Faculty of Science

Department of Physics

Syllabus

2022 Pattern

For

T.Y.B.Sc.(Sem-V)

in Physics

For Academic Year 2024-2025

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

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(Affiliated to Savitribai Phule Pune University, Pune)

T.Y.B. Sc. Sem-V(2022 Pattern) **[Physics]**

For academic Year 2024-2025

Semester	Paper Code	Title of Paper	No of Credits
V	PHY 351	Mathematical Methods of Physics-II	3
	PHY 352	Solid State Physics	3
	PHY 353	Classical Mechanics	3
	PHY 354	Atomic and Molecular Physics	3
	PHY 355	Elements of Material Science	3
	PHY 356	Elective-I (Select anyone)	3
		A] Renewable Energy Sources	
		B] Physics and Technology of sensors	
		C] Biophysics	
	PHY 357	Practical I	2
	PHY 358	Practical II	2
	PHY 359	Practical III	2
Total			**24**

VI	PHY 361	Classical Electrodynamics	3
	PHY 362	Quantum Mechanics	3
	PHY 363	Thermodynamics and Statistical Physics	3
	PHY 364	Nuclear Physics	3
	PHY 365A	Electronics II	3
	PHY 365B	Advanced Electronics	
	PHY 366	Elective-II (Select anyone)	3
		A] Solar Energy Conversion Devices	
		B] Sensors and its Applications	
		C] Physics of Nanomaterials	
	PHY 367	Practical IV	2
	PHY 368	Practical V	2
	PHY 369	Project	2
Total			**24**

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : T.Y.B.Sc.
Semester : V
Course Type : Theory
Course Code : USPH 351
Course Title :Mathematical methods in Physics-II
No. of Credits : 03
No. of Teaching Hours : 45

Course Objectives:

1. To learn mathematical tools required to solve physical problem.
2. To understand mathematical concepts related to physics.
3. To understand generalized coordinate system

Course Outcomes

After successful completion of the course student will be able to

1. Learn some mathematical techniques required to understand the physical phenomena at the undergraduate level.
2. The students will solve nonhomogeneous differential equations and partial differential equations using simple methods.
3. The students are expected to be able to solve simple problems on Matrix.
4. Understand the generalized coordinate system and transformation equation between cartesian coordinate and generalized coordinates.

1. Curvilinear Co-ordinates (12 L)

1.1 Introduction to Cartesian
1.2 Spherical polar and Cylindrical co-ordinate systems
1.3 Transformation equations, General Curvilinear co-ordinate system
1.4 Co-ordinate surface, lines, length, and volume elements in curvilinearsystem
1.5 Orthogonal Curvilinear co-ordinate system,
1.6 Expressions for: a) gradient b) divergence c) Laplacian d) Curl in Cartesian system

2. Special Theory of Relativity(11 L)

2.1 Introduction of Special Theory of Relativity and its limitations.

2.2 Newtonian relativity Galilean transformation equation

2.3 Lorentz transformations

2.4 Length contraction, Transformation of velocities

2.5 Variation of mass with velocity, Mass-energy relation

2.6 Problems

3. Differential Equations(10 L)

3.1 Partial differential equations

3.2 Degree, order, linearity, and homogeneity (Revision)

3.3 Method of separation of variables, Singular points

3.4 Frobenius method for power series

3.5 Solution of Legendre, Hermite and Bessel differential equation

3.6 Problems

4. Special Functions(8L)

4.1 Generating function for Legendre, Hermite Polynomials

4.2 Recurrence relations, differential equations, and properties of special functions

4.3 Bessel function of first kind and their properties

4.4 Problems

5. Matrix(4L)

5.1 Definition and Types of Matrix

5.2 Matrix representation

5.3 Caley -Hamilton theorem of matrix

5.4 Problems

References Books:

1. Mathematical method for Physicists, Arfken and Weber, Academic press New York.
2. Mathematical Physics, Rajput, Pragati Prakashan

Mathematical methods in the Physical sciences – Marry L. Boas, John Willy and Sons Publication.

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : T.Y.B.Sc.
Semester : V
Course Type : Theory
Course Code : USPH 352
Course Title :**Solid State Physics**
No. of Credits : 03
No. of Teaching Hours : 45

Course Objectives:

.1Understand the basics of crystallography.
.2Understand electrical properties of metals and Band theory of solids.
.3Understand the basics of magnetism.
.4To study the basics of Solid-State Physics and Semiconductor Physics

Course Outcomes:

This syllabus will also help students to lay a foundation for Materials science, electronics, and more advanced subjects like condensed matter in future.
CO1: List seven crystal systems.
CO2: Explain free electron theory and band theory.
CO3: Calculate lattice parameter from given XRD pattern.
CO4: Identify the structure of materials.
CO5: Evaluate the density of state equation in 3D.
CO6: Specify the importance of magnetic materials and classification based on susceptibility value.
CO7: classification of hard and soft magnet based on Hysteresis curve of magnetic sample.

Unit1. Free ElectronTheory of Solids **(14L)**

1.1 Classical free electron theory of metals
1.2 Drawbacks of classical theory

1.3 Energy levels and Density of orbital in 1D and 3D

1.4 Bloch theorem (only statement and properties)

1.5 Nearly free electron model, Fermi energy, Fermi level

1.6 Origin of energy gap

1.7 Distinction between metal, Semiconductor and insulator

1.8 Hall Effect

1.9 Problems

Unit2. Crystalline Solids (15 L)

2.1 Introduction: Classification of solids (crystalline, amorphous & polycrystalline),

2.2 Lattice, Basis, Translational vectors

2.3 Primitive unit cell, Symmetry operations

2.4 Different types of lattices 2D and 3D (Bravais lattices)

2.5 Miller indices inter planer distances.

2.6 Number of atoms per unit cell

2.7 Co-ordination number

2.8 Atomic radius and packing fraction for SC, BCC and FCC structures

2.9 Study of NaCl, diamond, CsCl, ZnS and HCP crystals

2.10 Concept of reciprocal lattice and its properties with proof.

2.11 X-ray diffraction: Crystal as a grating,

2.12 Bragg's law and Bragg's Diffraction condition in direct and reciprocal lattice

2.13 Experimental methods of X-ray diffraction: Laue method, Rotating Crystal method, Powder (Debye Scherer) method

2.14 Problems

Unit3. Semiconductor (6 L)

3.1 Intrinsic semiconductor

3.2 Conductivity

3.3 Carrier concentrations

3.4 Donor and Acceptor impurities

3.5 Extrinsic Semiconductor

3.6 Charge densities in a Semiconductor

3.7 Diffusion,

3.8 Carrier lifetime, the p-n junction as a diode

3.9 Volt-Ampere characteristics

3.10 Problems

Unit4. Magnetism (10 L)

4.1 Diamagnetism

4.2 Langevin theory of Diamagnetism

4.3 Application of diamagnetic material

4.4 Superconductor, Occurrence of Superconductivity

4.5 Critical magnetic field and Meissner effect

4.6 Paramagnetism, Langevin theory of Para magnetism

4.7 ferromagnetism, ferromagnetic domains

4.8 Hysteresis, Curie temperature

4.9 Anti-ferromagnetism, Neel temperature

4.10 Problems

Reference Books:

1. Solid State Physics-S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999).
2. Solid State Physics – Kakani and Hemrajani, S. Chand Publication.
3. Solid State Physics BySaxena, Gupta and Saxena, PragatiPrakation.
4. Introduction to Solid State Physics- Charles Kittel, John Wiley and Sons, 7th Edition.
5. Solid State Physics-A.J.Dekker, Macmillan India Ltd, (1998).
6. Solid State Physics- R.K. Puri, V.K. Babbar, S. Chand Publication.
7. Problems in Solid State Physics-S.O. Pillai, New Age International (P) Ltd.
8. Solid State Physics-Palanyswamy.
9. Solid State Physics- David, Snoke, Pearson Publication.
10. Semiconductor Physics and Devices: Donald Neamen (3rd Ed.) TMH.
11. S. M. Sze, 2nd ed, Semiconductor Devices: Physics and Technology. John Wiley & Sons.

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : T.Y.B.Sc.
Semester : V
Course Type : Theory
Course Code : USPH 353
Course Title :Classical Mechanics
No. of Credits : 03
No. of Teaching Hours : 45

Course Objectives:

1. To understand the Newton's laws and applications of Newton's laws of motion
2. To understand the Central forces, Types of central forces and Kepler's laws of planetary Motion.
3. To know the Lagrangian approach in classical mechanics.
4. To understand theory of scattering in detail

Course Outcomes

After completion of the course, the student should be able to:

CO1: The students will introduce about methods of solving equations of motions i.e. the Newton's laws of motion, linear momentum, angular momentum, and knowledge about the applications of Newton's laws of motion.

CO2: The students should be able to understand central forces and types of central forces in detail, ideas regarding equations of orbit and deduction of Kepler's laws.

CO3: This paper enables the students to understand the Lagrangian approach in classical mechanics.

CO4: The students should be able to understand theory of scattering, types of scattering and differential cross section.

CO5: Explain necessity of considering constraints.

CO6: Apply different techniques to find solutions of problems in Mechanics.

CO7: Determine the constraint equations and decide the generalized co- ordinates to be used.

Topics and Learning Points

Unit 1. Mechanics of System of Particles (11 L)

Introduction – Newton's laws of motion, Limitations of Newton's Laws, Applications of Newton's laws of motion: Projectile motion in various medium, Motion of a charged particle in constant electric, magnetic and electromagnetic field, System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles (statements only)

Problems

Unit 2. Motion in Central Force Field (11L)

Types of forces: Forces of Gravitation, Lorentz force, Hooks Force, Frictional Force, Fundamental Forces of Nature, Central force, equivalent one body problem, General features of motion, equation of orbit, Kepler's laws of planetary motion (statements only)

Problems

Unit 3. Scattering Theory of Particles (11 L)

Introduction, Elastic, and Inelastic Scattering, Laboratory and Centre of mass system, Relation between scattering angles in Lab and CM system, Inelastic scattering.

Problems

Unit 4. Langrangian Formulation (12 L)

Limitations of Newtonian mechanics, Types of constraints, degrees of freedom, generalized coordinates, configuration space, D'Alembert's principle, Virtual displacement, Principal of virtual work, Lagrange's equation of motion from D'Alembert's principle, Equation of motion of simple pendulum, spring mass arrangement, Attwood's machine, particle under gravity by using Lagrangian formulation.

Problems.

References:

1. Classical mechanics by J.C. Upadhyaya, Himalaya Publishing House.
2. Classical mechanics by N.C. Rana and P.S. Joag, Tata Mc-Graw Hill Publishing Company limited, New Delhi.
3. Classical Mechanics by P.V. Panat, Narosa publishing Home, New Delhi.
4. Classical Mechanics by Kumar, Gupta, Sharma.
5. Classical Mechanics by H. Goldstein, Narosa Publishing Home, New Delhi.
6. Classical Mechanics by D. S. Mathur.

Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata Mc- Graw Hill Publishing Company Limited, New Delhi.

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** T.Y.B.Sc.
Semester	**:** V
Course Type	**:** Theory
Course Code	**:** USPH 354
Course Title	**:Atomic and Molecular Physics**
No. of Credits	**:** 03
No. of Teaching Hours	**:** 45

Course Objectives:

After successful completion of the course students will be able to

1 The subject of Atomic and Molecular Physics has reached a significant advancement in high–precision experimental measurement techniques.

2 This area covers a wide spectrum ranging from conventional to new emerging multidisciplinary areas like molecular physics, optical science, especially spectroscopy.

3 In the present syllabus sequence of articles in each chapter enables the student to understand the gradual development of the subject.

Course Outcomes:

Upon successful completion of this course, the student will understand.

CO1: The application of quantum mechanics in atomic physics

CO2: The importance of electron spin, symmetric and antisymmetric wave functions, and vector atom model

CO3: Effect of magnetic field on atoms and its application

CO4: Learn Molecular physics and its applications.

CO5: This course will be useful to get an insight into spectroscopy.

CO6: Relate atomic theory to analyse spectra.

CO7: Evaluate spectroscopic data to identify elements using atomic spectra.

1. Atomic structure (9L)

1.1 Atomic Models (Rutherford, Bohr, Sommer field)

1.2 Energy levels and spectra (**1 to 2 Revision**)

1.3 Vector atom model (Concepts of space and quantization and electron spin)

1.4 Atomic excitation and atomic spectra

1.5 Problems Ref 1 ch4

2. One Valence Electron System (9 L)

2.1 Pauli Exclusion principle and electron configuration, quantum states, Spectral notations of quantum states.

2.2 Energy levels of Na atom, selection rules, spectra of sodium atom.

3. Two valence electron systems (9 L)

3.1 Spectral terms of two electron atoms, LS and JJ coupling schemes.

3.2 Lande's Interval rule, spectra of Helium atom

3.3 Problems, Ref 1: ch7, Ref. 2: ch8 and ch12

4. Zeeman Effect (9 L)

4.1 Early discoveries and developments

4.2 Experimental arrangement

4.3 Normal and anomalous Zeeman Effect

4.4 Stark effect (Qualitative discussion)

4.5 Problems Ref 2 ch10

5. X ray spectroscopy (9 L)

5.1 Nature of X rays

5.2 Discrete and continuous Xray spectra, Daune and Hunt's Rule

5.3 Xray emission spectra

5.4 Mosley's law and its applications

5.5 Auger effect

5.6 Problems Ref 2 ch16

Reference Books:

1. Concepts of Modern Physics 4th edition Arthur Baiser (McGraw Hill International ed)
2. Introduction to Atomic spectra White. H. E (McGraw Hill International edition)
3. Fundamentals of Molecular spectroscopy, C.N. Banwell and E.M Mc Cash (McGraw Hill International edition)
4. Modern Physics, J.B. Rajam

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : T.Y.B.Sc.
Semester : V
Course Type : Theory
Course Code : USPH 355
Course Title :**Elements of Material Science**
No. of Credits : 03
No. of Teaching Hours : 45

Course Objectives:

1. Students will demonstrate an understanding of core graduate-level theoretical knowledge in materials science.
2. An ability to use modern techniques, skills, and engineering tools appropriate to materials science.
3. An integrated understanding of structure, properties, processing, and performance of materials systems.

Course Outcomes:

1. CO1: Describe types of materials, their properties and identify types of defects.
2. CO2: Explain functional properties of ceramic bulk materials and different nanomaterials.
3. CO3: Select materials for design and construction. Test materials using different characterization methods with the fundamental principles underlying and connecting the structure and properties
4. CO4: Students are able to apply knowledge of advanced science and engineering principles to materials systems.
5. CO5: Students will demonstrate proficiency in the acquisition of data using a variety of laboratory instruments and in the analysis and interpretation of such data.
6. CO6: An ability to apply knowledge of mathematics, science, and engineering to materials issues.

7. CO7: An ability to design and conduct experiments and critically analyses and interpret data.

1. Introduction to Materials Science (12 L)

1.1 Historical perspectives of materials science

1.2 Classification of materials

1.3 Smart materials

1.4 Nano structured Materials

1.5 Organic Materials:Chemistry of polymer molecule, Molecular weight, Molecular structure

1.6 Material Properties: Mechanical, Electrical, Thermal and Magnetic

2. Defects in Solids (12L)

2.1 Types of materials: Conductors, Semiconductors, and Insulators

2.2 Defects in solids: Point, Line, Surface, and Volume

2.3 Solid solutions and their applications, Rules of solid solubility

2.4 Hume-Rothery's Rules of formation of solid solution

2.5 Diffusion in Solids: Introduction, Mechanisms of diffusion, Fick's laws of diffusion, Solution to Fick's second law, Few applications of diffusion process,

2.6 Kirkendall effect with example

3. Phase Diagram (12L)

3.1 Basic terms: System, Surrounding, Component, Coordinates, Phase, Equilibrium.

3.2 Phase Diagram: definition, importance, and objective

3.3 Lever rule, Gibb's phase rule

3.4 Phase diagram of a) Sugar water b) NaCl water

3.5 Types of phase diagrams with construction

3.6 Type-I: Lens type CuNi phase diagram

3.7 Type-II: Only introduction

3.8 Type-III: Eutectic type Pb-Sn phase diagram

3.9 Some applications of phase diagrams

4. Ceramic and Ferrite Materials (9 L)

4.1 Ceramic Phases, Classification of ceramic materials, Ceramic crystals (AX)

4.2 Mechanical behavior of ceramics

4.3 Electric properties of ceramics: dielectrics, semiconductors, piezoelectric

4.4 Magnetic Properties of ceramics: Magnetic Ceramics, hard and soft ferrites.

Reference books:

1. Elements of materials science and Engineering: H.Van Vlach
2. Materials Science and Engineering: V. Raghavan
3. Material Science: S. L. Kakani and Amit Kakani
4. Solid State Physics:A. J. Dekker

Materials Science &Engineering:An Introduction (6th Edition): William D. Callister

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme	: B.Sc. Physics
Programme Code	: USPH
Class	: T.Y.B.Sc.
Semester	: V
Course Type	: Theory
Course Code	: USPH 356 (A)
Course Title	: Renewable Energy Sources
No. of Credits	: 03
No. of Teaching Hours	: 45

Course Objectives:

1. To create awareness of environment quality
2. To develop skills in handling equipment's related to solar energy, biogas etc
3. To create manpower in renewable energy
4. Understand the various forms of conventional energy resources.
5. Learn the present energy scenario and the need for energy conservation.
6. Explain the concept of various forms of renewable energy.

Course Outcomes:

CO1:Understand the need of renewable energy resources and latest developments for environmental balance.

CO2: Use of solar energy in the energy production with different applications like - heating, cooling, desalination, power generation, drying, cooking etc for pollution free energy consumption

CO3: Understand concept and use of Wind Energy and the various components used in energy generation.

CO4: Understand the concept of Biomass energy resources and their classification along with marketing of waste for agriculture

CO5: Address various issues of environmental imbalance using promotion of Renewable energy sources than conventional energy resources.

CO6: Illustrate the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc for domestic and rural regions.

CO7: Awareness campaign for the promotion of Solar Energy, Wind energy, Biomass energy resources and biogas Plants- applications for environment sustenance.

1. Solar Energy (10 L)

1.1 Energy resources and forms of energy, Energy from sun
1.2 Solar constant, solar thermal collectors, solar pond, Solar boiler
1.3 Principle of Photovoltaic cell
1.4 Characteristics of solar cell
1.5 Large solar PV system,
1.6 Solar PV power system for space station
1.7 Assembly and maintenance
1.8 Solar charging, solar air heating and cooling system, Thermal pad
1.9 Solar water heaters, solar cookers, solar drying
1.10 Solar photovoltaic system
1.11 Solar energy pumps.

2. Energy Storage System (10 L)

2.1 Introduction
2.2 Battery Energy Storage Systems
2.3 Lead Acid Battery Cells,
2.4 Nickel-Cadmium Battery
2.5 Li-ion Battery,
2.6 Advanced Batteries.
2.7 Fuel Cell: Introduction,
2.8 Advantages of Fuel cell power sources,
2.9 Principle and operation of Fuel Cell
2.10 Classification and Types of Fuel Cells

3. Biomass energy (10 L)

3.1 Introduction
3.2 Biomass for urban waste and rural waste to biogas energy
3.3 Agricultural waste and agricultural energy crops, fruit farms
3.4 Anaerobic fermentation process in biogas plants
3.5 Principal of marine bioenergy resources
3.6 Bio-hydrogen production
3.7 Isolation of methane from Biogas & packing and its utilization.
3.8 Introduction to gasifiers.

4. Wind Energy (10 L)

4.1 Introduction, Basic concept, and component of wind energy conversion
4.2 Types of wind machines
4.3 Application of wind machine
4.4 Hybrid wind energy systems wind + diesel power

4.5 Wind + conventional grid
4.6 Wind + Photovoltaic system etc.
4.7 Wind to electrical energy conversion alternatives
4.8 Wind map of India,
4.9 Wind electrical energy stations in India.

5. Energy Audit (05 L)

5.1 Introduction
5.2 Types of energy audits
5.3 Walk through energy audit
5.4 Case Study, Audit report
5.5 Intermediate & Compressive Energy audit
5.6 Procedure of energy auditing.
5.7 Case Study: 1. Solar PV Panel
5.8 Biogas production from kitchen waste

References:

1. Biomass Renegerable Energy – D.O.hall and R.P. Overeed (John Wiley and Sons, NewYork, 1987)
2. Biomass for energy in the developing countries – D.O.Hall, G.W.barnard and P.A.Moss(Pergamon Press Ltd. 1982)
3. Thermo chemical processing of Biomass, Bridgurater A V.
4. Biomass as Fuel – L.P.White (Academic press1981)
5. Biomass Gasification Principles and Technology, Energy technology review No. 67, T.B. Read (Noyes Data Corp., 1981)

List of experiments:

1. Study of solar cell characteristics
2. PV- IV characteristics of solar cell
3. Performance evaluation of box type Solar Cooker
4. Recording the amount of sunlight receives throughout a day using Sunshine recorder.
5. Utilizing the latent heat absorbed by the condensing water steam using Solar Still.
6. Measure the solar radiation flux density using Pyrometer.

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics
Programme Code : USPH
Class : T.Y.B.Sc.
Semester : V
Course Type : Theory
Course Code : USPH 356 (B)
Course Title :Physics and Technology of sensors
No. of Credits : 03
No. of Teaching Hours : 45

Course Outcomes:

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

CO1: Understand the concept of sensors and its characteristics.

CO2: Understand the practical approach in design of technology based on different sensors.

CO3: Learn various sensor materials and technology used in designing sensors.

CO4: Getting information about various sensing parameter conditions for instrumentation.

CO5: Design experiments or demo using sensors for application.

CO6: Use of knowledge in electronics-based project work for demonstration.

CO7: Application of logic and electronics for new ideas and societal demands.

Topics and Learning Points

Unit 1. Sensors Classification and Characteristics [5 L]

Fundamentals and Characteristics Sensors, Signals and Systems, Sensor Classification, General specifications of sensors and transducers, Sensor Characteristics, Selection Criteria for sensors and transducers, Problems

Unit 2: Physical Principles of Sensing [12 L]

Resistive Sensors, Pressure Inductive sensor, Magnetic flow meter, Piezo electric sensors, Photo electric and Photo voltaic, Temperature and Thermal Properties of Material, Heat Transfer, Problems

Unit 3. Acceleration and Pressure Sensors [12 L]

Accelerometer characteristics, Capacitive accelerometers, Piezo-resistive accelerometers, Piezoelectric accelerometers, Thermal accelerometers heated plate accelerometer, heated gas accelerometer, Gyroscopes, rotor gyroscope, optical gyroscopes, piezoelectric cables, Strain Gauges, piezoelectric force sensors, Pressure gauges: mercury pressure sensor, bellows, membranes and thin plates, optoelectronic sensors.

Unit 4. Flow, Acoustic and Humidity Sensors [12 L]

Basics of flow dynamics, Pressure gradient technique, Thermal transport sensors, Ultrasonic sensors, Electromagnetic Sensors, Acoustic sensors: resistive microphones, condenser microphones, Fiber optic microphone Piezoelectric microphones, electric microphones, Solid state acoustic detectors, Humidity and moisture sensors, concept of humidity, Capacitive sensors, Electrical conductivity sensors – thermal conductivity sensor.

References:

1. D. Patranabis, Sensors and Transducers, 2nd ed., Prentice-Hall of India (2005).
2. Jacob Fraden, Handbook of Modern Sensors: Physics, Design, and Application, 3rd edition, Springer (2004).
3. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer
4. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi3. Mechatronics-Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).
5. Sensors and Transducers- Dr. A. D. Shaligram

List of Experiments:

1. Characteristics of Piezo-electric Transducer
2. Characteristics of Thermocouple
3. Operation of digital humidity sensor
4. Study of resistive soil moisture sensor
5. Study of digital response an IR motion sensor

Programme Code	**:** USPH
Class	**:** T.Y.B.Sc.
Semester	**:** V
Course Type	**:** Theory
Course Code	**:** USPH 356 (C)
Course Title	**:**Biophysics
No. of Credits	**:** 03
No. of Teaching Hours	**:** 45

Course Outcomes:

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

CO1: Understand Basic Structure of Cell

CO2: Identify Biophysical Techniques

CO3: Properties and their significance

CO4: Working of Nervous System

CO5: Apply the knowledge of Physics in Living things.

CO6: Understand the principles of electrical signalling in biological systems, including nerve impulses and action potentials.

CO7: Understand the role of biophysics in the study of sensory receptors and signal transduction.

Topics and Learning Points

Unit 1: Introduction of Biophysics **[16L]**

History of Biophysics, Concept of Biophysics and Physical properties applied to biology- Surface tension,Viscosity, adsorption, diffusion, osmosis, Cell: Animal and plant cell, types of cell, Functional aspects of cell membrane, cytoplasm, nucleus,mitochondria and chloroplastProtein structure (Primary and Secondary), amino acid structure, Genetic code-symmetry, DNA structure, Photosynthesis process: - electron transport, Gibbs's free energy, Redox couple, Redox potential,Oxidation and reduction, Examples of redox potential in biological system.

Unit 2: Bio-potentials[8L]

Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equationBio-electrodes- Half-cell potential, polarizable and non-polarizable electrodes,Microelectrode- metal andglass electrodes.

Unit 3: Bio-instruments **[7L]**

Basic principle, Construction and working of colorimeter, spectrophotometer, PH meter and Centrifugemeasurement, Electron Microscope: SEM, TEM.

Unit 4: Radiation Biophysics[14 L] Definition, Units of Radioactivity and radiation doses, Types of radiation (Ionizing and
non- ionizing),Applications: PET (Positron Emission Tomography), NMR (Nuclear Magnetic Resonance), MRI(Magnetic Resonance Imaging Techniques), Ultrasonography, CT (Computed Tomography) Scan.

References:

1. Introduction to Biophysics - by P. Narayanan.New Age P.
2. Medical Instrumentation - by Khandpur, TMH
3. Laboratory Manuals of Biophysics Instruments - by P.B. Vidyasagar
4. Biophysics -by Vatsala Piramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R.N. Roy
6. Photosynthesis - by Hall and Rao.
7. Introduction to Biomedical Equipment Technology (Fourth Edition) by-Joseph J.Carr
8. Text Book of Bio-medical Electronics-by S.S. Agrawal

List of Experiments:

1. Recording and analysis of ECG signals
2. Verification of Beer's and Lambert's Law
3. Absorption spectrum of Blood/Chlorophyll.
4. pH value of Amino acids.
5. Bimolecular model building using standard kits.
6. Separation of components of Milk/Chlorophyll using centrifuge machine.

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : T.Y.B.Sc.

Semester : V

Course Type :Practical

Course Code : USPH 357

Course Title : Practical-I

No. of Credits : 02

No. of Teaching Hours :60

Course Outcomes:

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

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

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

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

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

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

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

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

Student has to perform any EIGHT experiments from the list given below plus any TWO experiments from the optional subject. (TOTAL 10 experiments)

1. Moment of Inertia by Bifilar suspension
2. Young's modulus by Koeing method
3. Katter's pendulum
4. Y by vibration of wooden scale
5. Determination of Resolving Power of grating
6. Determination of wavelength of light by Michelson's interferometer
7. Young's modulus by Newton's rings
8. Determination of wavelength by Constant deviation spectrometer
9. Determination of refractive index of liquid using hollow prism.
10. Llyod's mirror
11. Study of diffraction using a reflection grating (metal ruler)
12. Determination of wavelength of given source by Newton's rings

CBCS Syllabus for T.Y.B.Sc. Physics(2022 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : T.Y.B.Sc.

Semester : V

Course Type :Practical

Course Code : USPH 358

Course Title : Practical-II

No. of Credits : 02

No. of Teaching Hours :60

Course Outcomes:

CO1: Use various instruments and equipment.
CO2: Design experiments to test a hypothesis and/or determine the value of an unknown quantity.
CO3: Investigate the theoretical background to an experiment.
CO4: Set up experimental equipment to implement an experimental approach.
CO5: Analyze data, plot appropriate graphs and reach conclusions from your data analysis.
CO6: Work in a group to plan, implement and report on a project/experiment.
CO7: Experimental Models for easy understanding and explanation Physics concepts.

Total-10 Experiments

Students must perform any **EIGHT** experiments from the list given below plus any **TWO** experiments from the optional subject **(TOTAL 10 experiments).**

1. Characteristics of JFET
2. Design and built astable multivibrator using IC 555/IC 741
3. Integrator and differentiator using IC 741
4. Instrumental amplifier using three op-amps
5. Digital to Analog Converters
6. Schmidt trigger
7. Plotting of graph using MS-Excel
8. Plotting of graph using origin software
9. Study of Multiplexer and Demultiplexer
10. Active Filters (High pass & Low Pass)
11. Temperature controller using AD590
12. Study of IC 7490 as mod 2, mod 5, mod 7 and mod 10 counter

Practical From Optional Course (Any-2)

1. Demonstrations: Any 2 demonstrations equivalent to 2 experiments
2. Study tour with report equivalent to 2 experiments

3. Mini project equivalent to 2 experiments

Computer aided demonstrations (Simulations or animations)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : T.Y.B.Sc.

Semester : V

Course Type :Practical

Course Code : USPH 359

Course Title : Practical-III

No. of Credits : 02

No. of Teaching Hours :60

Course Outcomes:

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.
CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.
CO6: Use of experiment to analyse various experimental parameters concerning their application .
CO7: Experimental Models for easy understanding and explanation Physics concepts.

Student has to perform any EIGHT experiments from the list given below plus any TWO experiments from the optional subject. (TOTAL 10 experiments)

1. Charging and discharging of a capacitor
2. Specific heat of graphite
3. Study of Solar constant
4. Transistor characteristics (CE configuration)
5. Thermal conductivity of rubber tube
6. Integrator and differentiator using IC 741
7. Study of Thermocouple
8. Phase shift Oscillator using IC 741
9. Thickness of sharp blade by laser diffraction.
10. Directional characteristics of Microphone

11. AC Wheatstone Bridge
12. Maxwell's Bridge
13. Rigidity Modulus of Brass by electromagnetic vibration
14. 'Y' by flexural vibration of steel bar

Practical From Optional Course (Any-2)

1. Demonstrations: Any 2 demonstrations equivalent to 2 experiments
2. Study tour with report equivalent to 2 experiments
3. Mini project equivalent to 2 experiments

Computer aided demonstrations (Simulations or animations)