culture of the country

CO5. The youth will be an individual with a great sense of patriotism and nation-pride.

CO6. The youths will be self-motivated to do research in the various fields of Bhāratīya knowledge tradition

CO7. The students would be able to convert Bhāratīya wisdom into the applied aspect of the modern scientific paradigm

Topics and Learning Points

UNIT 1: Introduction to Indian Knowledge System (6L)

1.1 Definition, Concept and Scope of IKS

1.2 IKS based approaches on Knowledge Paradigms

1.3 IKS in ancient India and in modern India

1.4 Ancient Indian Education System: Gurukul System

UNIT 2: Educational Institutions in Ancient India. (6L)

2.1 Takshashila University.

2.2 Nalanda University.

2.3 Vikramashila University.

2.4 Jagaddala Mahavihara University

UNIT 3: Literature, and Scholars in Ancient Bharat (12L)

3.1 Literature, Life and works of Kanada, Vaisesika, Patanjali

3.2 Literature, Life and works of Susruta, Aryabhata, Maitreyī

3.3 Literature, Life and works of Panini, Jivaka, Gārgī

3.4 Literature, Life and works of Agastya,Vālmīki, ĀdiŚaṅkarācārya

Unit 4: Introduction to Scientific theories from Pure Sciences from Ancient Indian Knowledge Systems (6L)

4. 1. Overview of theories from available ancient Indian literature about Physics, Chemistry and Mathematics

4.2. Interlinkings and applications

4 3. Underlined Philosophy behind the development of the ancient Indian Sciences – Physics Chemistry and Mathematics

References:

1. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan, Under Publication (2021).
2. History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ram krishan Mission Institute of Culture, Kolkata (2014).
3. History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ram krishan Mission Institute of Culture, Kolkata (2014).
4. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006).

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- III) **Subject**: Physics

Course: Knowledge System of Bharata **Course Code**: PHY-209-IKS

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)												
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13
CO 1	3	2	2	2	2	1	2	2	1	2	3	2	2
CO 2	3	2	2	2	2	2	2	2	1	3	3	2	2
CO 3	3	3	3	3	3	2	2	3	2	3	3	3	3
CO 4	3	2	2	2	2	2	2	2	1	2	3	2	3
CO 5	2	2	3	3	2	2	2	2	1	3	3	3	3
CO 6	3	3	3	3	3	2	3	3	2	2	2	3	2
CO7	3	3	3	3	3	2	3	3	2	2	2	3	2

Justification

PO1: Comprehensive Knowledge and Understanding

- **CO1–CO4, CO6, CO7 (3):** These COs provides deep insight into foundational, historical, and cultural knowledge.
- **CO5 (2):** Builds emotional connection with foundational concepts, moderately contributing to core understanding.

PO2: Practical, Professional, and Procedural Knowledge

- **CO3, CO6, CO7 (3):** Practical application of traditional sciences and architecture aligns with professional skill development.
- **CO1, CO2, CO4, CO5 (2):** Help frame professional ethics and awareness.

PO3: Entrepreneurial Mindset and Knowledge

- **CO3, CO5, CO6, CO7 (3):** Inspire innovation and national-pride-based initiatives, with research potential.
- **CO1–CO4 (2):** Establish cultural and intellectual heritage, sparking entrepreneurial ideation.

PO4: Specialized Skills and Competencies

- **CO3, CO5, CO6, CO7 (3):** Involve critical thinking, leadership, and communication of traditional knowledge.
- **CO1–CO4 (2):** Provide specialized cultural competence.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

- **CO3, CO6, CO7 (3):** Directly promote converting traditional knowledge into solutions and applications.
- **Others (2):** Moderate support for contextual reasoning and understanding.

PO6: Communication Skills and Collaboration

- **CO2–CO7 (2):** Foster group discussions, cultural exchange, and collaboration in presenting historical knowledge.

PO7: Research-related Skills

- **CO6, CO7 (3):** Strong encouragement toward research based on indigenous knowledge systems.
- **Others (2):** Encourage inquiry and historical investigation.

PO8: Learning How to Learn Skills

- **CO3, CO6, CO7 (3):** Involve exploration and application of evolving knowledge domains.
- **Others (2):** Instill a reflective learning process.

PO9: Digital and Technological Skills

- **CO3, CO6, CO7 (2):** Some research and application may require tech-based tools.
- **Others (1):** Minimal direct involvement.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

- **CO2, CO3, CO5 (3):** Rich cultural, social, and value-based discussions foster empathy and inclusion.
- **Others (2):** Moderate awareness and intercultural respect.

PO11: Value Inculcation and Environmental Awareness

- **CO1–CO5 (3):** Strong focus on values, ethics, pride in heritage, and sustainability principles.
- **CO6, CO7 (2):** Support application with ethical frameworks.

PO12: Autonomy, Responsibility, and Accountability

- **CO3, CO5, CO6, CO7 (3):** Promote independent research and responsibility in reviving traditions.
- **Others (2):** Contribute to responsible citizenship and learning.

PO13: Community Engagement and Service

- **CO3–CO5 (3):** Promote community pride and cultural preservation through outreach.
- **Others (2):** Support cultural and educational service indirectly.