# SavitribaiPhule Pune University

# Proposed structure of T. Y. B. Sc. (Physics) revised syllabus

# To be implemented from 2014-2015

| Sem III | Sem IV |
|---|---|
| PH-331: Mathematical Methods in Physics II | PH-341 Classical Electrodynamics |
| PH 332: Solid State Physics | PH-342: Quantum Mechanics |
| PH-333: Classical Mechanics | PH-343: Thermodynamics and Statistical Physics |
| PH-334: Atomic and Molecular Physics | PH-344: Nuclear Physics |
| PH-335: Computational Physics | PH-345: Electronics/Advanced Electronics |
| PH-336 Elective I : (Select any One) | PH-346 Elective II : (Select any One) |
| A: Astronomy and Astrophysics | G: Medical Electronics |
| B: Elements of Materials Science | H: Physics of Nanomaterials |
| C: Motion Picture Physics | I: Microcontrollers |
| D: Biophysics | J: Electro Acoustics and Entertainment Electronics |
| E: Renewable Energy Sources | K: Lasers |
| F: Applied Optics | L: Radiation Physics |
| PH-347: Laboratory Course I<br>PH-348: Laboratory Course II<br>PH-349: Laboratory Course III (Project) | |

# Semester III

T. Y. B. Sc. Physics

# PH331 : Mathematical Methods in Physics- II

**1. Curvilinear co-ordinates (14L)**

Introduction to Cartesian, Spherical polar and Cylindrical co-ordinate systems, transformation equations,General Curvilinear co-ordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.

Orthogonal Curvilinear co-ordinate system, Expressions for gradient, divergence, Laplacian and Curl, special case for gradient, divergence, Laplacian, and curl in Cartesian, spherical polar and cylindrical co-ordinate system.

(Chapter 2Ref.1 / Chapter 1Ref. 5 )

**2. The Special Theory of Relativity (14 L)**

Introduction, Newtonian relativity Galilean transformation equation, Michelson-Morley experiment, Postulates of special relativity,Lorentz transformations, Kinematic effects of Lorentz transformation, Length contraction, Proper time, Transformation of velocities, Variation of mass with velocity, Mass-energy relation.Four vectors.

(Chapter 13 Ref. 2)

**3. Differential equations (10 L)**

Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Singular points, Fuch's theorem (Statement only), Frobenius method for power series solution of Legendre, Hermite and Bessel differential equation. Problems

(Chapter 8 Ref. 1)

**4. Special functions (10 L)**

Generating function for Legendre,Hermite Polynomials, Recurrence relations, their differential equations and orthogonality properties. Bessel function of first kind and their properties. Problems

**Reference books:**


1. Mathematical methods for physicists, Arfken and Weber, Acadmic press Newyork.
2. Mathematical physics, Rajput, Pragatiprakashan
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**
**PH332: Solid State Physics**

**1. The Crystalline State (11 L)**

Lattice, Basis, Translational vectors, Primitive unit cell, Symmetry operations, Different types of lattices2D and 3D (Bravais lattices) ,Miller indices, Inter planer distances, SC, BCC and FCC structures, Packing fraction, Crystal structures NaCl, diamond, CsCl, ZnS, HCP, Concept of reciprocal lattice and its properties with proof.

Problems

**2. X ray Diffraction and Other Characterization Techniques (13 L)**

Introduction, Crystal as a grating, Bragg's law and Bragg's Diffraction condition indirect and reciprocal lattice Ewald's construction, Experimental methods of X-ray diffraction: Laue method, Rotating Crystal method, Powder(Debye Scherer) method, Analysis of cubic structure by powder method, Characterization Techniques: Thermal gravimetric analysis(TGA), UV-visible spectroscopy, Electron microscopy(SEM), Problems

**3. Free Electron and Band Theory of Metals (13 L)**

Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch theorem (statement only), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Origin of energy gap, Energy bands in Solids, Effective mass of electron (with derivation), Distinction between metal, semiconductor and insulator

Problems

**4. Magnetism (11 L)**

Diamagnetism, Langevin theory of Diamagnetism, Application of diamagnetic material: (Superconductor)Occurrence of Superconductivity, Critical magnetic field and Meissner effect, Paramagnetism, Langevin theory of Para magnetism, ferromagnetism, ferromagnetic domains, Hysteresis, Curie temperature. Ferromagnetism, Ferrites and its applications, antiferomagnetism, Neel temperature, 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.

**T. Y. B. Sc. Physics**
**PH 333 Classical Mechanics**

**1. Mechanics of system of particles (10 L)**

1 Introduction –newton's laws
2 Applications of Newton's laws of motionProjectile motion in various medium, Rocket motion, Motion of a charged particle in constant electric, magnetic and electromagnetic field.
3 System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles (statements only) Problems Ref 1 Ch. 3, Ref 2 Ch 1

**2. Motion in Central Force Field (10 L)**

1 Central force, equivalent one body problem
2 Motion in central force field
3 General features of motion, equation of orbit
4 Deduction of Kepler's laws of planetary motion
5 Orbits of artificial satellite Problems Ref1Ch. 5,Ref2Ch4

**3. Scattering of particles (10 L)**

Elastic and inelastic scattering, Elastic scattering - Laboratory and centre of mass system. Scattering, Relation between scattering angles in laboratory and centre of mass system. Differential cross-section, impact Parameter, total cross-section.

**4. Langrangian and Hamiltonian formulation (10 L)**

1 Limitations of Newtonian formulation
2 Types of constraints, degrees of freedom, generalized coordinates, configuration space
3 D' Alembert's principle of virtual work
4 Langrangian equation from D' Alembert's principle, cyclic coordinates
5 Phase space, Hamiltonian's equations

Problems Ref 1 Ch. 8, Ref 3

**5. Canonical Transformation and Poisson's Bracket (08 L)**

-Generating function,condition for Canonical transformation and problems , Defination , Identities , Poisson's Bracket , Jacobi identity

**Reference Books**


1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata McGraw Hill publishing Company Ltd.
2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata McGraw Hill Publishing company Ltd.
3. Principles of mechanics, J. L. Synge, B. A. Griffith, TataMcGraw Hill Publishing company Ltd.
4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House
5. Classical Mechanics by J.C. Upadhyaya, Himalaya publishing Houses.
6. Problem solution of classical mechanics by P.V.Panat

# T. Y. B. Sc. Physics

## PH334 Atomic and Molecular Physics

**1. Atomic structure** **(6 L)**

1 Rutherford model of atom
2 Electron orbits
3 Bohr atom
4 Energy levels and spectra (1 to 4 Revision)
Vector atom model (Concepts of space and quantization and electronspin)
5 Atomic excitation and atomic spectra, Problems Ref 1 ch4

**2. One and two valence electron systems** **(7 L)**

1 Pauli Exclusionprinciple and electron configuration, quantum states, Spectral notations of quantum states.
2 Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na atom, selection rules, spectra of sodium atom, sodium Doublet.

**3. Two valence electron systems** **(7 L)**

3 Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ coupling schemes.
4 SingletTriplet separation for interaction energy of LS coupling. Lande'sInterval rule, spectra of Helium atom, Problems Ref 1 ch7 Ref. 2 ch8 and ch12

**4. Zeeman Effect** **(4 L)**

1 Early discoveries and developments
2 Experimental arrangement
3 Normal and anomalous Zeeman Effect Problems
4 Stark effect (Qualitative discussion) Ref 2 ch10

**5. X ray spectroscopy** **(6 L)**

1 Nature of Xrays
2 Discrete and continuous Xray spectra, Daune and Hunt's Rule
3 Xray emission spectra
4 Mosley's law and its applications
5 Auger effect , Problems Ref 2 ch16

**6. Molecular spectroscopy** **(10 L)**

1 Rotational energy levels
2 Vibrational energy levels
3 Rotational and Vibrational spectra
4 Electronic spectra of molecules Problems Ref 1 ch8

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

1 Classical theory of Raman Effect. Molecular polarizability
2 Quantum theory of Raman Effect
3 Experimental set up for Raman Effect
4 Applications of Raman spectroscopy Ref 3 ch4

**Reference Books**


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

**T. Y. B. Sc. Physics**
**PH335: Computational Physics**

**1. Concepts of programming: (6 L)**

Definition and Properties of algorithms,
Algorithm development,
Flow charts- symbols and simple flowcharts.
Flow charts and Algorithms for Kinematic equations, Free fall, Equation of state, Factorial of a number.
Types of programming language: Lower, middle and higher level languages.

**2. C Programming (14 L)**

Structure of C program, Character set, key words, Constants andvariables, Variable names, Data types and their declarations, Symbolic Constants.
Input/output functions: scanf ( ), printf ( ), getchar ( ), putchar ( ), getch ( ), gets ( ), puts ( ).
Operators and Expressions: Arithmetic Operators, Relational Operators, LogicalOperators, Assignment Operators, Conditional Operator.
Formatted input/output
Control statements: If, if else, while, do while for loop, nested control structures (nested if, nested loops), break, continue, switch- case statement, goto statement.
Use of Library functions: e.g. mathematical, trigonometric, graphics.

**3. Arrays and Pointers in C (4 L)**

Arrays: 1-D, 2-D and String
Examples: Arranging numbers in descending and ascending order, Sum of matrices, multiplication of matrices.
Concept of Pointers

**4. User Defined Function in C (8 L)**

User defined functions: Definitions and declaration of function, functionprototype, passing arguments (Call by value, Call by reference).
Storage Classes: Auto, External, Static, Register variables.

**5. Graphics in C**: **(4L)**

Some simple graphic commands- Line, Circle, Arc, Ellipse, Bar.

**3. Computational Physics: [12 L]**

1. Errors in Computation: Inherent errors in storing numbers due to finite bit representation to use in
Computer, Truncation error, round off errors (Explain with the help of examples)
2. Iterative methods: Discussion of algorithm and flowcharts and writing Cprograms for finding single root of equation using bi-section method, NewtonRaphsonmethod.
4. Discussion of algorithm and flowcharts and writing C program for trapezoidalrule and Simpson's 1/3rd rule (derivation of formula is not expected).

**Reference Books:**


1. Programming in C- (Schaum's series) Gottfreid TMH
2. Programming in C- Balgurusami Prentice Hall publications
3. Let us C- YashwantKanetkar BPB publications
4. Programming with C- K.R. Venugopal, S. R. Prasad, TMH.
5. Introductory methods of numerical analysis-S. Sastry Prentice Hall
6. Computer oriented numerical methods – V. Rajaraman.

Following programs may be discussed thoroughly in theory lectures:

1. Sum of digits of an integer
2. To find factorial of a number
3. Verifying Boyle's law and Charles' law using equation of state.
4. Checking and printing of prime numbers
5. Solving kinematic equations and free fall equation: obtaining position vs. time data.
6. Obtaining rms velocity of gas using temperature and mass of the gas.
7. To find sin(x), cos(x) using series method
8. Sorting of (1) Numerical data (2) Character type data- ascending, descending.
9. Use of pointers – sorting (any one method of sorting)
10. Matrix operations – addition, subtraction, multiplication
11. Graphics- line, circle, arc, bar, ellipse.
12. Root of equation-Bisection method, Newton Raphson method
13. Numerical integration- Trapezoidal, Simpson's 1/3rd rule.

**T. Y. B. Sc. Physics**

**PH-336 Elective I (**A): Astronomy and Astrophysics

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**1. Fundamentals of Astronomy: (8 L)**

Introduction: Components of the Universe; Stars, Planets, Asteroids, Meteors, Comets, Galaxies. Solar System: Age, Origin Basic measurements: Planetary orbits, distances, physical size, mass, density, temperature, rotation period determination, Kepler's laws, EM Spectrum: radiation from heated objects', Wien's law, radiation curves, Doppler effect.

**2. Astronomical Instruments: (10 L)**

Optical telescopes, mounts, light gathering power, magnification, resolution. Spectroscopes, CCD camera, photometer, filters Radio telescopes, interferometry UV, IR, X-ray and Gamma ray telescopes. Orbiting space based telescopes: HST, Chandra.

**Star and Star Systems (10 L)**

Stars life cycle, Stellar processes (Nuclear). Neutron stars, black holes, Chandrasekhar limit. Spectral classification of stars, O,B,A,F,G,K,M. Star Systems: Binaries / Cepheids / RR Lyrae HR diagram: Significance Sun: Solar Cycle, Activity, Butterfly diagram, Photosphoric phenomenon Stars as distance estimators

**Galaxies, Dark Matter and Dark Energy (6 L)**

Galaxies, types, their formation, Quasars Hubble's tuning fork diagram Open and Globular clusters Dark Matter / Energy (evidence for both) Cosmology: (6 L) Theories: BBT, Steady State, Oscillating Universe Theory Hubble's law with equation, its significance Concept of space time, fate of our universe Multiverse (only introduction)

**Observational Astronomy: (8 L)**

Co-ordinate system, Celestial hemisphere, Concept of time, Magnitudes: apparent and absolute, constellations. Star dial, Observation of Sun, Eclipses, Moon, planets, meteor showers, transits, occultation's.

**List of Reference Books:**


1. Astronomy structure of the Universe. A.E. Roy and D. Clarke, Adam Hilger Pub.
2. Source Book of Space Sciences, Samuel Galsstone; D.VanNostrand Co. Inc
3. Astrophysics - Stars and Galaxiesl, K.D. Abhyankar, Tata McGraw Hill Pub.
4. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Pub.
5. Structure of the Universe, J.V. Narlikar
6. Astrophysics, BadyanathBasu.


**List of experiments:**

1. Study of Binocular, refracting and reflecting telescopes and their mounts.
2. To determine the diameter of the Moon.
3. Measurement of Solar Constant.
4. Observation of emission, continuous and absorption spectra. (Mercury, sodium or iodine spectra could be obtained.)
5. To determine the temperature of an artificial star.
6. To observe the Fraunhofer lines in sunlight and determine the elements present.
7. To obtain the Solar image on the screen and trace our the existing sunspots.
8. To locate and observe the various stars, constellation, planets.

**T. Y. B. Sc. Physics**

**PH-336 Elective I (B) Elements of Materials Science**

**1. Defects in Solids** **(7L+1P)**

1 Material Properties – Mechanical, Electrical and thermal
2 Impurities in solids.
3 Solid solutions in metals.
4 Rules of solid solubility.
5 Imperfection in crystals.
6 Defects in solids point, line, surface and volume.
7 Atomic diffusions definition, mechanism, Fick's laws.

**2. Single Phase Metals** **(6L+1P)**

1 Single phase alloys
2 Deformation
3 Elastic Deformation and Plastic Deformation
4 Mechanism of plastic Deformation by slip
5 Critical resolved shear stress (CRSS)
6 Plastic deformation in poly crystalline materials

**3. Molecular Phases** **(7L+1P)**

1 Introduction
2 Polymers, Polymerization
3 Molecular weight of polymers
4 Linear polymers addition and condensation
5 Cross linked polymer vulcanization of rubber

**4. Ceramic Materials** **(09L)**

1 Ceramic Phases, Classification of ceramic materials
2 Ceramic crystals (AX)
3 Mechanical behavior of ceramics
5. Electromagnetic behavior of ceramics – a) Electric propertiesdielectrics, semiconductors, piezoelectric b) Magnetic Properties MagneticCeramics, hard and soft ferrites

**5. Phase Diagrams** **(9L+2P)**

1. Basic terms System, Surrounding, Component, Coordinates, Phase, Equilibrium.
2. Phase Diagram definition, importance and objective
3. Lever rule
4. Gibb's phase rule
5. Phase diagram of a) Sugar water b) NaCl water
6. Types of phase diagrams with construction a) Type ILens typeCuNiphase diagram b) Type IIOnly introduction c) Type IIIEutectic typePbSnphase diagram
7. Isothermal cuts

**6. Introduction to smart materials** **(5L)**

Definition of smart materials, types and structure of smart materials, Properties of smart materials, Applications of smart materials.

**Reference books**


1. Elements of materials science and EngineeringI.H.Vanvlach ($4^{th}$Edition)
2. Materials science and Engineering - V. Raghvan


**List of experiments**

1. To determine the dipole moment of a given liquid
2. To determine magnetic susceptibility of $FeCl_3$
3. To determine the specific heat of graphite
4. Determination of the yield point and the breaking point of an elastic material

**T. Y. B. Sc. Physics**

**PH-336 Elective I (C) Motion Picture Physics**

**1. Introduction: (6 L)**

S. L. R. camera, T. L. R. camera, focal plane shutter, composition of films and paper (B/W) and colour reversal film, shutter speed and Aperture

**2. Camera lenses: (5 L)**

Aberrations in lens, angle f view, perspective and its types, camera formats, normal, wide angle, telephoto, zoom, filters

**3. Processing of photographic materials: (8 L)**

Different stages involved in processing B/W printing and colour printing, chemicals used in B/W processing. Colour processes- E-6, C-41, EP-2, RA-4. Factors affecting in developing process (B/W) Master print dupe negative, release print, rush print

**4. Printing Techniques: (4 L)**

B/W enlarger, its construction and working, contact printing and projection printing, printing methods (color).

**5. Lighting and special effects: (10 L)**

Light sources and their characteristics Laboratory special effects: Matte printing, Traveling mattes, slow motion, fast motion, freeze action, reverse action, blow up, and flip over.

**6. Motion picture techniques: (8 L)**

Essential parts of movie camera, camera lenses and types, lenses for wide screens, shutter, intermittent, motor drive, view drive, view finders and their types, magazine, camera accessories, camera movements, shots, sound recording on film, optical recording.

**7. Projection mechanism: (7 L)**

The projector and its essential parts, intermittent mechanism, drive mechanism, spool boxes, light sources, projection lens, projection screen and their formats.

**Reference Books :**

1. Basic photography – M.J.Lagford, Focal press (London).
2. Advanced photography - M.J.Lagford, Focal press (London).
3. Professional photography - M.J.Lagford, Focal press (London).
4. Basic Motion picture technology – L. Bernard Happe, Focal press (London). List of Experiments:

**Demonstrations**

1. Study of S.L.R camera
2. Study of different camera lenses
3. Study of B/W enlarger
4. Study of color enlarger

**A. Experiments to be performed** :

1. Observe the effect of shutter speed.
2. Contact printing from B/W negative.
3. Projection printing from B/W negative.
4. Shooting and outdoor Scene (B/W or Color).
5. Processing an exposed B/W negative film.
6. Printing from processed color negative film.
7. Shooting a still life (B/W or Color).
8. Shooting and arranging a group photograph.
9. Observe the effect of aperture on depth of film.
10. Portrait Lighting (B/W Film).

**T. Y. B. Sc. Physics**
**PH-336 Elective I (D) Biophysics**

**1. Introduction of Biophysics**

1.1 Definition and History of Biophysics [Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloids ] (3L)

1.2 Cell: Animal and plant cell, types of cell and composition, Functional aspects of cell membrane, cytoplasm, nucleus, mitochondria, chloroplast (Bioenergetics of mitochondria and chloroplast) (4L)

1.3 Protein structure (Primary, Secondary, Tertiary and Quaternary structure): Amino-acids structure ( Specify types), Bond length, Bond angles, peptides, and Bond-Rigid planer peptides. Cis and trans configuration, torsion angle, Ramchandran plot. Photosynthesis process:- electron transport, Gibbs's free energy, Redox couple. [Redox potential , Oxidation and reduction, Examples of redox potential in biological system. ] (6L)

1.4 Genetic code- symmetry, DNA structure (2L)

**2. Biopotentials**

2.1 Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation (2L)

2.2 Biopotntial amplifier: input impedance, frequency characteristics, gain, CMRR, Calibration, Noise, Temperature sensitive stability. (2L)

2.3 Compaind action potentials of the human body ECG, EEG, ERG, EOG (in brief) (4L)

2.4 Transducers: Definition, types- resistive, capacitive and inductive transducers, LVDT, photo diode (2L)

2.5 Bioelectrodes_- Half cell potential, polarizable and non-polarizable electrodes, metal and glass electrodes, types and electric characteristics (3L)

**3. Bioinstruments**

Basic principle, Construction and working of colorimeters, spectrophotometer, ECG machine, PH meter, Centrifuge measurement. (10L)

Electro microscope: SEM, TEM. (**2L**)

**4. Radiation Biophysics**

4.1 Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules NMR. (3L)

4.2 Nuclear detector (G M Counter), radioimmunoassays (in brief) (3L)

**5. New Fields**

5.1 Biostatistics and Biometry, Definition and concept in brief

5.2 Mathematical modelingand Computational biology (Concept only) ( 2 L)

**Reference Books:**

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 VatsalaPiramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R.N. Roy
6. Photosynthesis - by Hall and Rao.

**List of Experiment**

1. Recording and analysis of ECG signals
2. Verification of Beers and Lambert's Law
3. Absorption spectrum of Blood/Chlorophyll.
4. PH Value of Ammino acids.
5. Study of DNA melting
6. Bimolecular model building using standard kits.

**T. Y. B. Sc. Physics**

**PH-336 Elective I (E) Renewable Energy Sources**

**1. An Introduction to Energy Sources: (10L)**

Conventional and non-conventional sources of energy, Structure and characteristics of sun, Solar Constant, Electromagnetic energy spectrum, Solar radiations outside earth atmosphere, Solar radiation at the earth surface,problems.

Ref. 1: page no. 1 to 11and 15 to 37

Ref.3-3.1, 3.2, 3.3, 3.4, 3.5

**2. Photothermal Applications: (10L)**

Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis) , Concentrating collectors, Advantage and disadvantage, Solar distillation, Solar drying, Solar cooker(box type), Solar water heating systems.

Ref. 1: 3.3, 3.3(A), 3.5, 3.7, 3.8, 5.2, 5.8, 5.11.

Ref. 2: 2.2.6

**3. Photovoltaic systems: (10L)**

Introduction , Photovoltaic principle, Power output and conversion efficiency, Limitation to photovoltaic efficiency, Basic photovoltaic system for power Generation, Advantages and disadvantages, Types of solar cells, Application of solar photovoltaic systems.

Ref.3 -15.1, 15.3, 15.4, 15.5, 15.7, 15.8, 15.10.

**4. Energy from Biomass: (12L)**

Introduction , Bio -mass conversion technologies , Bio-gas generation Factors affecting bio-digestion (list of factors) , Working of biogas plant, Advantages and disadvantage of floating and fixed dome type plant, Bio-gas from plant wastes , Methods for obtaining energy from biomass , Thermal gasification of biomass , Working of downdraft gasifier , Advantages and disadvantages of biological conversion of solar energy

Ref 1: 7.1, 7.2, 7.2.1, 7.2.2, 7.4, 7.5, 7.6, 7.7, 7.8, 7.11, 7.23, 7.24.1, 7.25.

Ref 2: 10.3 (page no 374 to 380)

**5. Wind Energy (06L)**

Introduction , Classification and description of wind machines, Wind data

Ref -2 (10.2 pages from 353-366)

**Reference Books:**

1. Non conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation**,** G. D. RAI (5th edition), Khanna Publishers,Delhi.

**List of Experiments:**

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. Thermal efficiency of liquid – flat plate collector.
5. Study of box type solar cooker.
6. Determination of instantaneous thermal efficiency of parabolic collector.
7. Efficiency and fill factor of solar cells.

**T. Y. B. Sc. Physics**
**PH-336 Elective I (F) Applied Optics**

1. Fermat Principles and its applications: Laws of reflection and refraction from Fermat's principle
   Ray paths in inhomogeneous medium, The ray equation and its solution (6L)
2. The matrix method in Paraxial optics: The matrix method, Unit planes, Nodal planes, a system of two thin lenses. (6L)
3. Multiple beam interferometry : Multiple reflection from plane parallel film, The Fabry-Perot Etalon, The Fabry-Perot interferometer, Resolving power, Interference filters. (6L)
4. Diffraction : Two slit Fraunhofer diffraction pattern, N-Slit Frauhofer diffraction pattern, Fresnel half period zones, the zone plate, Fresnel diffraction, Gaussian beam propagation. (6L)
5. Polarization :Malus law, Double refraction, Quarter wave plate, half wave plate, Optical activity, Wollstom prism, Rochon Prism. (6L)
6. Holography : Importance of coherence, Principle of holography and characteristics, Recording and reconstruction, classification of hologram and application, non-destructive testing. (6L)
7. Fibre optics: Total internal reflection, the optical fibre, the coherent bundle, Numerical aperture, Attenuation in optical fibres, single mode and multimode fibres, Pulse dispersion in optical fibres. (6L)
8. Detection of optical radiation: Human eye, bolometer, pyro-electric, photoconductive detector, photo voltaic detector and photoemissive detector, p-i-n photodiode, APD photodiode. (6L)

References :

(1) GhatakAjoy, Optics 3rd Edition, The McGraw Hill companies.
(2) M. Born and E. Wolf, Principles of Optics, Cambridge University Press
(3) F. A. Jenkins, H. E. White, Fundamentals of Optics, Mc Graw Hill

List of Experiments:

(1) Michelson Interferometer
(2) Fibre optics communication
(3) Farbry Perot Etalon
(4) Polarization of light by reflection

# Semester IV

## T. Y. B. Sc. Physics

## PH-341: Classical Electrodynamics

**1. Electrostatics: (16 L)**

1.1. Coulomb's law, Gauss law, Electric field, Electrostatic Potential

1.2. Potential energy of system of charges.

1.3. Statement of Poisson's equation, Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system,

1.4. Method of image charges: Point charge near an infinite grounded conducting plane, Point charge near grounded conducting sphere.

1.5. Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric constant, bound volume and surface charge densities.

1.6. Electric field at an exterior and interior point of dielectric.

**2.Magnetostatics: (16 L)**

2.1. Concepts of magnetic induction, magnetic flux and magnetic field

2.2. Magnetic induction due to straight current carrying conductor, Energy density in magnetic field, magnetization of matter. Relationship between **B,H**and **M.**

2.3 Biot-Savart's law, Ampere's law for force between two current carrying loops, Ampere's circuital law,

2.4Equation of continuity, Magnetic vector potential **A**.

2.5. Magnetic susceptibility and permeability, Hysteresis loss, B-H curve.

**3. Electrodynamics: (16 L)**

3.1. Concept of electromagnetic induction,Faradays law of induction, Lenz's law, displacement current, generalization of Amperes' law

3.2. Maxwell's equations (Differential and Integral form) and their physical significance

3.3. Polarization, reflection & refraction of electromagnetic waves through media

3.4. Wave equation and plane waves in free space.

3.5.Poynting theorem&Poynting vector, Polarizations of plane wave.

3.6. Microscopic form of ohm's law ($\mathbf{J}=\sigma.\mathbf{E}$)

**Reference Books:**


1) Introduction to Electrodynamics - By D. J. Griffith

2) Classical Electrodynamics – By J. D. Jackson.

3) Introduction to Electrodynamics - By A. Z. Capri, Panat P. V.

4) Electricity and magnetism – By Reitz and Milford

5. Electrodynamics - By Gupta, Kumar, Singh (PragatiPrakashan)

6. Electromagnetic field and waves - By Paul-Lorrain and Dale R Corson

7. Electricity and magnetism – By Murugeshan (S. Chand)

**T. Y. B. Sc. Physics**

# PH-342:Quantum Mechanics

**. Origin of Quantum Mechanics: (10 L)**

1. Historical Background
   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. Wave function of a particle having definite momentum.
5. Concept of wave packet, phase velocity, group velocity and relation betweenthem
6. Heisenberg's uncertainty principle with thought experiment.
   - Electron diffraction experiment, different forms of uncertainty.

**2. The Schrodinger equation: (15 L)**

1. Physical interpretation of wave function
2. Schrodinger time dependent equation.
3. Schrodinger time independent equation.(Steady state equation).
4. Requirements of wave function.
5. Probability current density, equation of continuity, and its physical significance.
6. Definition of an operator in Quantum mechanics.
   - Eigen function and Eigen values.
7. Expectation value – Ehrenfest's theorem

**3. Applications of Schrodinger Steady state equation: (12 L)**

1. Free particle.
2. Particle in infinitely deep potential well (one - dimension).
3. Particle in three dimension rigid box.
4. Step potential.
5. Potential barrier. (Qualitative discussion).Barrier penetration and tunneling effect.
6. Harmonic oscillator (one-dimension), correspondence principle.

**4. Spherically symmetric potentials: (06 L)**

1. Schrodinger's equation in spherical polar co-ordinate system.
2. Rigid rotator (free axis).
3. Hydrogen atom: Qualitative discussion on the radial and angular parts of thebound state energy, energy state functions, Quantum numbers n, $l$, $m_l$, $m_s$–Degeneracy.

**5. Operators in Quantum Mechanics: (05 L)**

1. Hermitian operator.
2. Position, Momentum operator, angular momentum operator, and total energyoperator (Hamiltonian).
3. Commutator brackets- Simultaneous Eigen functions.
4. Commutator algebra.
5. Commutator brackets using position, momentum and angular momentumoperator.
6. Raising and lowering angular momentum operator.
7. Concept of parity, parity operator and its Eigen values.

**Reference Books:**


1. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
2. Quantum Mechanics. - B. H. Brandsen and C. J. Joachain: Pear son Education
3. Concepts of Modern physics. - By A. Beiser Published by Mc. Grawthill. Chapter 2,3,5,6.
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.
7. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub. Co.
8. Quantum Mechanics an accessible introduction
   - Robert Scherrer Pearson - Addison Wesley

**T. Y. B. Sc. Physics**

## PH-343: Thermodynamics and Statistical Physics

**1. Kinetic Theory of Gases: (8L)**

Assumptions of Kinetic theory of gases, Mean free path, Transport phenomenon, Viscosity, Thermal conductivity and diffusion, Problems

**2. Maxwell Relations and Application: (10 L)**

Thermodynamical functions: Internal Energy, Enthalpy, Helmholtz function, Gibb's function, Derivation of Maxwell Relations, First and Second TdS Equations, Specific heat and latent heat equations, Joule Thomson effect (Throttling Process)

**3. Elementary Concepts of Statistics: (10L)**

Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Calculation of mean values, Probability distribution for large-scale N, Gaussian probability distributions,

**4. Statistical Distribution of System of Particles: (8L)**

Specification of state of system, Statistical ensembles, Basic Postulates, Probability calculations, Behaviors of density of states, Thermal, Mechanical and general interactions

**5. Statistical Ensembles: (6L)**

Micro canonical Ensemble (Isolated System), Canonical ensembles, simple application of canonical ensemble, Molecules in Ideal gas, Calculation of mean values in canonical ensemble.

**6. Quantum Statistics: (6L)**

Quantum distribution function, Maxwell-Boltzmann's statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics, Comparision of the distributions.

**References:**


1. Statistical and Thermal physics
   - By Lokanathan, R.S. Gambhir,
2. Fundamentals of statistical and thermal physics
   - By F.Reif
3. Perspectives of modern physics
   - By A. Beiser
4. Fundamental of Statistical Mechanics
   - By B.B. Laud
5. A primer of Statistical Mechanics
   - By R.B. Singh
6. Statistical Mechanics
   - By Gupta, Kumar

**T. Y. B. Sc. Physics**
**PH 344 Nuclear Physics**

**1. Basic Properties of Nucleus** **(07 L)**

Composition, charge, size, density of nucleus, Nuclear Angular momentum,Nuclear magnetic dipole moment, Electric quadrupole moment, parity andsymmetry, Mass defect and Binding energy, packing fraction, classificationof nuclei, stability of nuclei (N Vs Z Curve) and problems.
Ref 1, ch (1), Ref 2, ch (4)
Problems Ref 4 ,ch (26)

**2. Radioactivity** **(10 L)**

Radioactivity disintegration (concept of natural and artificial radioactivity,Properties of α, β, γrays, laws of radioactive decay, halflife, mean life,specific activity and its units, successive disintegration and equilibriumsand radioisotopes).
Application of radioactivity(Agricultural, Medical, Industrial, Archiological).
Problems
Ref 1 ch (8), Ref 2 – ch (15)
Problems Ref 4 ch (27, 29)

**3. Nuclear forces** **(08 L)**

Meson theory of nuclear forces, Properties of nuclear forces, properties ofdeuteron system, Elementary particles, Quarks model for elementaryparticles.
Ref1ch (2, 3), Ref 2 ch (10), Ref 3 ch (3)
Problems Ref 4 ch (26)

**4. Particle Accelerator and Detectors** **(07 L)**

Introduction to particle Accelerators, Linear (electron/proton Linac)Cyclic (Cyclotron)
Classification of Nuclear Detector
Gas filled Detectors (G. M. counter)
Solid state detectors (NaI(Tl)scintillation counter)
Problems Ref 1ch(7,12)

**5. Nuclear Reactions** **(08 L)**

Introduction to Nuclear reactions, compound nucleus, Qvalue equation,Exothermic and Endothermicreaction, Threshold energy, Conservationlaws, nuclear crosssection.
Problems
Ref 1ch(13), Ref 2ch(12)Problems Ref 4ch (30)

**6. Nuclear Energy** **(08L)**

Nuclear fission, chain reaction and critical mass, nuclear reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, nuclear fusion, stellar energy.
Problems. Ref 2ch(14), Problems Ref 4ch (31)

**Reference Books**


1 Introduction to Nuclear PhysicsH.A.Enge (Addition Wesley co.)
2 The Atomic NucleusR.D.Evans (Tata McGraw Hill co.)
3 Concepts of Nuclear Physics – B.L.Cohen (Tata McGraw Hill co.)
4 Schaum's Outline Series Modern PhysicsR.Gautrearu (McGraw Hill co.)
5 Introduction to Nuclear Physics, S. B. Patel


**Additional References**


1 Atomic and Nuclear PhysicsShatendra Sharma (Pearson Education,1st Edition)
2 Nuclear PhysicsKaplan (Narosa Publishing House)
3 Introduction to Nuclear PhysicsY.R. Waghmare (Oxford IBH.)

## T. Y. B. Sc. Physics
## PH345:Electronics

**1. Special Purpose Diodes** **(4L)**

LED and Photodiode, Varactor (working and characteristics), Optocoupler. Problems Ref. 1 Article5.8

**2. Transistor amplifier** **(8L)**

Classification of amplifier, class A, B (working, gain and efficiency calculation) class C and AB (working only), class B push pull amplifier, cross over distortion, differential amplifier (transistorized). Problems

Ref. 1 Article11.3, 11.4, 11.5, 11.6, 12.5, 17.1

**3 Field Effect Transistor** **(8L)**

Introduction, classification, principle, working and IV characteristics of JFET,MOSFET (DE MOSFET and E only MOSFET),Application of JFET :-as Variable resistor, electronic switch and analogue multiplexer.Problems

Ref. 1 Article13.1 to 13.9, 14.1to 14.5

**4 Operational Amplifier** **(4L)**

Applications of OPAMP integrator, Differentiator, Comparator, Schmitt Trigger,Instrumentation Amplifier.Problems

Ref. 1 Article20.4, 20.5, 22.1 to22.3, 22.5, 22.10

**5. Timer (IC555)** **(4L)**

Block diagram, Astable, monostable and bistablemultivibrator (working and design) Problems Ref. 1 Article23.7, 23.8

**6. Regulated Power Supply** **(4L)**

Block diagram of 3 pin IC regulator, study of IC 78XX, 79XX, dual power supply (using 3 pin IC) Block diagram of IC723 circuits and design of basic low voltage (2 to7 volt) andhigh voltage (7 to 28volt) regulator.

Problems

Ref. 1 Article24.4, for IC723 refer data book.

**7. Combinational Circuits** **(6L)**

Introduction to SOP and POS techniques, reduction of Boolean expression using Kmap methods ( up to 4 variables), design of half adder , full adder ,half substractor , full subtractor, binary to gray and gray to binary code convertor. Introduction to multiplexer (4:1) and demultiplexer (1:4)

Ref. 2 Article5.1 to 5.8.1, 6.1, and 6.2

**8. Sequential Logic Circuits ,** **(10L)**

**Flipflops**

RSflip flop using NAND/NOR clocked RS, D, JK, and Tflip flops, preset and clear inputs.

**Counters**

4-bit ripple counter, 4-bit parallel counter.

**Registers**

Buffer registers (SISO, SIPO, PISO, PIPO) use of register as a memory.

Ref. 2 Article7.1 to7.9, 8.1, 8.2, 8.4, for IC7490 Refer Data book

**References**


1 Electronic Principles (6th edition), Malvino (Tata McGraw Hill, New Delhi)

2 Modern Digital Electronics (3rd Edition), R.P.Jain, (Tata McGraw Hill, New Delhi)

3 Basic Electronics by R. S. Sedha, S. Chand publication

**T. Y. B. Sc. Physics**

## PH345:Advanced Electronics

**(Important Note:** This course is designed for the student who has offered Electronics as one of the subjects at S.Y.B.Sc. level**)**

**1. Sensors: (16 L)**

**Metal resistance versus Temperature devices:**

Metal resistance versus Temperature devices, resistance versus temperature approximation, resistance temperature detectors.

**Thermistors:**

Semiconductor resistance versus Temperature, Thermistor characteristics.

**Thermocouples:**

Thermoelectric effects, Thermocouple characteristics, Thermocouple sensors.

**Other Thermal Sensors:**

Bimetal strip, Gas thermometers, Vapour pressure thermometers, Liquid expansion thermometers, solid state temperature sensors.

**Motion sensors:**

Types of motions, Accelerometers' principles, Types of accelerometers, applications

**Optical sensors:**

**Photo detectors:**

Photo detector characteristics, photoconductive detectors, photo voltaic detectors, photo diode detectors, photo emissive detectors.

**Pyrometry:**Thermal radiation, broadband pyrometers, narrowband pyrometers.

**Optical sources:**Conventional light sources, Laser principles

**Applications:**Label inspection, Turbidity, Ranging.

**2. Signal Conditioning using OP-AMP: (12 L)**

**Principles of Analog Signal Conditioning:**

Signal level and bias changes, linearization, conversions, filtering and impedance matching, concept of loading.

Passive circuits: Divider circuits, bridge circuits, RC filters, Operational Amplifier, characteristics and Specification of OP-AMP Circuits in Instrumentation, Voltage Follower, Inverting and Non-Inverting Amplifier, Instrumentation Amplifier, I to V Converter and V to I converter, Integrator( Low Pass Filter), Diffrentiator( High Pass Filter) 1st and 2nd order

**3. Digital signal conditioning (10 L)**

Review of digital fundamentals, digital information, Fractional Binary System, Boolean algebra, Digital Electronics, Combinational Circuits, Multiplexer, De- Multiplexer, Encoder, Decoder Converters: DAC, ADC, Data Acquisition System

**Characteristics of digital data**

Digitized values, sampled data systems, linearization

**4. Introduction to Process Control: (10 L)**

**Control systems:** Process control principles, servo mechanism, discrete state Control of systems

**Process control block diagram**

Identification of elements, block diagram

**Control system evaluation:** Stability, steady state regulation, Transient regulation, Evaluation criteria

**Numerical Problems On Above Lectures**

**Reference Books:**

**1.** Process Control Instrumentation Technology by C.D. Johnson Pearson Education 8th edition (Economic Edition).

**2.** Computer Based Industrial Control by Krishna Kant (Eastern Economic Edition)

**3.** Instrument of Device System by Rangan, Mani, Sharma

**4.** Instrument measurement and analysis by B. C. Nakra, K. K. Chaudhari

## T. Y. B. Sc. Physics

## PH346 Elective II(G) : Medical Electronics

**1. Introduction:** **(10 L)**

1. 1 Terminology of medical instrumentation,
1.2 Physiological system of body
1.3 Sources of bioelectric signals,
1. 4 Origin of bioelectric signals,
1.5 Analysis of ECG pattern
1.6 Nernst equation
1.7 Various types of bioelectric signals,
1.8 Basic medical instrumentation system,
1.9 Introduction to man instrument system,
Problems

**Reference: 1**

**2. Bio potential Electrodes and sensors:** **(12 L)**

2.1 Electrode-electrolyte interface,
2.2 Polarizable and non-polarizable electrodes,
2.3 Electrodes for ECG,EEG, EMG,
2.4 Resistive sensor
2.5 Capacitive sensor
2.6 Inductive sensor
2.7 Piezoelectric sensor
2.8 Radiation sensor
2.9 Temperature sensor
Problems

**Reference: 2**

**3. Amplifiers and Signal Processing:** **(09 L)**

3.1 Introduction
3.2 Basic amplifier requirements
3.3 The Differential amplifier
3.4 Common mode rejection
3.5 Instrumentation amplifier
3.6 Isolation amplifier
3.7 Pateint safety
3.8 Cardiac monitor
Problems

**Reference:- 2**

**4. Clinical Laboratory Instrumentation:** **(07 L)**

4.1 Spectrophotometry,
4.2 Spectrophotometer type instruments
4.3 Calorimetry and calorimeter,
4.4 Clinical flame photometer
Problems

**Reference: 1**

**5. Measurements of Pressure and Volume Flow of Blood: (10 L)**

5.1 Direct measurements of blood pressure,
5.2 Indirect measurements of BP.
5.3 Heart sounds, Phonocardiography,
5.4 Ultrasonic blood flow meter
5.5 Laser Doppler blood flow meter
Problems

**Reference: 1**

Reference Books:

1. Handbook of Biomedical Instrumentation, R.S. Khandpur

2. Medical Instrumentation application design, John G Webster, Houghon Mifflin Co.
3. Introduction to Biomedical Electronics, Joseph DfuBovy, Mc Graw Hill.
4. Clinical Biophysics, P. Narayanan
5. Introduction to Bio0medical equipment technology, fourth edition, by Joseph J. Carr and John M. Brown

**Practicals**

1. Measurement of BP using Mercury sphygmomanometer and digital BP meter
2. Recording of ECG and its analysis
3. Absorbance using calorimeter/ Absorption spectra using Spectrophotometer
4. Pulse oxymetry
5. Use of biosensor

**T. Y. B. Sc. Physics**

## PH346 Elective II (H): Physics of Nanomaterials

**Course Objectives:**

The main objectives of course are to introduce the basic physics behind size and effect of nano materials and to understand the working principle of equipments used in nanostructures. In this course, students will gain knowledge of introduction to nanomaterials and their properties and growth techniques. It also discusses tools like UV, XRD, SEM and TEM to characterize the nanomaterials and applications of nanomaterials.

1. **Introduction to nanomaterials: (10 L)**
   Introduction to nano-sized materials and structures
   Brief history of nanomaterials and challenges in nanotechnology
   Significance of nano-size and properties, classification of nanostructured materials
2. **Methods of synthesis of nanomaterials: (12 L)**
   Bottom-up and Top-down approaches
   Physical methods: High energy ball milling, Physical vapour deposition, Ionized cluster beam deposition, sputter deposition, Ultrasonic spray pyrolysis etc.
   Chemical methods: colloidal method, co-precipitation and sol-gel method
   Hybrid method: Electrochemical and chemical vapour deposition.
3. **Characterization techniques: (11 L)**
   UV- visible spectroscopy
   X-ray diffraction
   Scanning electron microscopy
   Transmission electron microscopy
4. **Properties of nanomaterials: (05 L)**
   Mechanical, Electrical, Thermal, Optical, solubility, melting point and Magnetic properties
5. **Special nanomaterials: (06 L)**
   Carbon nanotubes, quantum dots, NanocrystallineZnO and $TiO_2$.
6. **Applications: (04 L)**
   Nanoelectronics, Medical, Biological, Automobiles, Space, Defense, Sports, Cosmetics, Cloth industry etc.

**Reference Books:**


1. Nanotechnology: Principles and Practices by Sulbha Kulkarni, Capital Publishing Co. New Delhi.
2. Introduction to nanotechnology, by C. P. Poole Jr. and F. J. Ownes, Willey Publications.
3. Origin and development of nanotechnology by P. K. Sharma, Vista International publishing house.
4. Nanostructure and nanomaterials synthesis, Properties and applications, by G. Cao, Imperials College Press, London.


**List of experiments:**

1. Synthesis of metallic nanoparticles by wet chemical method.
2. Study of optical absorption of nanoparticles.
3. Determination of nanoparticles size from X-ray diffraction spectra.
4. Synthesis of silver nanoparticles from silver nitrate by reduction using surfactant.

**T. Y. B. Sc. Physics**

**PH346 Elective II (I): Microcontrollers**

1. **ARCHITECTURE OF 8051: [10]**

Comparison of Microprocessor and Microcontroller, Overview of the 8051 family, Block diagram of Microcontroller, Functions of each block, Pin details of 8051, A and B CPU registers, Flags and Program status word (PSW), Program Counter and Data Pointer, PSW register, Memory Organization of 8051, Internal RAM, Stack and Stack Pointer, Special function registers, Internal ROM, I/O Ports, Oscillator and Clock

2. **8051 ASSEMBLY LANGUAGE PROGRAMMING: [10]**

Introduction to 8051 Assembly programming, Assembling and running an 8051 program, 8051 data types and directives, Intel hex file, Jump, loop, and call instructions, 8051 I/O programming, Addressing modes,

3. **ARITHMETIC & LOGIC INSTRUCTIONS AND PROGRAMS: [10]**

Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction, BCD, ASCII, and other application programs.

4. **TIMER AND INTERRUPTS PROGRAMMINGIN ASSEMBLY: [6]**

Timers. Programming 8051 timers, counter programming, Programming timers 0 and 1 in 8051, 8051 interrupts, Interrupt priority in the 8051

5. **SERIAL COMMUNICATION: [4]**

Basics of Serial programming , RS 232 Standards, 8051 connection to RS 232, 8051 Serial Communication Programming,

6. **INTERFACING TECHNIQUES [8]**

LCD and Keyboard interfacing,ADC, DAC, and sensor interfacing (LM35)

**Reference Books:**


1. 8051 Microcontroller by Kenneth J.Ayala.
2. 8051 Microcontroller and Embedded Systems using Assembly and C by Mazidi, Mazidi and D MacKinlay, 2006 Pearson Education Low Price Edition.
3. Microprocessor and Microcontroller by R.Theagarajan, Sci Tech Publication, Chennai
4. Programming customizing the 8051 Microcontroller by MykePredko, Tata McGraw Hill


# List of Experiments

1. Use of Keil/Pinacle software.
2. Addition of two 16 bit numbers
3. Multiplication of two 8 bit numbers.
4. Write a program to find largest/smallest number in given block
5. Write a program to toggle bits of port 1 with delay which depends on value of number in R0
6. Memory block transfer from one location to another.
7. Find two’s complement of given number.
8. LCD Interfacing
9. Keyboard Interfacing
10. ADC Interfacing
11. Temperature Sensor Using LM 35

# PH-346 Elective II –(J): Electro Acoustics and Entertainment Electronics

**1. Speech and Hearing: (03 L)**

Human voice and speech mechanism. Human hearing mechanism, theories of hearing

**2. Electro Acoustic Transducers: (25 L)**

1. Microphones: Design and operational features of carbon, moving coil and condenser microphones. Expressions for sensitivity, calibration, directivity.Problems.

2. Loudspeakers: Direct radiator dynamic type, expression for efficiency, radiated output power, effect of voice coil parameters. Horn loudspeaker cutoff frequency, output of horn.Loudspeaker cabinets – types, bass reflex cabinets.Problems.

3. Sound reinforcement system for auditoria: Power handling capacities, testing and evaluating amplifier specifications for auditoria. High-Fidelity (Hi-fi) acoustic evaluation of an auditorium/studio articulation test, sound level distribution, measurement of reverberation time.Acoustic delay units.

**3. Sound recording and reproduction: (18 L)**

1. Basic requirements of a system for good quality sound recording and reproduction, volume compressors, expanders, equalizers, graphic equalizers, monophonic, stereophonic sound reproducing system, surround sound. Noise reduction. Dolby A ,B system

2. Magnetic tape sound recording and reproduction basic principles, digital audio tape recording(DAT), basic principles of compact disc audio systems, motion picture sound recording and reproduction system, motion picture sound recording and reproduction variable area and variable density

**4. Ultra Sonics principles and applications (2L)**

**Reference Books:**


1. Fundamentals of Acoustics: Kinsler and fray etal, 4thedition, John Wiley and sons
2. Music, physics and Engineering H.F.Olson Dover publication 1960
3. Basic Acoustics D.E.Hall, Oxford University Press.
4. Acoustics Sourcebook Sybil Parker (Ed) McGraw Hill
5. Handbook for sound engineers G.M.Balov (Ed) New audio cyclopedia
6. Consumer Electronics by S.P. Bali ( Pearson Publication)
7. Electroacoustics by Mendel and Kleiner (CRC Press)


**List of experiments:**

1. Non linear distortion of an amplifier.
2. Study of properties of porous acoustic materials.
3. Callibration of microphone by closed chamber method.
4. Study of a tape recorder.
5. Study of graphic equalizer.
6. Study of mufflers of noise reduction.
7. Use of distortion factormeter.
8. Acoustical evaluation of a Hall/Studio.
9. Ultrasonic Interferometer (modified).

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**PH346 Elective II ( K): Lasers**

1. **Introduction to Lasers: (08 L)**
   Ordinary light and Lasers, Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Transition Lifetimes, Allowed and Forbidden Transitions, Stimulated Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Einstein's relations.
2. **Laser Action: (06 L)**
   Condition for large stimulated emission, Population inversion Condition for light amplification, Gain coefficient Active medium, Metastable states Pumping schemes: three level and four level
3. **Laser Oscillator: (07 L)**
   Optical feedback, round trip gain, threshold gain, critical population inversion, Optical resonator, condition for steady state oscillations, cavity resonance frequencies.
4. **Laser Output: (03L)**
   Lineshape broadening:
   - Lifetime broadening
   - Collision broadening
   - Doppler broadening
5. **Characteristics of Laser: (04 L)**
   Directionality,
   Monochromaticity
   Coherence
   Brightness
6. **Types of Lasers: (12 L)**
   Solid State Lasers – Ruby Laser, Diode Laser
   Gas Lasers – HeNe Laser, $CO_2$ Laser
   Liquid Lasers: Tunable dye laser
7. **Applications of Lasers: (08 L)**
   Industrial – welding, cutting, drilling
   Nuclear Science – laser isotope separation, laser fusion,
   Defense - range finder
   Medical - eye surgery
   Optical - holography, supermarket scanners, compact discs

**Reference Books:**


1. An introduction to Lasers – theory and applications, M.N. Avadhanulu, S.Chand and Co. New Delhi
2. Experiments with HeNe Laser by Sirohi
3. Optical fibre and Laser – Principle and applications, Anuradha De, New Age International Publishers, Second edition


**List of Experiments:**

1. Determination of wavelength of HeNe Laser by transmission grating and reflection grating.
2. Beam divergence of a Diode Laser.
3. Determination of the diameter of a thin wire using a laser.
4. Measurement of wavelength of Laser beam using Michelson Interferometer.
5. To study the interference of light using optical fibres
6. Measurement of the focal length of a given convex lens using a laser.

**T. Y. B. Sc. PHYSICS**

**PH346 Elective II ( L): Radiation Physics**

## [1] Low Energy Radiation: 8 Lectures.

Introduction to Microwave and Radio waves covering spectrum, power levels and detection methods. Laboratory sources of infrared, visible and ultra- violet radiation with details of energy spectrum. Detectors for microwaves, Infrared and Ultra violet radiation. Interactions of ultra violet and microwave radiation with matter

## [2]Energetic Radiation : 8 Lectures.

Introduction to Cosmic radiation .Types of particles and their energies in cosmic rays. Basic laboratory sources of electrons and ions up to 50 keV. Focusing of electron and ion beams with magnetic and electrostatics lenses. Methods for measurement of electron and ion beam current and flux. Different types of neutron sources based on radioactive sources.

## [3] X-Ray Radiography: 8 Lectures.

Principle and methods of generation of characteristics X-Rays. Interaction of X-Rays with matter, attenuation coefficient..Methods for recording X-Ray radiograph using photographic plate. Modern digital methods for recording X-ray radiograph. Medical applications of X-rays.

## [4] Radiation Detectors and Dosimetry: 8 Lectures.

Working principle of ionization chamber and Scintillator detector, Units for radiation exposure, absorbed dose, Relative biological effective dose and dose equivalent. Fricke Dosimeter.Personal dosimeters, Film badge dosimeters, thermoluminescent dosimeter. Calibration of dosimeters. Measurement of dose delivered by an electron accelerator and high strength Cobalt -60 source.

## [5]Radiation Protection: 8 Lectures.

Interaction of MeV energy electrons ,ions and gamma-rays with matter. Materials for radiation shielding. Radiation Protection and Safety rules as per the regulatory guidelines of the Government of India, Safety codes for handling radioactive sources. Monitoring of radiation levels around an open radioactive source and MeV energy electron accelerator.

## [6] Radioactive Isotopes and Applications. 8 Lectures.

Naturally occurring radioactive isotopes. Production of radioactive nuclides in nuclear reactors and by charged particle beams from accelerators. Measurement of radioactivity and lifetime of radioactive sources.Radioactive pharmaceuticals and labeled compounds. Radioactive nuclei used in diagnostic applications. Applications of gamma-rays in sterilization of medical instruments , medication items and preservation of food.

**Reference and Text Books:**

(1)Nuclear and Radiation Physics in Medicine.
Tony Key . World Scientific.2014
(2)Radiation Protection and Health Science.
Marilyn E. Noz .World Scientific. 2007.
(3)Introduction to radiation Protection .
Grupen C. Springer. 2008.

(4)Introduction to Radiological Physics and radiation dosimetry.
Frank H. Attix. Wiley.1986.
(5)Radiation Physics for Medical Physicists.
Podgorsak Ervin B. Springer.2005.
(6)Techniques for Nuclear and Particle Physics experiments.
Leo. W.R. Springer.2005.

**List of Experiments:**

1) Study of Inverse square law for radiation emitted by radioactive sources using radiation survey meter.
2) Location of a hidden radioactive source by survey meter and measurement of radiation level in air around that source.
3) Measurement of linear absorption coefficient for a brick or a stone using gamma ray source and radiation survey meter.
4) Study of X-ray radiograph of a fracture bone and structurally damaged piece of a material. Estimation of size of the crack using standard procedure.
5) Estimation of attenuation coefficient for gamma rays in atleast four different soil samples using radiation survey meter.

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**PH347 Laboratory Course I**

## GROUP I

## GENERAL PHYSICS (ANY EIGHT)

1. Viscosity of liquid by Rotating cylinder method
2. Moment of Inertia by Bifilar suspension
3. Young's modulus by Newton's rings
4. Young's modulus by Koeing method
5. Determination of wavelength of light by Michelson's interferometer
6. Surface tension liquid by Fergusson method
7. Surface tension of mercury by Quincke's method
8. Hall Effect
1. Energy gap of a semiconductor
10. Study of XRD spectra of any matter
11. Resistivity by Four probe method
12. Platinum resistance thermometer
13. Kater's pendulum
14. Study of forced oscillations by electromagnetically driven simple pendulum
15. Y by vibration of wooden scale
16. Study of damped oscillations of physical pendulum and finding log decrement.

## GROUP II

## ATOMIC AND MOLECULAR PHYSICS AND OPTICS (ANY TWO)

1. Determination of Rydberg's constant
2. Zeeman Effect
3. Llyod's mirror
4. Determination of Resolving Power of grating
5. Determination of wavelength by Constant deviation spectrometer
6. Determination of refractive index of liquid using hollow prism.

## STATISTICAL PHYSICS AND THERMODYNAMICS (ANY TWO)

1. Verification of Stefan's law by torch bulb filament
2. Thermal conductivity by Forbes Method.
3. Thermal conductivity of rubber tubing
4. Determination of pressure coefficient of air by constant volume thermometer.

## NUCLEAR AND QUANTUM MECHANICS (ANY TWO)

1. Characteristics of G.M. tube
2. Inverse square law ($\gamma$-rays)
3. e/m by Thomson method
4. Determination of Planck's constant

## ELECTROMAGNETISM (ANY TWO)

1. Self Inductance by Anderson's bridge
2. Core losses in transformers
3. Electromagnetic pendulum
4. Inductance by Maxwell's bridge

## Additional Activities (Any Two)

a. Demonstrations- Any 4 demonstrations equivalent to 2 experiments

b. Study tour with report equivalent to 2 experiments

c. Mini project equivalent to 2 experiments

*d.* Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

*Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities*

*should be equivalent to twenty experiments.*

**T. Y. B. Sc. Physics**

## PH348: Laboratory Course II

### GROUP I

**ELECTRONICS (ESSENTIAL) (ANY TWO)**

**(For the students not offering advance electronics in theory courses)**

1. Characteristics of JFET
2. Design and built astablemultivibrator using IC 555/IC 741
3. IC 723 as regulated power supply
4. Integrator and differentiator using IC 741

**ADVANCED ELECTRONICS (ANY TWO)**

**(For the students offering advance electronics in theory courses)**

1. Instrumental amplifier using three op-amps
2. Temperature controller using PT 100 / thermocouple /thermistor temperature sensors
3. Object counter (two digit)
4. Study of LVDT
5. Schimdt trigger

**ACOUSTICS and Lasers (ANY TWO)**

1. Frequency response of loudspeaker (twitter, woofer, mid-range)
2. Study of interference by Quinck's method
3. Use of Ultrasonic interferometer to measure velocity of sound in liquids
4. Transmission loss using expansion chamber muffler.
5. Study of diffraction using a reflection grating (metal ruler)
6. Study of the characteristics of a laser beam.
7. Determination of the diameter of a thin wire using a laser beam.

**NOTE: Four practicals**will be from **optional course I and II** (two each).

### GROUP II

**COMPUTER INTERFACED PHYSICS EXPERIMENTS/INSTRUMENTATION (ANYTWO)**

1. Charging and discharging of capacitor and RC time constant
2. Measurement of g using simple pendulum
3. Velocity of sound
4. Radiation detection
5. IV Characteristics of diode
6. Temperature controller using AD590
7. Study of IC 7490 as mod 2, mod 5, mod 7 and mod 10 counter

**C-PROGRAMMING (ANY FOUR)**

1. Factorial of a number by simple and recursive method.
2. To find out the first 100 prime numbers
3. Matrix multiplication
4. Graphics (line, circle, arc, ellipse, bar, draw poly)
5. Position time data using kinematic equations
6. Finding pressure using Vander Waals' equation of state

**COMPUTATIONAL PHYSICS (NUMERICAL BASED) (ANY TWO)**

1. Roots of an algebraic equation (Bisection)
2. Roots of polynomial (Newton Raphson)
4. Trapezoidal and Simpson's 1/3 rule

**Additional Activities (Any Two)**

a. Demonstrations- Any 4 demonstrations equivalent to 2 experiments
b. Study tour with report equivalent to 2 experiments

c. Mini project equivalent to 2 experiments

*d.* Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

*e.* Use of plagiarism software to find plagiarism in research work.

*Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities should be equivalent to twenty experiments.*

**T. Y. B. Sc. Physics**

# PH348 Laboratory Course III

**Project**

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It is expected that

1. The student does work equivalent to about twenty laboratory experiments through out both the semesters in the third year.

2. One bears in mind that the project work is a practical course and it is intended to develop a set of skills pertaining to the laboratory work apart from the cognition of students. Therefore, the guides should not permit projects that involve no contribution on part of student.

3. The project must have a clear and strong link with the principles of basic physics and/or their applications.

4. The theme chosen should be such that it promotes better understanding of physics concepts and brings out the creativity in the students.

5. The evaluation of the project work must give due credit to the amount of the project work actually done by a student, skills shown by the student, understanding of the physics concepts involved and the presentation of the final report at the time of viva voce.

6. The viva voce should be conducted at least for thirty minutes per student. Extra care must be taken in the evaluation of projects done in a pair or group. Delegation of the work done by individuals must be sought from the students in such cases.

7. Any ready-made material used in the report (such as downloaded pages from the web) must be clearly referred to and acknowledged.

Time schedule for project work:

(1) Allotment of Internal guide by 30$^{th}$ July

(2) Submission of synopsis by 14$^{th}$ August

(3) Project work revision – every week

(4) First draft by 15$^{th}$ February

(5) Final report submission by 5$^{th}$ March.

Any non-adherence to this norm should attract a penalty by way of deduction in the marks awarded to a student. It is recommended that the College will provide consumables/contingencies for every project, to the tune of Rs. 500/- each. It is also recommended that a teacher will look after 4 projects at one time.