Faculty of Science

Department of Physics

Syllabus

For

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

in Physics

For Academic Year 2021-2022

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

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T.Y.B. Sc. Sem-V [Physics] 2021-2022

Semester	Paper Code	Title of Paper	No of Credits
V	PHY 3501	Mathematical Methods of Physics-II	3
	PHY 3502	Classical Mechanics	3
	PHY 3503	Advanced Optics	3
	PHY 3504	Solid State Physics	3
	PHY 3505	Atomic and Molecular Physics	3
	PHY 3506	Elective-I (Select anyone)	3
		A] Elements of Material Science	
		B] Renewable Energy Sources	
		C] Physics and Technology of sensors	
	PHY 3507	Practical I	2
	PHY 3508	Practical II	2
	PHY 3509	Project I	2
Total			24
VI	PHY 3601	Classical Electrodynamics	3
	PHY 3602	Quantum Mechanics	3
	PHY 3603	Statistical Physics	3
	PHY 3604	Nuclear Physics	3
	PHY 3605	Electronics II/ Advanced Electronics	3
	PHY 3606	Elective-II (Select anyone)	3
		A] Physics of Nanomaterials	
		B] Solar Energy Conversion Devices	
		C] Sensors and its Applications	
	PHY 3607	Practical III	2
	PHY 3608	Practical IV	2
	PHY 3609	Project II	2
Total			24

T. Y. B. Sc. Physics

PHY 3501: Mathematical Methods in Physics-II

Class: **T.Y. B. Sc. (Semester-V)** Paper: **I**

Credit: **3** No. of lectures: **48**

Learning 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

Learning 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 curvilinear system

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 (12 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 (12 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 (8 L)

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 (4 L)

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
3. Mathematical methods in the Physical sciences – Marry L. Boas, John Willy and Sons Publication.
4. Introduction to special relativity, Robert Resnick, Willyeastrn Ltd.
5. Mathematical Physics, B. D. Gupta
6. Mathematical Physics, H. K. Dass

T.Y.B.Sc. Physics

PHY 3502: Classical Mechanics

Class: T.Y. B. Sc. Sem: V **Paper II**

Credit: 3 **No of lectures: 48**

Learning Objectives:

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

Learning Outcomes:

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

1. The students will introduce about the newton's laws of motion, linear momentum, angular momentum, and knowledge about the applications of newton's laws of motion.
2. 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.
3. This paper enables the students to understand the Langrangian approach in classical mechanics.
4. The students should be able to understand theory of scattering, types of scattering and differential cross section.

1. Mechanics of System of Particles (12 L)

1.1 Introduction –newton's laws, Limitations of Newton's Laws

1.2 Applications of Newton's laws of motion: Projectile motion in various medium, Rocket motion, Motion of a charged particle in constant electric, magnetic and electromagnetic field.

1.3 System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles (statements only)

1.4 Problems

2. Motion in Central Force Field (12 L)

2.1 Types of forces: Forces of Gravitation, Lorentz force, Hooks Force, Frictional Force, Fundamental Forces of Nature Central force, equivalent one body problem

2.2 Motion in central force field

2.3 General features of motion, equation of orbit

2.4 Deduction of Kepler's laws of planetary motion

2.5 Orbits of artificial satellite

2.6 Problems

3. Scattering Theory of Particles (12 L)

3.1 Introduction, Elastic, and Inelastic Scattering

3.2 Laboratory and Centre of mass system

3.3 Relation between scattering angles in Lab and CM system

3.4 Inelastic scattering

3.5 Differential cross section, impact parameter and total cross section

3.6 Problems

4. Langrangian Formulation (12 L)

4.1 Limitations of Newtonian mechanics

4.2 Types of constraints, degrees of freedom, generalized coordinates, configuration space.

4.3 D'Alemberts principle, Virtual displacement, Principal of virtual work

4.4 Langrage's equation of motion from D'Alemberts principle

4.5 Equation of motion of Simple pendulum, spring mass arrangement, Attwood's machine, particle under gravity by using Langrangian formulation.

4.6 Problems.

Reference Books:

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

T.Y.B.Sc. Physics

PHY 3503: Advanced Optics

Class: T.Y. B. Sc. Sem: V **Paper III**

Credit: 3 No. of lectures: **48**

Learning Objectives:

1. Understand the diffraction and polarization processes and applications of them in physical situations.
2. Understand the applications of interference in design and working of interferometers.
3. Understand the resolving power of different optical instruments.

Learning Outcomes:

1. Describe how light can constructively and destructively interfere.
2. Explain why a light beam spreads out after passing through an aperture.
3. Analyze simple examples of interference and diffraction phenomena.
4. Be familiar with a range of equipment used in modern optics.

1. Interference (13 Lecture)

1.1 Revision to Interference

1.2 Phase change on reflection (Stokes Treatment)

1.3 Interference by parallel sided thin films

1.4 Interference due to reflected light

1.5 Interference due to refracted light

1.6 Interference due to Wedge Shaped thin film

1.7 Principle construction and working of Michelson Interferometer & its applications.

1.8 Problems.

2. Diffraction (13 Lecture)

2.1 Types of Diffraction: Fresnel's diffraction and Fraunhoffer's diffraction

2.2 Fraunhoffer's diffractions at a double slit

2.3 Plane diffraction grating

2.4 Newton's Rings

2.5 Rayleigh's criterion for resolution

2.6 Resolving power of telescopes and microscopes.

2.7 Dispersive and resolving power of grating.

2.8 Problems.

3. Polarization (13 Lecture)

3.1 Introduction

3.2 Brewster's law

3.3 Law of Malus

3.4 Polarization by double refraction.

3.5 Nicol prism.

3.6 Elliptically and circularly polarized light

3.7 Quarter wave plate

3.8 Polarimeter

3.9 Problems

4. Optical Fibber (09 Lecture)

4.1 Introduction

4.2 Structure and types of fibres

4.3 Numerical Aperture (Definition only)

4.4 Pulse dispersion in step index fiber

4.5 Optical communication system (Qualitative treatment only)

4.6 Advantages and disadvantages of optical fiber

4.7 Fiber materials, photonic crystal, fiber optic cables

4.8 Problems

References Books:

1. Textbook of Optics: N. Subrahmanyam and Brij Lal: S. Chand Publication.
2. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
3. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
4. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand publication
5. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986.Addison-Wesley
6. Fiber optic communication-Joseph C. Palais 4 th edition, Pearson Education

T. Y. B. Sc. Physics

PHY3504: Solid State Physics

Class: T.Y. B. Sc. Sem V **Paper IV**

Credit: 3 **No of lectures: 48**

Learning objectives:

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

Learning Outcomes:

This syllabus will also help students to lay a foundation for Materials science, electronics, and more advanced subjects like condensed matter in future.

1. Free Electron Theory of Solids (15 L)

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 Hall Effect, Origin of energy gap

1.7 Energy bands in Solids,

1.8 Effective mass of electron (with derivation),

1.9 Distinction between metal,

1.10 Semiconductor and insulator

1.11 Problems

2. Crystalline Solids (16 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 Ewald's construction,

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

2.15 Problems

3. 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

4. Magnetism (11 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.

T. Y. B. Sc. Physics

PHY 3505: Atomic and Molecular Physics

Class: **T.Y. B. Sc. (Semester- V)** Paper**: V**

Credit: **3** No. of lectures: **48**

Learning Objective:

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.

Learning Outcomes:

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

1. The application of quantum mechanics in atomic physics
2. The importance of electron spin, symmetric and antisymmetric wave functions, and vector atom model
3. Effect of magnetic field on atoms and its application
4. Learn Molecular physics and its applications.
5. This course will be useful to get an insight into spectroscopy.

1. Atomic structure (8 L)

1.1 Rutherford model of atom

1.2 Electron orbits

1.3 Bohr atom and Sommer field atomic Model

1.4 Energy levels and spectra (1 to 4 Revision)

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

1.6 Atomic excitation and atomic spectra,

1.7 Problems Ref 1 ch4

2. One Valence Electron System (8 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 (8 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 (8 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 (8 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

6. **Raman spectroscopy (8 L)**

6.1 Classical theory of Raman Effect. Molecular polarizability

6.2 Quantum theory of Raman Effect

6.3 Experimental set up for Raman Effect

6.4 Applications of Raman spectroscopy Ref 3 ch4

Reference Books:

1. Concepts of Modern Physics 4 th 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

T. Y. B. Sc. Physics

PHY 3506: A] Elements of Material Science

Class: T.Y. B. Sc. Sem V (Elective) **Paper VI**

Credit: 3 **No of lectures: 48**

Learning 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.

Learning Outcomes:

1. Students are able to apply knowledge of advanced science and engineering principles to materials systems.
2. Students will demonstrate proficiency in the acquisition of data using a variety of laboratory instruments and in the analysis and interpretation of such data.
3. An ability to apply knowledge of mathematics, science, and engineering to materials issues.
4. An ability to design and conduct experiments and critically analyse 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 (12L)

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

List of experiments:

1. Determination of the yield point and the breaking point of an elastic material
2. To determine magnetic susceptibility of $FeCl_3$
3. To determine the dipole moment of a given liquid
4. To determine the specific heat of graphite
5. Ionic conductivity of NaCl
6. Synthesis of metal oxide ceramic powder by solid state route
7. Plotting Pb-Sn phase diagram

T. Y. B. Sc. Physics

PHY 3506: B] Renewable Energy Sources

Class: **T.Y. B. Sc. Semester-V** (Elective) **Paper: VI**

Credit: **3** No. of lectures: **48**

Learning 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.

Learning Outcomes:

1. Know the need of renewable energy resources and latest developments.
2. Use of solar energy in the energy production with different applications like - heating, cooling, desalination, power generation, drying, cooking etc
3. Appreciate the need of Wind Energy and the various components used in energy generation.
4. Understand the concept of Biomass energy resources and their classification.

1. **Solar Energy** **(12 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 IV 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 **Battery:** 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 (06 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.

Case Study: 1. Solar PV Panel

2. Biogas production from kitchen waste

References:

1 Biomass Renegerable Energy – D.O.hall and R.P. Overeed (John Wiley and Sons, New york, 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.

T.Y.B.Sc. Physics

PHY 3506: C] Physics and Technology of Sensor

Class: T.Y. B. Sc. Sem: V (Elective) Paper VI

Credit: 3 No of lectures: 48

Learning objectives:

1. Select the right sensor for a given application.
2. Understand physics behind sensor fabrication.
3. Simulate, synthesize, and layout a complete sensor or sensor system, a device or microsystem.

Learning Outcome:

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

1. Understand the concept of sensors and its characteristics.
2. Understand the practical approach in design of technology based on different sensors.
3. Learn various sensor materials and technology used in designing sensors.

1. Sensors Classification and Characteristics (8 L)

1.1 Fundamentals and Characteristics Sensors

1.2 Signals and Systems

1.3 Sensor Classification

1.4 General specifications of sensors and transducers

1.5 Sensor Characteristics

1.6 Selection Criteria for sensors and transducers

1.7 Problems

2. Physical Principles of Sensing (12 L)

2.1 Resistive Sensors

2.2 Pressure Inductive sensor

2.3 Magnetic flow meter

2.4 Piezo electric sensors

2.5 Photo electric and Photo voltaic

2.6 Temperature and Thermal Properties of Material

2.7 Heat Transfer

2.8 Problems

3. Acceleration and Pressure Sensors (12 L)

3.1 Accelerometer characteristics

3.2 Capacitive accelerometers

3.3 Piezo-resistive accelerometers

3.4 Piezoelectric accelerometers

3.5 Thermal accelerometers heated plate accelerometer, heated gas accelerometer.

3.6 Gyroscopes, rotor gyroscope, optical gyroscopes, piezoelectric cables.

3.7 Strain Gauges, piezoelectric force sensors

3.8 Pressure gauges: mercury pressure sensor, bellows, membranes and thin plates, optoelectronic sensors.

4. Flow, Acoustic and Humidity Sensors (12 L)

4.1 Basics of flow dynamics

4.2 Pressure gradient technique

4.3 Thermal transport sensors

4.4 Ultrasonic sensors

4.5 Electromagnetic Sensors

4.6 Acoustic sensors: resistive microphones, condenser microphones

4.7 Fiber optic microphone Piezoelectric microphones, electric microphones

4.8 Solid state acoustic detectors

4.9 Humidity and moisture sensors, concept of humidity

4.10 Capacitive sensors,

4.11 Electrical conductivity sensors – thermal conductivity sensor.

5. Sensor Materials and Technologies (4 L)

5.1 Sensor Materials

5.2 Surface Processing

5.3 Technology of Sensors

Reference Books:

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

T.Y.B.Sc. Physics

PHY 3507: Practical -I

Class: T.Y. B. Sc. Sem: V **Paper VII**

Credit: 2 **No of Practical: 10**

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.

T.Y.B.Sc. Physics

PHY 3508: Practical -II

Class: T.Y. B. Sc. Sem: V **Paper VIII**

Credit: 2 **No of Practical: 10**

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

1. Energy gap of a semiconductor
2. Resistivity by Four probe method
3. Platinum resistance thermometer
4. Core losses in transformers
5. Hall Effect
6. Electromagnetic pendulum
7. Study of damped oscillations of physical pendulum and finding log decrement.
8. Verification of Stefan's law by torch bulb filament
9. Thermal conductivity by Forbes Method.
10. Thermal conductivity of rubber tubing
11. Determination of Rydberg's constant
12. Dielectric constant of a Non-polar liquid

T.Y.B.Sc. Physics

PHY 3509: Project -I

Class: T.Y. B. Sc. Sem: V Paper IX

Credit: 2

The student will have to perform the project course for both semesters V and VI. The continuous evaluation of the project will be done during each semester. Student must complete 50% project work in semester V and evaluation will be done at the end of semester and credit will be assigned to the students according to their performance.