UNIVERSITY OF MUMBAI

R. E. SOCIETY'S,
R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND
R. V. JOGALEKAR COLLEGE OF COMMERCE
(AUTONOMOUS), RATNAGIRI

REVISED (2024-25) SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS FOR THE SECOND YEAR (SEMESTER III & IV) OF PROGRAM BSc AS PER NEP 2020

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2024-25

Program Outcomes of BSc with Physics Major

Name of Program	BSc
Level	UG
Number of Semesters	08
Year of Implementation	2024-25
Program Specific Outcomes (PSO)	After successful completion of this program, learners will be able to: PSO1. Understand fundamental physics concepts and will be able to apply physics principles to real world problems. PSO2. Think critically and develop the ability to apply theoretical and mathematical principles to solve complex problems in various areas of physics. PSO3. Acquire hands-on experience in conducting experiments, using laboratory equipments, analyzing experimental data and will be able to draw meaningful conclusions of experiment and to interpret results. PSO4. Recognize the interconnections between physics and other disciplines, such as, mathematics, chemistry and engineering and will be able to work effectively in those interdisciplinary fields. PSO5. Possess basic programming skills, will be introduced to the field of automation and will be equipped with essential knowledge and skills to work with basic automation systems. PSO6. Develop the ability to work individually as well as in collaboration. PSO7. Pursue higher studies and will be able to take research opportunities.
Relevance of PSOs to the local, regional, national and global developmental needs	Science graduates with Physics major can go for higher studies and pursue careers directly related to physics, like, research, academics, etc. Other than this, Science graduates with Physics major can also pursue careers in other fields, such as, data science, engineering, IT, automation, government jobs, medical physics and healthcare industry, national security, etc., due to their analytical, problem solving and critical thinking abilities.

	BSc program with Physics major produces graduates with a diverse skill set capable of addressing various challenges. This can lead to improve research and innovation, economic growth and sustainable development from local to global level. The relevance of BSc program with Physics major to developmental needs enhances its overall impact on society and makes it more responsive to the evolving demands of the scientific, technological and societal landscape.

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Scheme of Evaluation

Course Evaluation and Conversion of Marks:

Every course of SYBSc in the subject Physics is evaluated through Continuous Internal Evaluation (40%) and Semester End Evaluation (60%).

Every Major and Minor theory course of SYBSc in the subject Physics will be evaluated on 50 marks scale. These courses have maximum 20 marks for Continuous Internal Evaluation and maximum 30 marks for Semester End Evaluation.

Every Major and Minor practical/lab course of SYBSc in the subject Physics will be evaluated on 100 marks scale. These courses have maximum 40 marks for Continuous Internal Evaluation and maximum 60 marks for Semester End Evaluation. For these courses, the marks obtained by a learner in Continuous Internal Evaluation of a course out of 40, will be converted to marks out of 20 and marks obtained by a learner in Semester End Evaluation of a course out of 60, will be converted to marks out of 30. Converted marks will be reflected in learner's marksheet.

All Major and Minor courses offered in the subject Physics for SYBSc are 2 credit courses and every 2 credit course will either be evaluated on 50 marks scale, or be evaluated on 100 marks scale and finally marks obtained by a learner out of 100 will be converted to 50 marks scale.

The Skill Enhancement Courses (SEC) offered in the subject Physics for SYBSc are 2 credit courses and these courses are evaluated on 50 marks scale.

Passing Scheme:

For each course of BSc in the subject Physics, there will be separate head of passing for Continuous Internal Evaluation and for Semester End Evaluation. Course grade points and course grade will be decided by the aggregate marks obtained by a learner.

$$\text{Aggregate Marks} = \text{Marks Obtained by a learner in Continuous Internal Evaluation} + \text{Marks obtained by a learner in Semester End Evaluation}$$

In order to earn credits of this course, a learner is required to secure a minimum of 40% marks in Continuous Internal Evaluation and 40% marks in Semester End Evaluation.

Credit and Grade Scheme:

% of Aggregate Marks Obtained	Course Grade Point	Course Grade	Performance Indicator	Credits Earned
90.0 to 100	10	O	Outstanding	2
80 to 89.99	9	A+	Excellent	
70 to 79.99	8	A	Very Good	
60 to 69.99	7	B+	Good	
55 to 59.99	6	B	Above Average	
50.0 to 54.99	5	C	Average	
40 to 49.99	4	P	Pass	
Less Than 40	0	F	Fail	0
Absent	0	Ab	Absent	

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Scheme of Courses Offered in the Subject Physics for SYBSc as per NEP

Semester III			Semester IV		
Course Code	**Nomenclature**	**Credits**	**Course Code**	**Nomenclature**	**Credits**
Discipline Specific Course (DSC)			***Discipline Specific Course (DSC)***		
Major			***Major***		
USPH301	Mechanics and Thermodynamics	**02**	USPH401	Optics and Cosmology	**02**
USPH302	Electronics	**02**	USPH402	Quantum Physics	**02**
USPH303	Mathematical Methods in Physics	**02**	USPH403	Applied Physics	**02**
USPH304	Physics Lab - III	**02**	USPH404	Physics Lab - IV	**02**
Minor			***Minor***		
USPH305	Basics of Mechanics and Electricity	**02**	USPH405	Basics of Optics and Electronics	**02**
USPH306	Experimental Physics Lab - I	**02**	USPH406	Experimental Physics Lab - II	**02**
Skill Enhancement Course (SEC)			***Skill Enhancement Course (SEC)***		
USPHS307	Digital Computer Electronics and Microprocessor 8085 - I	**02**	USPHS407	Digital Computer Electronics and Microprocessor 8085 - II	**02**
			Community Engagement Program (CEP) / Field Project (FP)		
			USPHC408	Community Engagement and Service	**02**
			OR		
			USPHF408	Field Project	**02**

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Syllabi of Courses Offered in the Subject Physics for Semester III

Nomenclature of the Course	**Mechanics and Thermodynamics**
Course Code	USPH301
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that it equips learners with a strong foundation in mechanics and thermodynamics, enables them to apply their knowledge to various scientific, engineering and practical situations. Learner will develop the skill to analyze and solve mechanics problems, particularly related to compound pendulum, center of mass and oscillations, using appropriate mathematical and analytical techniques. The course equips learners with a comprehensive understanding of various thermodynamic processes, principles that govern energy conversion, limitations of conversion of energy into work, Carnot's cycle, Carnot's theorems, entropy, second and third law of thermodynamics, Maxwell's thermodynamic relations and their applications. The course also equips learners with basic understanding of heat engines including ideal and practical engines, internal and external combustion engines, such as, Carnot's ideal heat engine, Steam engine, Petrol engine, Diesel engine and learners will be able to assess the performance of these engines through efficiency calculations. The course equips learners with a comprehensive understanding of low temperature physics, as well as, principles, processes and techniques involved in converting gases into liquids. The learners will understand principle, design and operation of refrigeration systems. The learners will also understand properties, behavior and applications of liquid helium at extremely low temperature. This knowledge will prepare the learners for careers in research and engineering fields. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Mechanics and Thermodynamics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH101: Classical Physics'.

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the concepts of mechanics & properties of matter & to apply them to problems.

CO2. Comprehend the basic concepts of thermodynamics & its applications in physical situations.

CO3. Understand about situations in low temperature.

CO4. Demonstrate tentative problem solving skills in all above areas.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Mechanics	**1. Compound pendulum:** Expression for period, Maximum and minimum time period, Centre of suspension and oscillations, Reversible compound pendulum, Kater's reversible pendulum, Compound pendulum and simple pendulum - a relative study Reference: HP **2.** Center of Mass, Motion of the Center of Mass, Linear momentum of a Particle Linear momentum of a System of Particles, Linear momentum w.r.t. CM coordinate (i.e., shift of origin from Lab to CM), Conservation of Linear Momentum, Some Applications of the Momentum Principle, System of Variable Mass, Torque acting on a Particle, Angular Momentum of a Particle, Angular Momentum of System of Particles, Total angular momentum w.r.t. CM coordinate, Conservation of Angular Momentum Reference: HP **3.** Oscillations, The Simple Harmonic Oscillator, Relation between Simple Harmonic Motion and Uniform Circular Motion, Two Body Oscillations, Damped Harmonic Motion, Forced Oscillations and Resonance	10

		Reference: HP	
II	Thermodynamics - I	**1.** (Review: Zeroth and first law of thermodynamics) Conversion of heat into work, heat engine, Carnot's ideal heat engine, Carnot's cycle: its efficiency Reference: AH **2.** Second law of thermodynamics - Statements, Equivalence of Kelvin-Plank and Clausius statement, Carnot's theorem, Reversible and irreversible process, Absolute scale of temperature Reference: AH **3.** Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, Generalized form of first and second law, Entropy change of an ideal gas, Entropy of steam, Entropy and unavailable energy, Entropy and disorder, Absolute entropy Reference: AH	10
III	Thermodynamics – II	**1.** Third law of thermodynamics, Nernst heat theorem, Consequences of the third law, Maxwell's thermodynamic relations, Clausius – Clapeyron equation, Thermal Expansion Reference: AH **2. Heat Engines:** Rankine cycle, Steam engine, Otto engine, Efficiency of Otto cycle, Diesel cycle, Efficiency of Diesel cycle, Otto and Diesel cycle comparison Reference: AH, BSH **3. Low Temperature Physics:** Different methods of liquefaction of gases, Methods of freezing mixture, Cooling by evaporation, Cooling by adiabatic expansion, Joule - Thompson effect, JT effect of Van der Waal's gas, Liquefaction of helium, Properties and uses of liquid Helium Reference: BSH	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. HP: Mechanics, H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.)
2. AH: Thermal Physics, A. B. Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008-09
3. BSH: Heat, Thermodynamics and Statistical Physics, Brij lal, N. Subramanyam, P. S. Hemne, S. Chand, edition 2007

Additional reference:

1. Resnick and Halliday, Physics – I
2. Mechanics, K. R. Symon
3. Classical Dynamics of particles and systems, Thornton and Marian, CENGAGE Learning
4. Basic Thermodynamics, Evelyn Guha, Narosa Publications
5. Classical mechanics, Kleppener, Kollenkov
6. A treatise on heat, Meghanad Saha and B. N. Srivastava, 1969, India Press.
7. Mechanics and Electrodynamics, Rev. Edn. 2005, Brij lal and N. Subramanyam and Jeevan Seshan

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Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100%	I	06 04

	internal option		
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Nomenclature of the Course	**Electronics**
Course Code	USPH302
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. Learners will develop a basic understanding of variations of transistor parameters and their impact on circuit performance. Learners will develop the skill to analyze and design various transistor biasing circuits, general amplifier circuits and oscillator circuits. Learners will also attain a basic understanding of the fundamental principles of operational amplifiers, including its structure, operation and its versatile applications in electronics. These skills will empower learners to contribute effectively in the field of analog electronics, signal generation, signal processing, frequency control, circuit design, etc. Learners will also develop the skill to handle binary data and to perform arithmetic operations. Learners will develop the skill to analyze and optimize sequential circuits using flip-flops for a variety of digital applications. Learners will also understand types of digital registers and data transfer mechanisms that these registers allow for a wide range of digital applications. Learners will also develop a basic understanding of the fundamental principles of digital counters and will be able to analyze and design asynchronous and synchronous counters for a variety of digital applications. These skills will empower learners to contribute effectively in the field of digital systems, computer architecture and digital signal processing. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Electronics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH202: Electricity and Electronics'.

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the basics of transistor biasing, operational amplifiers, their applications.

CO2. Understand the basic concepts of oscillators and be able to perform calculations using them.

CO3. Understand the working of digital circuits.

CO4. Demonstrate quantitative problem solving skill in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Analog Electronics - I	**1. Transistor Biasing**: Inherent Variations of Transistor Parameters, Stabilization, Essentials of a Transistor Biasing Circuit, Stability Factor, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Biasing with Collector Feedback Resistor, Voltage Divider Bias Method, Stability factor for Potential Divider Bias Reference: MM **2. General amplifier characteristics:** Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, phase reversal, frequency response, Decibel gain and Band width Reference: AM **3. Feedbacks in Amplifiers:** General theory of feedback, reasons for negative feedback, loop gain, Practical circuit of transistor amplifier with and without feedback Reference: MM	10

II	Analog Electronics - II	**1. Oscillators:** Introduction, effect of positive feedback. Requirements for oscillations, Phase shift oscillator, Wien Bridge Oscillator, Colpitt's Oscillator, Hartley Oscillator Reference: AM **2. Operational Amplifiers:** Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, AC analysis, Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, OPAMP with Negative feedback, Inverting Amplifier, Non -Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP Integrator and Differentiator, Comparator Reference: MM	10
III	Digital Electronics	**1.** Digital IC signal levels, Binary addition, Unsigned binary numbers, Sign magnitude numbers, 1's complement, 2's complement, Converting to and from 2's complement representation, 2's complement arithmetic, adder-subtractor (Ignore IC specific diagrams) Reference: LMS **2.** RS Flip-Flops (only NOR gate latch, NAND gate latch), Gated Flip-Flops, Edge- Triggered RS Flip-Flop, Edge-Triggered D Flip-Flop, Edge-Triggered JK Flip-Flop, JK Master- Slave Flip-Flops, Bounce elimination switch Reference: LMS **3.** Types of registers: SISO, SIPO, PISO, PIPO (general description) Reference: LMS **4.** Asynchronous counter - 3 bit (Ignore IC specific diagrams), Synchronous counter only Mod 8, Decade Counters, Mod 5 and Mod 10 Reference: LMS	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. MM: Principles of Electronics, V. K. Mehta and Rohit Mehta, S. Chand – Multicoloured illustrative edition
2. AM: Electronic devices and circuits, An introduction Allan Mottershead, PHI Pvt. Ltd.– EEE – Reprint – 2013
3. LMS: Digital Principles and Applications, Leach, Malvino, Saha - 6th edn.

Additional References:

1. Digital Fundamentals, Thomas L. Floyd, 10th edn.
2. Modern Digital Electronics, R. P. Jain, 4th edn.

Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Nomenclature of the Course	**Mathematical Methods in Physics**
Course Code	USPH303
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum focuses on providing basic understanding of various mathematical methods to learners that are essential for solving complex problems in physics. Curriculum covers various mathematical methods commonly used in physics, such as, vector algebra, vector calculus, differential equations, etc. This will empower learners to contribute effectively to the field of experimentation, research and theoretical developments. The curriculum is so designed that along with learning various mathematical methods, learners are also introduced to some of the real world examples, where they can find direct applications of these methods to analyze real world scenarios, e.g., the curriculum equips learners to analyze transient response of series LR, CR, LCR circuits. The curriculum also equips learners with basic understanding of curvilinear coordinate systems, particularly cylindrical and spherical coordinates and this will help learners to visualize systems geometrically.

Nomenclature: Mathematical Methods in Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the basic concepts of mathematical physics and applications of them in physical situations.

CO2. Understand various mathematical skills and tools for studying physics.

CO3. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Vector Algebra	**1.** Vectors, Scalars, Vector algebra, Laws of vector algebra, Unit vector, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Problems based on vector algebra, Dot or scalar product, Cross or vector product, Commutative and distributive laws, Scalar triple product (omit proof), Vector triple product (omit proof), Problems and applications based on dot, cross and triple products Reference: DJG **2.** The ∇ operator, Definition and physical significance of gradient, divergence and curl (omit proofs), Problems based on gradient, divergence and curl Reference: DJG	10
II	Vector Calculus	**1.** Line, Surface and Volume Integrals, The Fundamental Theorem of Calculus, The Fundamental Theorem of Gradient, The Fundamental Theorem of Divergence, The Fundamental Theorem of Curl (Statement and Geometrical interpretation is included, Proof of these theorems are omitted). Problems based on these theorems are required to be done Reference: DJG	10

		2. Curvilinear Coordinates: Cylindrical Coordinates, Spherical Coordinates Reference: DJG	
III	Differential Equations	**1.** Introduction, Ordinary differential equations, First order homogeneous and non-homogeneous equations with variable coefficients, Exact differentials, General first order Linear Differential Equation, Second order homogeneous equation with constant coefficients, Problems, depicting physical situations like LC and LR circuits, Simple harmonic motion (Spring mass system) Reference: CH **2. Transient response of circuits:** Series LR, CR, LCR circuits (Growth and decay of current/charge) Reference: CR	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. DJG: D. J. Griffith, Introduction to Electrodynamics, 3rd Ed
2. CH: Charlie Harper, Introduction to Mathematical Physics, 2009 (EEE) PHI Learning Pvt. Ltd.
3. CR: D. Chattopadhyay, P. C. Rakshit, Electricity and Magnetism, 7th Edition, New Central Book Agency

Additional References:

1. Brij Lal, N. Subrahmanyam, Jivan Seshan, Mechanics and Electrodynamics, S. Chand (Revised and Enlarged Edition 2005)
2. A. K. Ghatak, Chua, Mathematical Physics, 1995, MacMillan India Ltd.
3. Ken Riley, Michael Hobson and Stephan Bence, Mathematical methods for Physics and Engineering, Cambridge (Indian Edition)
4. H. K. Dass, Mathematical Physics, S. Chand & Co.
5. Jon Mathews & R. L. Walker, Mathematical Methods of Physics, W. A. Benjamin Inc.
6. Murray R. Spiegel, Schaum's ouline of theory and problems of vector analysis,

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Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Physics Lab – III**
Course Code	USPH304
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Practical
Type	Major
Revision specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab – III

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

CO1. Understand & practice the skills while performing experiments.

CO2. Understand the use of apparatus and their use without fear & hesitation.

CO3. Correlate the physics theory concepts to practical application.

CO4. Understand scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, all 5 skill experiments from this course and minimum 8 experiments (4 from 'Mechanics' group and 4 from 'Electricity' group) from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of third semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'Mechanics' group and 1 from 'Electricity' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'Mechanics' group and experiments done from 'Electricity' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Skill Experiments	1. Wiring of simple circuit using breadboard 2. Use of Oscilloscope 3. Spectrometer: mean μ of yellow doublet of mercury source 4. Drawing of graph on semi logarithmic / logarithmic scale 5. Radius of ball bearings (single pan balance)	**20**
B	Mechanics	1. Determination of acceleration due to gravity by using bar pendulum 2. Concept of beats: Determination of frequency of beat using two independent sine wave trains 3. Moment of inertia of Compound Pendulum by method of coincidence 4. Determination of Young's Modulus of wire from Searle's experiment by Flexural Oscillations method 5. Determination of Modulus of Rigidity of wire from Searle's experiment by Torsional Oscillations method 6. Temperature coefficient of resistance of conducting material 7. Determination of Young's Modulus by Koenig's Method 8. Determination of Young's Modulus by bending of bar	**20**
C	Electricity	1. Charging and discharging of capacitor in series CR dc circuit 2. Figure of merit of a mirror galvanometer 3. High resistance by mirror galvanometer 4. Verification of Thevenin's theorem for dc electrical networks 5. Verification of Norton's Theorem for dc electrical networks 6. Verification of Maximum Power Transfer	**20**

		theorem for dc electrical networks 7. Verification of Reciprocity theorem for dc electrical networks 8. Verification of Superposition theorem for dc circuits	

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics, Harnam Singh, S. Chand & Co. Ld. 2001
3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics, C. L. Arora, 1st Edition, 2001 S. Chand and Co. Ltd.
5. Practical Physics, C. L. Squires, 3rd Edition, Cambridge University
6. University Practical Physics , D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics, Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	20
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	10
Viva	10

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours)

Question No	Group	Title	Method	Marks
1	B	Mechanics	Experiment performance as per practical slip	30
2	C	Electricity	Experiment performance as per practical slip	30

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Nomenclature of the Course	**Basics of Mechanics and Electricity**
Course Code	USPH305
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum focuses on providing basic understanding of concepts and principles related to elasticity, gravitational physics, and surface tension. This will provide knowledge and will develop skills required to perform experiments related to mechanics and to assess the accuracy of experimental results. The curriculum also equips learners with skills, knowledge and techniques necessary for circuit analysis and proper electrical measurements in various applications and aware learners about safety precaution while taking electrical measurements. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Basics of Mechanics and Electricity

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the basic concepts in mechanics

CO2. Understand the basic principles of electric circuits, including voltage, current, resistance and power and be able to analyze circuits.

CO3. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Basics of Mechanics	**1.** Definition and concept of elasticity, Stress-Strain relationship, Determination of Young's modulus for isotropic materials Reference: CA, BJD **2.** Introduction to shear stress and shear strain, Determination of modulus of rigidity for isotropic materials Reference: CA, BJD **3.** Newton's law of universal gravitation, Variation of gravitational acceleration with altitude and depth, experimental determination of gravitational acceleration Reference: HRW **4.** Definition and explanation of surface tension, Measurement techniques for surface tension Reference: CA, DAJ	10
II	Basics of Electrical Measuring Devices & Measurements	Voltmeter, Ammeter, Galvanometer (Ballistic and Dead beat), DMM 3½ digit – Resolution, Sensitivity and General Specifications, Electrical measurement techniques and precautions Reference: HSK, AW	10

III	Basics of Electrical circuit analysis	Passive circuit elements - Resistor, Inductor, Capacitor, Colour coding of resistor, Coding of Capacitor, AC and DC Electric Circuits, Characteristics of AC and DC signals, Constant Voltage source and Constant Current Source, Kirchhoff's law Reference: CR, RS, BT	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. CR: D. Chattopadhyay, P. C. Rakshit, Electricity and Magnetism, 7th Edition, New Central Book Agency
2. RS: A textbook of applied electronics, R. S. Sedha, S. Chand
3. BT: Basic Electronics - Solid State, B. L. Theraja, S. Chand
4. HSK: Electronic Instrumentation, H. S. Kalsi, Tata McGraw Hill
5. AW: A Course in Electrical and Electronic Measurement Techniques, Albert D. Helfrick, William D. Cooper, Prentice Hall India
6. CA: B.Sc. Practical Physics, C. L. Arora, 1st Edition, 2001 S. Chand and Co. Ltd.
7. BJD: Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, and David F. Mazurek, McGraw Hill Education
8. HRW: Fundamentals of Physics, David Halliday, Robert Resnick, Jearl Walker, Wiley
9. DAJ: Surface Tension, D. Andrew Jones, Springer

Additional References:

1. Concepts of Physics, H. C. Verma

Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05

Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Experimental Physics Lab – I**
Course Code	USPH306
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Practical
Type	Minor
Revision specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Experimental Physics Lab – I

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, all 5 skill experiments from this course and minimum 8 experiments (4 from 'Basic Experiments in Mechanics' group and 4 from 'Basic Experiments in Electricity' group) from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of third semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'Basic Experiments in Mechanics' group and 1 from 'Basic Experiments in Electricity' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'Basic Experiments in Mechanics' group and experiments done from 'Basic Experiments in Electricity' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Skill Experiments	1. Wiring of simple circuit using breadboard 2. Use of Oscilloscope 3. Spectrometer: mean μ of yellow doublet of mercury source 4. Drawing of graph on semi logarithmic / logarithmic scale 5. Radius of ball bearings (single pan balance)	**20**
B	Basic Experiments in Mechanics	1. Y by bending 2. Coupled oscillations and resonance of two bar pendulums 3. Surface tension of liquid 4. Searle's experiment: determination of Y 5. Searle's experiment: determination of η 6. Resonance Pendulum 7. Determination of acceleration due to gravity by using bar pendulum 8. Concept of beats	**20**
C	Basic Experiments in Electricity	1. Verification of Thevenin's theorem for dc circuits 2. Verification of Norton's Theorem for dc circuits 3. Figure of merit of a mirror galvanometer 4. LCR parallel resonance 5. Determination of absolute capacitance using BG 6. Charging and discharging of capacitor in series CR dc circuit 7. Frequency of ac mains using sonometer 8. De-Sauty's bridge: Determination of unknown capacitance	**20**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics, Harnam Singh, S. Chand & Co. Ld. 2001
3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics, C. L. Arora, 1st Edition, 2001 S. Chand and Co. Ltd.
5. Practical Physics, C. L. Squires, 3rd Edition, Cambridge University
6. University Practical Physics , D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics, Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	20
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	10
Viva	10

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours)

Question No	Group	Title	Method	Marks
1	B	Mechanics	Experiment performance as per practical slip	30
2	C	Electricity	Experiment performance as per practical slip	30

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Name of the Course	**Digital Computer Electronics and Microprocessor 8085 - I**
Course Code	USPHS307
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Practical
Type	Skill Enhancement Course (SEC)
Revision specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The experiments on digital electronics included in curriculum will provide knowledge regarding with various digital components commonly used in computer and will develop the skills to work with these components. The experiments on microprocessor included in curriculum provide knowledge about hardware and software of microprocessor 8085 to learners. The curriculum is so designed that it offers hands-on approach to learn the subject and learner will also develop the skill to write and perform basic assembly language program with 8085 microprocessor. This will provide the foundation to learners to pursue careers in the field of embedded systems design, digital electronics, computer engineering, automation and related fields. Additionally, experiments with microprocessor 8085 included in following physics lab courses will reinforce learner's theoretical understanding to practical applications.

Nomenclature: Digital Computer Electronics and Microprocessor 8085 - I

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

- CO1. Understand basic principles and concepts of digital electronics and become familiar with various digital components commonly used in computer
- CO2. Implement digital circuits and develop skills in troubleshooting, identifying and fixing issues in digital circuits
- CO3. Understand architecture, operation and basic assembly language programming of 8085 microprocessor
- CO4. Write and perform basic assembly language programming with 8085 microprocessor

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Instructions for learners:

1. All readings should be written with proper units.
2. Skill of doing the experiment and understanding relative concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, minimum 8 experiments from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course.
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 1 experiment from this course and experiment will be of two hours duration.
7. Evaluation in viva voce will be based on experiments done from this course.
8. While evaluating practical, weightage will be given to circuit diagram, observations, tabular representation, truth table, experimental skills and procedure, flowchart, assembly language program and result (whichever applicable).

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Regular Experiments	1. Study of 3 to 8 decoder (74LS138) 2. Study of 8 to 3 priority encoder (74LS148) 3. Study of Octal latch (74LS373) 4. Study of basics of microprocessor 8085 and instruction set - I 5. Study of microprocessor 8085 kit and commands 6. Microprocessor 8085: Addition of two 8-bit numbers 7. Microprocessor 8085: Subtraction of one 8-bit number from the other 8. Microprocessor 8085: Comparison of two 8-bit numbers and finding greatest/smallest number 9. Microprocessor 8085: Checking whether an 8-bit number is even or odd and storing even number at another memory location 10. Microprocessor 8085: Checking whether an 8-bit number is positive or negative and storing positive number at another memory location. Microprocessor kit / Simulator to perform above practicals.)	**60**

Learning Resources recommended:

1. Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India
2. Microprocessor 8085 User Manual

Evaluation Pattern:

A. Continuous Evaluation (20 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot	10

graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (30 Marks – 2 hours)

Question No	Group	Title	Method	Marks
1	A	Regular Experiments	Experiment performance as per practical slip	30

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Syllabi of Courses Offered in the Subject Physics for Semester IV

Name of the Course	**Optics and Cosmology**
Course Code	USPH401
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that learners will develop a comprehensive understanding of the phenomena like, diffraction of light, polarization of light. After that, learners will be well-prepared to predict, analyze and interpret these phenomena and will be able to use it in various contexts, including optics, spectroscopy, material characterization, photography, imaging, etc. The study of these phenomena will empower learners to contribute effectively in the field of research, technology development and innovations. The curriculum also focuses on the structure and evolution of the universe across different scales and wavelengths, which contributes to learner's understanding of the fundamental principles of modern astrophysics. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Optics and Cosmology

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH202: Optics'.

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the phenomenon like, diffraction of light, polarization of light and their applications in physical situations.

CO2. Understand the structure of universe and fundamentals of cosmology and astronomy

CO3. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Diffraction of Light	**1. Fresnel's Diffraction:** (Review: Introduction, Huygens' – Fresnel theory, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction) Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straight edge), Diffraction due to a narrow slit, Diffraction due to a narrow wire Reference: BSA **2. Fraunhoffer Diffraction:** Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction pattern and missing orders, Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima Reference: BSA	10
II	Polarization of Light	**1.** Introduction to Polarization of light, Types of polarization, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially	10

		polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Brewster's law, Polarization by refraction – pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarizer and Analyzer, Malus' Law Reference: BSA **2.** Polarization by double refraction, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray, Retarders, Quarter wave plate, Half wave plate, Production of linearly polarized light, Production of elliptically polarized light, Production of circularly polarized light, Analysis of polarized light, Applications of polarized light Reference: BSA	
III	Cosmology	**1.** Introduction to Cosmology: The large scale structure of the Universe, Types of galaxies, Radio sources, Quasars, Doppler shift and expansion of the Universe, Hubble's law, Radiation background Reference: JVNI, JVNE **2.** Astronomy in different bands of radiation- Optical, Radio and x-ray astronomy Reference: JVNI, JVNE	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. BSA - A Text Book Of Optics, Dr. N. Subrahmanyam, Brij lal, Dr M. N. Avadhanulu (S. Chand, 25th Revised edition 2012 Reprint 2013)
2. JVNI: Introduction to Cosmology, J. V. Narlikar, 3rd Ed. 2002, Cambridge University Press

3. JVNE: Elements of Cosmology, J. V. Narlikar, 1996, University Press

Additional reference:

1. Optics, Ajoy Ghatak, 5th edition
2. General Relativity & Cosmology, S. K. Srivastava, Prentice Hall of India

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Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Quantum Physics**
Course Code	USPH402
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	This course focuses on Schrödinger's equation and its applications, which provide a strong foundation for developing skills, which are essential for understanding quantum mechanics, conducting research and pursuing careers in fields of theoretical physics. Curriculum focuses on development of skills to calculate expectation values, probabilities and uncertainties based on solutions to Schrödinger's equation. Curriculum also focuses on development of skills in applying Schrödinger's equation to various physical systems, including particle in a box, harmonic oscillator and hydrogen atom to determine energy levels and wave functions.

Nomenclature: Quantum Physics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH201: Modern Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the postulates of quantum mechanics and understand its importance in explaining significant phenomena in Physics.
2. Demonstrate quantitative problem solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
		Background reading for Unit I, II and III (Review): **1.** Origin of Quantum Mechanics: a) Review of Black body radiation b) Review of photoelectric effects **2.** Matter waves - De Broglie hypothesis, Davisson and Germer experiment **3.** Wave particle duality **4.** Concept of wave packet, phase velocity, group velocity and relation between them **5.** Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty	
I	The Schrodinger wave equation	**1.** Concept of wave function, Born interpretation of wave function **2.** Concept of operator in quantum mechanics examples – position, momentum and energy operators **3.** Eigenvalue equations, expectation values of operators **4.** Schrodinger equation **5.** Postulates of Quantum Mechanics **6.** Analogy between Wave equation and Schrodinger equation **7.** Time dependent and time independent (Steady State) Schrodinger equation, Stationary State **8.** Superposition principle **9.** Probability current density, Equation of	10

		continuity and its physical significance Reference: AB	
II	Applications of Schrodinger steady state equation – I	**1.** Free particle **2.** Particle in infinitely deep potential well (one - dimension) **3.** Particle in finitely deep potential well (one - dimension) **4.** Step potential **5.** Particle in three dimensional rigid box, degeneracy of energy state Reference: AB	10
III	Applications of Schrodinger steady state equation - II	**1.** Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability) **2.** Theory of alpha particle decay from radioactive nucleus **3.** Harmonic oscillator (one-dimension), correspondence principle Reference: AB	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. AB – Arthur Beiser, Perspective of Modern Physics, McGraw Hill

Additional References:

1. Concepts of Modern Physics, A. Beiser (6th Ed.) Tata McGraw Hill.
2. Quantum Mechanics, S P Singh, M K Bagade, Kamal Singh, - S. Chand: 2004 Ed.
3. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles, R. Eisberg and R. Resnik Published by Wiley.
4. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
5. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
6. Quantum Mechanics. - By L. I. Schiff.

Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Applied Physics**
Course Code	USPH403
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The topics on ultrasonic included in curriculum covers areas from theoretical foundations to practical applications which will equip learners with skills which are necessary for designing, building and operating ultrasonic transducers, receivers and signal processing systems in electronics and instrumentation. Learners will also gain comprehensive understanding of how sound interacts with buildings and how to create acoustically comfortable and functional spaces. The topics on radio communication included in curriculum provide understanding about fundamental principles of radio communication, including modulation, demodulation, propagation, and signal processing in analog and digital communication. This will provide the foundation to learners to pursue careers in the field of telecommunication, wireless technology, networking and related fields. Learners will also gain the comprehensive knowledge about classification of materials based on their electrical, optical and magnetic properties and the application of dielectric materials. This will help learners to analyze and select materials for various applications, considering their electrical, magnetic and optical properties. These skills will help learners to contribute effectively in the field of research specifically in material science and in the field of engineering, manufacturing, product design, etc. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Applied Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

1. Understand basics of ultrasonic, from fundamental principles to practical applications
2. Understand acoustics of building and will be able to apply it.
3. Understand principles and components of radio communication system.
4. Understand various modulation techniques including analog and digital modulation.
5. Understand the fundamental principles of material science and classification of materials.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Ultrasonics and Acoustics Of Building	**1. Ultrasonics:** Piezoelectric effect, Production of Ultrasonic waves: Piezoelectric crystal method, Magnetostriction method, Detection, Properties and Applications of Ultrasonic waves Reference: SPP, RK **2. Acoustics of Buildings:** Reverberation, Explanation of Sabine's formula & Importance of Sabine's Formula, Absorption Coefficient, Acoustics of Buildings, Factors Affecting Acoustics of Buildings, Sound Distribution in an Auditorium Reference: RK	10
II	Radio Communication	**1. Basics of Communication**: Electromagnetic spectrum, Block diagram of communication system, types of communication system: simplex, duplex, analog and digital communication, base band and broad band communication, Noise concept and types, signal	10

		to noise ratio, noise figure, noise temperature, Need of modulation, concept of modulation Reference: LF **2. Amplitude Modulation:** AM waveform, mathematical expression of AM, concept of sideband, demodulation principles, AM Receiver: TRF and super heterodyne receiver Reference: LF, VM **3. Frequency Modulation:** Definition, mathematical representation, frequency spectrum, bandwidth and modulation index Reference: LF, VM **4.** Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM Reference: LF	
III	Properties of Material	**1. Electrical properties of materials:** Energy band diagram for materials – conductors, semiconductors and insulators, Electrical conductivity in metals, semiconductors and insulators (dielectrics), Effect of temperature on conductivity Reference: WD **2. Optical properties of materials:** Reflection, refraction, absorption and transmission of electromagnetic radiation in solids Reference: WD **3. Magnetic properties of materials:** Origin of magnetism in solids (basic idea), Types of magnetic order (paramagnetism, diamagnetism, antiferromagnetism, ferromagnetism, ferrimagnetism), magnetic hysteresis Reference: WD **4. Applications:** Applications of dielectric	10

		materials: Piezoelectric, ferroelectric and pyroelectric materials Reference: WD	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. SPP: Fundamentals of Vibration and Waves, S. P. Puri, Tata McGraw Hill
2. RK: Properties of Matter and Acoustics, R. Murugeshan and K. Shivaprasathm S. Chand & Co. Ltd. (2005 Edition)
3. LF: Communication Electronics: Principles and applications by Louis E Frenzel 3rd edition TMH Publications.
4. VM: Principles of Electonics, V. K. Mehta, Rohit Mehta, S. Chand & Company, Multicolour Illustrative Edition
5. WD – Material Science and Engineering, An Introduction, 10th edition, William D. Callister, Jr. David G. Rethwisch

Additional reference:

1. A Textbook of Sound, Brij Lal, Subramanyam
2. A Textbook of Sound, M. N. Srinivasan, Himalaya Publishing House
3. Acoustics – Waves and Oscillations, S. N. Sen, Wiley Estern Ltd.
4. Sound, F. G. Mee, Heinemann Educational Books Ltd.
5. Ajoy Ghatak: Optics (5th edn)
6. Rolf E. Hummel, Electronic Properties of Materials
7. V. Raghavan, Materials Science and Engineering: A First Course
8. Electronics Communication Systems by Kennedy
9. Telecommunication Switching Systems and Network by Vishwanathan and Thiagarajan, PHI publication
10. Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication.

Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be	10

considered)	
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	II	06 04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Physics Lab – IV**
Course Code	USPH404
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Practical
Type	Major
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results. Learner will also develop the skill to write and perform basic assembly language program with 8085 microprocessor.

Nomenclature: Physics Lab – IV

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. To learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.
5. Write and perform basic assembly language programming with 8085 microprocessor.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of performing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, 5 demonstration experiments and minimum 08 experiments (4 from 'Optics' group and 4 from 'Electronics' group) should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of fourth semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per minimum requirements.
6. For Semester End Examination, the learner will be examined in 2 experiments (1 from 'Optics' group and 1 from 'Electronics' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on demonstration experiments, experiments done from 'Optics' group and 'Electronics' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, flowchart, assembly language program, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Optics	1. Optical lever: determination of μ 2. Determination of Cauchy's constants 3. R.P. of telescope 4. R. P. of prism 5. Determination of wavelength of LASER using diffraction grating 6. Total internal reflection : Determination of μ 7. Fresnel's biprism: Determination of λ 8. LASER beam profile	**20**
B	Electronics	1. Passive low pass filter 2. Passive high pass filter 3. Passive band pass filter 4. OPAMP: Inverting amplifier with different gains 5. OPAMP: Non-inverting amplifier with different gains and voltage follower 6. CE amplifier: variation of gain with load 7. Colpitt's oscillator 8. Study of MS-JK flip flop	**20**
C	Demonstration Experiments	1. Waveform generation using OPAMP 2. Fraunhoffer diffraction due to single slit, double slit, Missing orders of interference maxima in double slit diffraction pattern 3. Fraunhoffer diffraction – Grating Spectra 4. Total internal reflection 5. Double refraction 6. ac operations of a CE amplifier 7. First order active filter	**20**

Learning Resources recommended:

1. Advanced course in Practical Physics, D. Chattopadhya, P. C. Rakshit & B Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B. Sc. Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001

3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B. Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint.

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	20
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	10
Viva	10

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours)

Question No	Group	Title	Method	Marks
1	A	Optics	Experiment performance as per practical slip	30
2	B	Electronics	Experiment performance as per practical slip	30

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Nomenclature of the Course	**Basics of Optics and Electronics**
Course Code	USPH405
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum focuses on theoretical understanding of optics and learners will develop skills to apply optical principles to various scientific and engineering disciplines. Learners will develop the skill to analyze and design general amplifier circuits, oscillator circuits and filter circuits. Learners will also attain a basic understanding of the fundamental principles of operational amplifiers, including its structure, operation and its versatile applications in electronics. These skills will empower learners to contribute effectively in the field of analog electronics, signal generation, signal processing, frequency control, circuit design, etc. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Basics of Optics and Electronics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand the different phenomenon and basic concepts in optics.

CO2. Understand fundamental principles and practical applications of amplifiers and oscillators.

CO3. Understand the basic principles of filter circuits.

CO4. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Basics of Optics	Polarization of Light, Diffraction of Light, Types of Diffraction of Light, Difference between Interference and Diffraction, Resolving power of optical instruments, Rayleigh's Criterion Reference: SBA	10
II	Basics of Amplifiers and Oscillators	**1. Amplifiers:** Introduction, Amplifier notations, General Characteristics: Gain, Frequency response, decibel gain and bandwidth, Feedbacks in amplifiers – Positive and Negative - basic concept Reference: VM, RS **2. Oscillators:** Introduction, Comparison between Oscillator and amplifier, Classification of oscillators, Nature of sinusoidal oscillations, Requirements for oscillations Reference: VM, RS	10
III	Basics of Operational Amplifiers and Filter Circuits	**1. Operational Amplifier:** Introduction to Operational Amplifier , Ideal Op- Amp , CMRR, Inverting and Non- Inverting Amplifier, Op- Amp - Summing, Difference, Integral and Differential Op-Amp Reference: VM, RS	10

		2. Filter Circuits: Introduction and Types - Low Pass Filter, High Pass Filter, Band Pass Filter, Band Stop Filter Reference: VM, RS	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. SBA: Dr. N. Subrahmanyam, Brij lal and Dr. M. N. Avadhanulu, A Textbook of Optics, 25th Revised Edition 2012 (Reprint2016), S. Chand & Company Pvt. Ltd.
2. VM: Principles of electronics, V. K. Mehta, Rohit Mehta, S. Chand
3. RS: A textbook of applied electronics, R. S. Sedha, S. Chand

Additional References:

1. Optics, Ajoy Ghatak 6th Edition, McGraw Hill Education (India) Private Limited
2. Basic Electronics - Solid State, B. L. Theraja, S. Chand

Evaluation Pattern:

A. Continuous Internal Evaluation (20 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 10 marks / 2 unit tests of 05 marks each / 3 unit tests of 05 marks each and best two out of three will be considered)	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (Paper Pattern) (30 Marks – 1 hour):

Question No.	Question Type	Unit	Marks
1	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	I	06 04
2	A) Long answer based questions with 100% internal option B) Short answer based questions with 100%	II	06

	internal option		04
3	A) Long answer based questions with 100% internal option B) Short answer based questions with 100% internal option	III	06 04

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short answer based questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

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Name of the Course	**Experimental Physics Lab – II**
Course Code	USPH406
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Practical
Type	Minor
Revision specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Experimental Physics Lab – II

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, 5 demonstration experiments from this course and minimum 8 experiments (4 from 'Basic Experiments in Optics' group and 4 from 'Basic Experiments in Electronics' group) from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of third semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'Basic Experiments in Optics' group and 1 from 'Basic Experiments in Electronics' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'Basic Experiments in Optics' group and experiments done from 'Basic Experiments in Electronics' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Basic Experiments in Optics	1. Optical lever: Determination of μ 2. Single slit diffraction using LASER 3. Determination of Cauchy's constants 4. R.P. of telescope 5. R.P. of grating 6. Determination of wavelength of LASER using diffraction grating 7. Brewster's law: Determination of μ 8. Cylindrical Obstacle: Determination of λ	**20**
B	Basic Experiments in Electronics	1. OPAMP: Inverting amplifier with different gains 2. OPAMP: Non-inverting amplifier with different gains and voltage follower 3. CE amplifier: determination of bandwidth 4. Hartley oscillator 5. RC Phase shift oscillator 6. Square wave oscillator using gates 7. Passive low pass filter 8. Passive high pass filter	**20**
C	Demonstration Experiments	1. Waveform generation using OPAMP 2. Fraunhoffer diffraction due to single slit, double slit, Missing orders of interference maxima in double slit diffraction pattern 3. Fraunhoffer diffraction – Grating Spectra 4. Total internal reflection 5. Double refraction 6. ac operations of a CE amplifier 7. First order active filter	**20**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics, Harnam Singh, S. Chand & Co. Ld. 2001
3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics, C. L. Arora, 1st Edition, 2001 S. Chand and Co. Ltd.
5. Practical Physics, C. L. Squires, 3rd Edition, Cambridge University
6. University Practical Physics , D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics, Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	20
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	10
Viva	10

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours)

Question No	Group	Title	Method	Marks
1	A	Optics	Experiment performance as per practical slip	30
2	B	Electronics	Experiment performance as per practical slip	30

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Name of the Course	**Digital Computer Electronics and Microprocessor 8085 - II**
Course Code	USPHS407
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Practical
Type	Skill Enhancement Course (SEC)
Revision specific to employability/ entrepreneurship/ skill development	Syllabus ensures a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The experiments on digital electronics included in curriculum will provide knowledge regarding with various digital components commonly used in computer and will develop the skills to work with these components. The experiments on microprocessor included in curriculum provide knowledge about hardware and software of microprocessor 8085 to learners. The curriculum is so designed that it offers hands-on approach to learn the subject and learner will also develop the skill to write and perform basic assembly language program with 8085 microprocessor. This will provide the foundation to learners to pursue careers in the field of embedded systems design, digital electronics, computer engineering, automation and related fields. Additionally, experiments with microprocessor 8085 included in following physics lab courses will reinforce learner's theoretical understanding to practical applications.

Nomenclature: Digital Computer Electronics and Microprocessor 8085 - II

Eligibility: -- To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH307: Digital Computer Electronics and Microprocessor 8085 – I'.

Course Outcomes:

On successful completion of this course, a learner will be able to:

- CO1. Understand basic principles and concepts of digital electronics and become familiar with various digital components commonly used in computer
- CO2. Implement digital circuits and develop skills in troubleshooting, identifying and fixing issues in digital circuits
- CO3. Understand architecture, operation and basic assembly language programming of 8085 microprocessor
- CO4. Write and perform basic assembly language programming with 8085 microprocessor

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Instructions for learners:

1. All readings should be written with proper units.
2. Skill of doing the experiment and understanding relative concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, minimum 8 experiments from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course.
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Physics department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 1 experiment from this course and experiment will be of two hours duration.
7. Evaluation in viva voce will be based on experiments done from this course.
8. While evaluating practical, weightage will be given to circuit diagram, observations, tabular representation, truth table, experimental skills and procedure, flowchart, assembly language program and result (whichever applicable).

Curriculum:

Group	Title	Learning Points	No. of lectures (60 min.)
A	Regular Experiments	1. 4-bit adder/ subtractor 2. 4-bit ripple/ decimal counter (7490 and 7493) 3. Study microprocessor 8085 instruction set - II 4. Microprocessor 8085: Multiplication of two 8-bit numbers 5. Microprocessor 8085: Data block transfer 6. Microprocessor 8085: Finding greatest/smallest number from array of elements 7. Microprocessor 8085: Finding number of even/odd/positive/negative elements from array of elements 8. Microprocessor 8085: Use of monitor routines to display a number 9. Microprocessor 8085: Use of monitor routines to display a message 10. Microprocessor 8085: Use of monitor routines to display Hexadecimal up/down counter Microprocessor kit / Simulator to perform above practicals.)	**60**

Learning Resources recommended:

1. Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India
2. Microprocessor 8085 User Manual

Evaluation Pattern:

A. Continuous Evaluation (20 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot	10

graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 20.	
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (30 Marks – 2 hours)

Question No	Group	Title	Method	Marks
1	A	Regular Experiments	Experiment performance as per practical slip	30

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Guidelines for Community Engagement and Service (CEP)

Nomenclature of the Course	**Community Engagement and Service**
Class	S Y B Sc
Semester	IV
Course Code	USPHC408
No. of Credits	02
Nature	Project
Type	Elective Course

Course Outcomes:

After successful completion of this course the learner will be able to

CO1: contribute positively to the community by addressing local needs and challenges through science-based activities such as conservation of environment, promotion of good health and STEM education initiatives.

CO2: develop a sense of social responsibility and civic engagement by actively participating in community-based projects and understanding the importance of giving back to society.

CO3: gain interdisciplinary perspectives by applying scientific knowledge and skills to real-world issues, collaborating with individuals from diverse backgrounds, including community members, educators and professionals.

CO4: reflect on their experiences, challenges and accomplishments which will contribute to their personal growth, self-awareness and resilience.

CO5: enhance their employability and career readiness by gaining practical experience, networking opportunities and exposure to real-world applications of scientific knowledge.

CO6: cultivate a lifelong commitment to community continuing to apply their scientific expertise and skills to address societal issues and contribute to positive change throughout their lives.

Guidelines for Community Engagement and Service (CEP)

This course requires learners to participate in field based learning /projects generally under the supervision of faculty. It will involve activities that expose learners to the socio-economic issues in the society.

Learner has to work 90 hours in a semester for Community Engagement and Service Project.

30 hours for classroom activities

- Classroom activities include preparation for community engagement and service, independent reading and study, analysis of data and preparation of report etc.

60 hours for Field work

- Field work includes implementation of the planned community engagement activities according to the programme schedule, collection of data
- Engagement activities may include events, workshops, meetings or door-to-door outreach.

Learners can participate in activities related to National Service Scheme (NCC), National Cadet Corps (NCC), Adult education / Literacy initiatives, Mentoring of school learners / Organization of Open Day/ Celebration of day on various national and international days like National Science Day, International day of women and Girls in Science etc

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
CEP report	15
Active Participation	05

B) Semester End Examination: Maximum Marks (30):

Method	Marks
Field work Undertaking and completing community engagement and service	30

Guidelines for Field Project (FP) for S Y B Sc Programme

Nomenclature of the Course	**Field Project**
Class	S Y B Sc
Semester	IV
Course Code	USPHF408
No. of Credits	02
Nature	Project
Type	Elective Course

Course Outcomes:

After successful completion of this course the learner will be able to

CO1: enhance their ability to identify and address scientific problems or challenges using creative and analytical approaches.

CO2: acquire practical research skills, including literature review, experimental design, data collection, analysis and interpretation essential for pursuing further studies or careers in scientific research.

CO3: improve their scientific communication skills by writing comprehensive project reports, presenting their findings orally and effectively conveying complex scientific concepts to diverse audiences.

CO4: develop critical thinking skills by analyzing data, identifying patterns, and drawing evidence-based conclusions from their observations in the field.

CO5: enhance their employability by acquiring practical skills and experiences valued by employers in scientific fields, preparing them for future careers or further studies

Guidelines for Field Project

This course requires learners to participate in field based learning projects generally under the supervision of faculty.

Learner has to work 60 hours in a semester for Field Project.

20 hours for classroom activities

- Classroom activities include preparation for field activity, independent reading and study, analysis of data and preparation of report etc.

40 hours for Field work

- Field work includes implementation of the planned activities according to the programme schedule, collection of data
- Engagement activities may include events, workshops, meetings or door-to-door outreach.

A minimum of 4-6 weeks of summer work, either on college campus in activities related to conservation of environment / biodiversity or community based work in the neighboring community (through NCC/NSS unit) or field level work with a recognized NGO or regional case studies programme at Villages may be undertaken as a part of Field projects.

In rare cases field visits may be included in the Field project. In such case, field visits need to be arranged meticulously so that there is graded sequence and the submission is a compliance of all visits to make it a unified activity.

Evaluation Pattern

C) Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
Field Project Report	10
Viva-voce	10

D) Semester End Examination: Maximum Marks (30):

Method	Marks
Field work	15
Presentation	15

Sr. No.	*Activities for Field Project and Community Engagement and Service*
1	Host science talks or webinars open to the public on topics of scientific interest
2	Anti-Drug awareness campaign in an urban/ rural area
3	Engage community members in citizen science projects
4	Organize a science fair or exhibition
5	Aids awareness campaign in an urban/ rural area
6	Environment awareness campaign
7	Water Conservation Awareness program in an urban/ rural area
8	Design and execute a waste management initiative in an urban neighbourhood
9	Conduct surveys on access to clean water and sanitation facilities in both rural and urban settings
10	Conduct / participate in workshops or seminars to provide guidance and information about career opportunities in STEM fields
11	Organize science outreach workshops for local schools or community centres on various science topics
12	Create educational materials on environmental conservation and distribute them in schools and communities.
13	Conduct research projects on fruit processing and value added products.
14	Conduct research projects on fish industry and its impact on communities.
15	Conduct research projects on fruit industry and its impact on communities.
16	Organize events for building scientific temper
17	Implement initiatives to promote sustainable energy practices in rural environment.
18	Establish community-driven initiatives for disaster preparedness and response.
19	Organize community clean-up drives in both rural and urban areas.
20	Collaborate with local businesses to provide vocational training and job opportunities.
21	Conduct workshops on digital literacy and technology skills for community members.
22	Establish community-led initiatives for environmental conservation and biodiversity preservation.
23	Organize campaigns to promote responsible consumption and waste reduction.
24	Implement initiatives to address food insecurity and malnutrition in both settings.
25	Establish community-based initiatives for urban agriculture projects.
26	Organize capacity-building workshops for community-based environmental organizations.
27	Establish community-led initiatives for waste reduction and recycling.
28	Survey on quality and availability of water
29	Survey on quality of soil and soil fertility
30	Conduct research on the impact of pollution on marine ecosystem.
31	Conduct research projects on the environmental issues.
32	Conduct research on the impact of pollution on biodiversity.
33	Any other subjects of your choice and get it approved by the field project or CEP guide

R. E. Society's

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce (Autonomous), Ratnagiri

Syllabus of Open Elective Courses Offered by Department of Physics for Second Year (Semester III & IV) Bachelor's Programme (NEP 2020 & CBCS)

From Academic Year 2024-25

Open Elective Courses for SYBA / SYBCom / SYBMS / SYBAF / SY BSc IT / SY BSc CS

Nomenclature of the Course	**Physics in Everyday Life - I**
Class	SYBA / SYBCom / SYBMS / SYBAF / SYBSc IT / SYBSc BT / SYBSc CS
Semester	III
Course Code	USOEPH304
No. of Credits	04
Nature	Theory
Type	Open Elective Course

Course Outcomes:

After successful completion of this course the learner will be able to

CO1: relate underlying connection between everyday phenomenon happening around and physics behind it.

CO2: identify aspects of nature which can be understood using principles of physics.

CO3: understand principles of physics behind natural calamities.

CO4: analyze the physics involved in the daily activities in kitchen.

CO5: explain principles of physics used in kitchen appliances.

CO6: understand construction and working of music generating instruments.

CO7: analyze principles of physics involved in musical instruments.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Physics in Nature	Rainbow, Mirage, Blue Sky, White Clouds, Red Sunsets Waterfalls, The Sun – Earth & Moon, Eclipses Rainfall, Aurora Lightning, Earthquake, Tsunami, Tornado
II	Physics in Kitchen	**Physics of Food & Drinks** Physics of Making Tea and Coffee Physics of Carbonated Drinks Physics of Ice cream Physics of Baking- Cake, Pastry and Cookies **Physics of Kitchen Appliances** Refrigerators, Induction Stove Tops, Microwave Ovens, Pressure Cooker, Mixer
III	Physics of Musical Instruments	**String Instruments**- Violin, Guitar, Sitar; **Percussion Instruments**- Drum, Tabla; **Keyboard Instruments**-Piano, Harmonium; **Brass/Wind Instruments**- Trumpet, Bugle

Prescribed Text/s:
How things work: The Physics of everyday life, Louis A Bloomfield, 5th edition- John Wiley & Sons Publication
Conceptual Physics, Paul Hewitt, 12th edition- Pearson Publication

Other Learning Resources recommended:
https://www.youtube.com/@lecturesbywalterlewin.they9259
Scientific papers of C.V. Raman-Internet Archives
https://www.peepultree.world/livehistoryindia/story/people/c-v-ramans-work-on-indian-music

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Physics in Nature	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	20
II	Physics in Kitchen	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	20
III	Physics of Musical Instruments	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	20

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks (40):

Method	Marks
Class Test	20
Assignment	10
Attendance and active participation	10

B) Semester End Examination: Maximum Marks (60):

Question No. and Sub questions	Unit and sub unit	Type of Question	Marks
Q.1A	I	Long Note - 2 out of 4	12
Q.1B	I	Short Note - 2 out of 4	08
Q.2A	II	Long Note- 2 out of 4	12
Q.2B	II	Short Note - 2 out of 4	08
Q.3A	III	Long Note - 2 out of 4	12
Q.3B	III	Short Note - 2 out of 4	08

Nomenclature of the Course	**Physics in Everyday Life – II**
Class	SYBA / SYBCom / SYBMS / SYBAF / SYBSc IT / SYBSc BT / SYBSc CS
Semester	IV
Course Code	USOEPH404
No. of Credits	02
Nature	Theory
Type	Open Elective Course

Course Outcomes:

After successful completion of this course the learner will be able to
CO1: understand basic laws of physics behind different sports.
CO2: relate basic equations of physics applied in various sports activities.
CO3: explain principles of physics in functioning of various mechanisms in human body.
CO4: understand various physical processes in human body and relate them with laws of physics.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Physics of sports	Cricket, Tennis, Football, Javelin throw, Discus throw, Shot put, Running, Swimming
II	Physics in Human Body	Breathing System, Circulation System, Speech and Hearing, Eye and Vision

Prescribed Text/s:

How things work: The Physics of everyday life, Louis A Bloomfield, 5th edition- John Wiley & Sons Publication
Conceptual Physics, Paul Hewitt, 12th edition- Pearson Publication

Other Learning Resources recommended:

https://www.youtube.com/@lecturesbywalterlewin.they9259

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Physics in playground	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	15
II	Physics in Human Body	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	15

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
Class Test	10
Assignment	05
Attendance and active participation	05

B) Semester End Examination: Maximum Marks (30):

Question No. and Sub questions	Unit and sub unit	Type of Question	Marks
Q.1A	I	Long Note - 2 out of 4	12
Q.1B	I	Short Note - 1 out of 2	03
Q.2A	II	Long Note- 2 out of 4	12
Q.2B	II	Short Note - 1 out of 2	03

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Nomenclature of the Course	**General Physics**
Class	SYBSc BT
Semester	IV
Course Code	USOEPH407
No. of Credits	02
Nature	Theory
Type	Open Elective Course

Course Outcomes:

After successful completion of this course the learner will be able to

CO1: have a firm foundation in the fundamentals and applications of optics and electromagnetic radiations.

CO2: have a firm foundation in the fundamentals and applications of heat, sound, magnetism and fluid dynamics.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Optics and Electromagnetic Radiations	**Introduction to Optics and Lasers:** **1. Optics:** Properties of Light - Reflection, Refraction, Dispersion, Interference. **2. Lasers:** Properties of Lasers, Stimulated Emissions, Laser Action; Applications of Laser. **3. Electromagnetic Radiations:** Introduction to Electromagnetic Radiation. **4. Spectroscopy:** Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer: Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer. **5. Microscopy:** Types of Microscopy; Electron Optics; Electron Microscopy- Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy.
II	Heat, Sound, Magnetism and Fluid Dynamics	**1. Heat:** Concept of Temperature; Modes of Heat Transfer; Measuring Temperature; Platinum Resistance Thermometer; Thermocouple and Thermistors. **2. Sound:** Types of Sound Waves - Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves. **3. Magnetism:** Magnetic Field; Magnetism of Earth; Para-magnetism, Diamagnetism, Ferromagnetism. Nuclear Magnetism and Bio-magnetism. **4. Fluid Dynamics:** **Viscosity:** Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of 'η' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. **Surface Tension:** Definition - Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability;

		Temperature Dependence of Surface Tension. Applications in Biology.

Prescribed Text/s:

1.Brij Lal Subramanium, Chapter 3, 8, 14, 22
2. Concepts of modern Physics, Beiser, Topics 2.1 – 2.2
3. TY College analytical Chemistry, Himalaya Publications
4. Instrumentation: Devices and systems by C. S. Rangan, TMH Publication
5. Biophysical Chemistry – Principles and Techniques, Upadhyay and Nath

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Optics and Electromagnetic Radiations	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	15
II	Heat, Sound, Magnetism and Fluid Dynamics	Chalk & Board, Flipped Classroom, Engaging Activities, Demonstrations	15

Evaluation Pattern

A) Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
Unit Test	10
Assignments / Seminars	05
Attendance and active participation in classroom	05

B) Semester End Examination: Maximum Marks (30):

Question No. and Sub questions	Unit and sub unit	Type of Question	Marks
Q.1A	I	Long Note - 1out of 2	06
Q.1B	I	Do as directed – 4 out of 6	04
Q.2A	II	Long Note- 1out of 2	06
Q.2B	II	Do as directed – 4 out of 6	04
Q.3	I & II	Short Note- 2 out of 4	10

University of Mumbai
R. E. Society's,
R. P. Gogate College of Arts & Science and
R. V. Jogalekar College of Commerce (Autonomous),
Ratnagiri

Syllabus for Approval

Sr. No.	Headings	Particulars
1	Title of the syllabus	**SYBSc Physics Semester III and IV**
2	Eligibility for admission	---
3	Passing Marks	---
4	Ordinances / Regulations (if any)	---
5	Number of years/ semesters	**Number of years: 01** **Number of semester: 02**
6	Level	**Undergraduate**
7	Pattern	**Semester (CBCS)**
8	Status	**Approved**
9	BoS meeting held on	**23rd April 2024**
10	Mode of conduction of meeting	**Hybrid**
11	Syllabus to be implemented from academic year	**2024-25**

Date: 30/4/2024

Name: Dr. Dhale B.B.

Signature:

Chairman

Board of Studies in Physics

HEAD OF THE
Physics Department
R.P.Gogate College of Arts & Science & R.V.Jogalekar
College of Commerce (Autonomous) Ratnagiri.