FACULTY OF SCIENCE

Revised Syllabus for the

T.Y.B.Sc. Physics (Semester System)

(From Academic Year 2010-2011)

UNIVERSITY OF PUNE

Salient Features of Revised Syllabi in Physics

As far as possible to promote :

1) Physics Education Through Master Texts :

It helps in understanding the theoretical and mathematical development of the subject and to create interest in the subject. So we are going to adopt the Master Texts, wherever possible, as our text books.

2) Physics Education Through Experimentation :

It helps in general to improve scientific attitude. So emphasis is given on the development of experimental skills, data analysis, calculations, and also on the limitations of the experimental method and data and, results obtained.

3) Physics Education Through Problem Solving :

It helps in understanding the concepts of physics. It underline the strength of equations, formulae, graphs, mathematical tools to tackle the problems. So accordingly, we have introduced compulsory problem part in the question paper; 25% for F. Y. B. Sc. and 37.5% for S.Y. B. Sc. and T. Y. B.Sc.

4) Physics Education through History and Philosophy :

It helps in understanding the conceptual development of the subject and thereby increase the interest in the subject. A topic on this is introduced in the Emerging Physics Course.

5) Physics Education Through Awareness of Misconceptions :

It improves the scientific awareness among the students. A discussion on Paradox etc. is encouraged.

6) Physics Education Through Proto-research:

It creates interest in the subject and improves technological aspect. Accordingly, miniprojects, hands-on activities, projects, models and demonstrations etc. is included in the syllabi.

7) Physics Education Through Qualitative Overview :

It creates interest in the subject to continue to work in the field of science in general and physics in particular. Accordingly future directions and frontiers of the subject are included in the syllabi.

Proposed structure of T.Y.B.Sc (Physics) Syllabus

Sem III	Sem IV
PH-331: Mathematical Methods in Physics	PH 341: Solid State Physics
PH-332 Classical Electrodynamics	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:'C' Programming and 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	F: Renewable Energy Sources
B: Elements of Materials Science	G: Physics of Nanomaterials
C: Motion Picture Physics	H: Microcontrollers
D: Biophysics	I: Electro Acoustics and Entertainment Electronics
E: Medical Electronics	J: Lasers
PH-347: Laboratory Course I PH-348: Laboratory Course II PH-349: Laboratory Course III (Project)	

T.Y.B.Sc (Physics) Course Equivalence

Old Courses	New Courses
PH-331: Mathematical Methods in Physics PH-341: Solid State Physics	PH 331: Mathematical Methods in Physics PH 341: Solid State Physics
PH-332 Classical Electrodynamics PH-342: Quantum Mechanics	PH-332 Classical Electrodynamics PH-342: Quantum Mechanics
PH-333: Classical Mechanics PH-343: Thermodynamics and Statistical Physics	PH-333: Classical Mechanics PH-343: Thermodynamics and Statistical Physics
PH-334: Atomic and Molecular Physics PH-344: Nuclear Physics	PH-334: Atomic and Molecular Physics PH-344: Nuclear Physics
PH-335:'C' Programming and Computational Physics PH-345: Electronics/Advanced Electronics	PH-335:'C' Programming and Computational Physics PH-345: Electronics/Advanced Electronics
PH-347: Laboratory Course I	PH-347: Laboratory Course I
PH-348: Laboratory Course II	PH-348: Laboratory Course II
PH-349: Laboratory Course III (Project)	PH-349: Laboratory Course III (Project)
PH-336: Elective- I (Select Any One)	PH-336: Elective- I (Select Any One)
A: Astronomy and Astrophysics I and II	A. Astronomy and Astrophysics *
D: Biophysics I & II	D. Biophysics *
G: Communication Electronics I & II	G: Communication Electronics I & II *
H: Electro-Acoustics & Entertainment Electronics I & II	H: Electro Acoustics and Entertainment Electronics *
E: Medical Instrumentation I & II	E. Medical Electronics *
C: Motion Picture Physics I & II	C. Motion Picture Physics *
F: Renewable Energy Sources I & II	F. Renewable Energy Sources *
I: Basic Microprocessor & Programming I & II	I: Microcontrollers *
B: Elements of Materials Science (PH 336/ PH 346)	B. Elements of Materials Science (PH 336 (B))
J: Lasers (PH 336/ PH 346)	J: Lasers (PH 346 (J))

K: Vacuum Technology	K: Vacuum Technology *
L: Auxiliary Electronics	L: Auxiliary Electronics *

***- Question paper should be set for three successive turns from Academic Year 2010-11. There after student has to opt new elective course (s).**

ATKT RULES:- Existing rules shall apply.

Structure of Question paper:- Existing structure shall continue.

PH-331: Mathematical Methods in Physics

1) **Introduction to partial differential equations: (13 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

2) **Special functions: (11 L)**

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

Problems

3) **Curvilinear co-ordinate system: (12 L)**

Introduction to Cartesian, Spherical polar and Cylindrical coordinate systems, transformation equations.

General curvilinear coordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.

Orthogonal Curvilinear coordinate 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.

Problems

4) **The Special Theory of Relativity:**

1. Concept of space, time and mas (absolute and invariant nature according to Newtonian Mechanics), frames of reference, Newtonian relativity, Galilean transformation and its inverse. **(02 L)**

2. The need for ether hypothesis, Michelson-Morley Experiment and its result along with explanation provided by MM, Fitzgerald and Einstein. **(02 L)**

3. Einstein's Postulates, Lorentz transformation and its inverse, geometry of relativity (relativity of simultaneity, lorentz contraction, time dilation, twin paradox, barn and ladder paradox, structure of space-time. **(04 L)**

4. Additon of velocities, concept of expanding universe **(01 L)**

5. Relativistic mass (rest mass is least), mass and evergy ($E=mc^2$), relativistic momentum and energy (massless particle, Compton scattering)

Problems **(03 L)**

Reference Books:

1. Mathematical Physics – P. K. Chattopadhyay New Age International Publishers.
2. Mathematical methods in the Physical Sciences (Second Edition) – Marry L. Boas John Willy and Sons Publication.
3. Fourier series – Seymour Lipschutz, Schaum outlines series.
4. Laplace transform : Seymour Lipschutz, Schaum outlines series.
5. Mathematical methods for Physicists : Weber and Arfken. (6^{th} edition) Academic press – N. Y.
6. Introduction to Special Relativity – Robert Resnick Wiley Eastern Ltd.
7. Physics, 4^{th} Edition, volume I, Resnik, Halliday, Krane, John Wiley and Sons Ltd.

PH-332: Classical Electrodynamics

1. Electrostatics: (16 L)

1. Coulomb's law, Gauss law, Electric field, Electrostatic Potential.
2. Potential energy of system of charges.
3. Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system.
4. Method of image charge.
   Examples of 1) point charge near an infinite grounded conducting plane.
   2) Point charge near grounded conducting sphere.
5. Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric constant, bound volume and surface charge densities.
6. Electric field at an exterior and interior point of dielectric.

Problems:

2. Magnetostatics: (16 L)

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

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

Energy density in magnetic field, magnetization of matter (**B,H,M**)

Magnetic susceptibility and permeability.

Hysteresis loss, B-H curve.

Diamagnetic, paramagnetic and ferromagnetic substances.

3. Electrodynamics: (16 L)

1. Time varying fields: Faradays law of induction, generalization of Amperes' law, Maxwell's equation (Differential and Integral form)
2. Wave equation and plane waves in free space.
3. Poynting theorem, Polarizations of plane wave.
4. Microscopic form of ohm's law (**J**=σ.**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
4) Electricity and magnetism – By Reitz and Milford

PH 333: Classical Mechanics

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

1. Introduction (review of classical mechanics)

2. Applications of Newton's laws of motion-Projectile motion in resistive medium, Rocket 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

Ref: 1 Ch. 5, Ref: 2 Ch 4

3. Scattering of particles: (10 L)

Elastic and inelastic scattering

Elastic scattering-Laboratory and centre of mass system

Relation between scattering angles in laboratory and centre of mass system

Inelastic scattering-cross section, differential cross section, total cross section, impact Parameter.

4. Langrangian and Hamiltonian formulation: (10 L)

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

Problems

Ref: 1 Ch. 8, Ref: 3

5. Moving coordinate system: (08 L)

Inertial and Non-inertial frames of references, Galilean invariance

Rotating co-ordinate system

Corioli's force

Effect of Corioli's force on cyclone formation, river flow, flight of missiles and freely falling body on Earth's surface

Problems

Ref: 1 Ch. 9, Ref: 4

Reference Books:

1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata Mc Graw Hill publishing Company Ltd.

2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata Mc Graw Hill Publishing company Ltd.

3. Principles of mechanics, J. L. Synge, B. A. Griffith, Tata Mc Graw Hill Publishing company Ltd.

4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House

PH-334: 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)

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

6. Atomic excitation and atomic spectra

Problems

Ref: 1 ch-4

2. One and two valence electron systems (14 L)

1. Pauli Exclusing principle 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. Spectral terms of two electron atoms, terms for equivalent electrons, L-S and J-J coupling schemes.

4. Singlet-Triplet separation for interaction energy of L-S coupling. Lande Inteval rule, spectra of Helium atom

Problems

Ref: 1 ch-7

Ref. 2 ch-8 and ch-12

3. Zeeman Effect (4 L)

1. Early discoveries and developments

2. Experimental arrangement

3. Normal and anomalous Zeeman Effect

Problems

Ref: 2 ch-10

4. X-ray spectroscopy (6 L)

1. Nature of X-rays

2. Discrete and continuous X-ray spectra, Daune and Hunt's Rule

3. X-ray emission spectra

4. Mosley's law and its applications

5. Auger effect

Problems

Ref: 2 ch-16

5. 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 ch- 8

6. 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 ch-4

Reference Books:

1. Concepts of Modern Physics 4th edition
- Arthur Baiser (Mc-Graw Hill International edition)

2. Introduction to Atomic spectra
-White.H.E (Mc-Graw Hill International edition)

3. Fundamentals of Molecular spectroscopy
-C.N Banwell and E.M McCash (Mc-Graw Hill International edition)

4. Modern Physics
-J.B.Rajam

PH-335: 'C' Programming and Computational Physics

1. Concepts of programming: (04 L)

Definition and Properties of algorithms,

Algorithm development,

Flow charts- symbols and simple flowcharts.

2. C Programming (28 L)

Introduction: Structure of C program, Character set, key words, Constants and variables, Variable names, Data types and their declarations, Symbolic Constants.

Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator.

Input/output functions: scanf ( ), printf ( ), getchar ( ), putchar ( ), getch ( ), Formatted input/output, gets ( ), puts ( ).

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.

Arrays: 1-D, 2-D and String

Concept of Pointers

User defined functions: Definitions and declaration of function, function prototype, passing arguments (Call by value, Call by reference).

Storage Classes: Auto, External, Static, Register variables.

File handling: Use of text files- Reading and writing

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

3. Computational Physics: [16 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 C programs for finding single root of equation using bi-section method, Newton-Raphson method.

3. Least Square Curve fitting: Discussion of algorithm and flowcharts and writing C program for straight line fit with example in physics.

4. Discussion of algorithm and flowcharts and writing C program for trapezoidal rule 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- Yashwant Kanetkar 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.
7. Mastering turbo C- Stan Kelly- Bootle, BPB publications.

Following programs may be discussed thoroughly in theory lectures:

1. Sum of digits of an integer
2. To find factorial of a number
3. Checking and printing of prime numbers
4. Generation of Fibonacci numbers
5. To find sin(X), cos(X) using series method
6. Sorting of (1) Numerical data (2) Character type data- ascending, descending.
7. Use of pointers – sorting (any one method of sorting)
8. Matrix operations – addition, subtraction, multiplication
9. Graphics- line, circle, arc, bar, ellipse.
10. Graphics- Drawing of Miller planes
11. Root of equation-Bisection method, Newton Raphson method
12. Numerical integration- Trapezoidal, Simpson's 1/3rd rule.
13. Least square curve fitting- data for ohm's law (given V and corresponding I).
14. Use of text files – storage and retrieval of data

PH-336 Elective I-A: Astronomy and Astrophysics

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 Sytems: 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, Quazars

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.Van Nostrand 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, Badyanath Basu.

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.

PH-336 Elective I-B: Elements of Materials Science

1. Properties of Materials: (3L+1P)

1. Introduction.
2. Mechanical Properties- Stress, Strain, Elastic Strain, Plastic Strain, strength, plasticity, Ductility, Hardness, Toughness, Malleability, Creep, Fatigue, Stiffness, Fracture.
3. Thermal Properties: Specific Heat, Thermal Expansion, Thermal Conductivity.
4. Electrical Properties: Resistivity, Conductivity, dielectric strength.
5. Magnetic Properties: magnetic susceptibility, Giant Magnetic Resonance (GMR).
6. Structure, properties and processing relationships.

2. Atomic Disorder in Materials: (7L+1P)

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

3. Single Phase Metals: (6L+1P)

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

4. Molecular Phases: (7L+1P)

1. Introduction
2. Polymers

3. Polymerization
4. Molecular weight of polymers
5. Linear polymers- addition and condensation
6. Cross linked polymer- vulcanization of rubber

5. Ceramic Materials: (10L)

1. Ceramic Phases
2. Classification of ceramic materials
3. Ceramic crystals (AX)
4. Mechanical behaviour of ceramics
5. Electromagnetic behaviour of ceramics –
   a) Electric properties- dielectrics, semiconductors, piezoelectric
   b) Magnetic Properties- Magnetic Ceramics, Ferrites [Normal ($MnFe_2O_4$) and Inverse (Fe_3O_4)], hard and soft magnets.

6. Phase Diagrams: (9L+2P)

1. Basic terms-System, Surrounding, Component, Co-ordinates, 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 I- Lens type- Cu-Ni phase diagram
   b) Type II- Only introduction
   c) Type III- Eutectic type-Pb-Sn phase diagram
7. Isothermal cuts
8. Material balance

Reference books:

1. Elements of materials science and Engineering-I.H.Vanvlach (4th 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

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
5. Study of B/W enlarger
6. 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).

Visits: Visits to projection rooms should be arranged wherever feasible.

Note: B/W or Color Film can be used as per situation.

PH-336 Elective I-D: Biophysics

1. Introduction of Biophysics

1.1 Definition and History of Biophysics **(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: Amino-acids structure, 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. **(5L)**

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

2. Biopotentials

2.1 Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation **(3L)**

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. **(4L)**

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, radioimmunoassays (in brief) **(3L)**

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 Vatsala Piramal, 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.

PH-336 Elective I - E: Medical Electronics

1. Introduction: (10 L)

Essential features of instruments, Need of instruments in medicine.

Basic transducers and principles. Conversion of physiological changes into electrical signals, Displacement measurements, resistive transducers, Bridge circuits, Inductive, Piezoelectric, Capacitive transducers, Temperature radiation thermometry.

2. Biopotential Electrodes: (10 L)

Electrode-electrolyte interface, polarization, polarization and non-polrizable electrodes, microelectrodes. Electrocardiography, Standard limb leads, Augmented limb leads, Functional blocks of electrocardiogram. Pacemakers.

3. Amplifiers and Signal Processing: (08 L)

Ideal Op Amps, Differential amplifiers, Integrator, differentiators, Active filters, Impendance matching, Instrumentation Amplifier.

4. Clinical Laboratory Instrumentation: (08 L)

Spectrophotometry, Blood gas and acid base measurements, chromatography, electrophoresis, and heamatology, Cultural counting for blood cell count.

5. Measurements of Pressure and Volume Flow of Blood: (12 L)

Direct measurements of blood pressure, Band requirements for measurements, indirect measurements of BP. Heart sounds, Photocardiography,

Indicator dilution methods, electromagnetic flow meters, Ultrasonic flow meters, electric impedance, phethysmography, microwave diatherapy, short wave diatherapy, X-ray units its power requirements, precautions.

Reference Books:

1. Medical Instrumentation application design, John G Webster, Houghon Mifflin Co.
2. Introduction to Biomedical Electronics, Joseph Dfu Bovy, Mc Graw Hill.
3. Handbook of Biomedical Instrumentation, R.S. Khandpur
4. Medical Physics, J.B.Cameron
5. Clinical Biophysics, P. Narayanan

List of Experiments:

1. Measurements of B.P. and recording of Kortov sound.
2. Measurements of body temperature using GSR and thermister probe.
3. Measurements of skin resistance using GSR.
4. Blood haemoglobin and blood groups.
5. Study of Cardiogram.
6. Study of encephalogram.
7. Signal and Classification.

PH-341: Solid State Physics

1. The Crystalline State: (11 L)

Lattice, Basis, Translational vectors, Primitive unit cell, Symmetry operations, Different types of lattices-2D 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: (11 L)

Introduction, Crystal as a grating, Bragg's law and Bragg's Diffraction condition in direct and reciprocal lattice- Ewald's construction, Debye Schrrerer method, Analysis of cubic structure by powder method

Characterization Techniques: Principle, Working and Applications

Thermal Technique: Thermo Gravimetric Analysis (TGA)

Spectroscopy: Ultra-Violet (UV)

Electron Spectroscopy : Scanning 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 function (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: (13 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, Ferrimagnetism, Ferrites and its applications, Antiferromagnetism, 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 – By Kakani and Hemrajani, S. Chand Publication.
3. Solid State Physics - By Saxena, Gupta and Saxena, Pragati Prakation.
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.

PH-342: Quantum Mechanics

1. Origin of Quantum Mechanics: (10 L)

1. Historical Background
   a) Review of Black body radiation
   b) Review of photoelectric effects.
2. Wave particle duality
3. Matter waves
   - De Broglie hypothesis.
   - Davisson and Germer experiment.
4. Concept of wave packet, phase velocity, group velocity and relation between them
5. Heisenberg's uncertainty principle with thought experiment.
   - Electron diffraction experiment, different forms of uncertainty.

Problems: Ref – 1 and 3

2. The Schrodinger equation: (15 L)

1. Wave function and its physical interpretation.
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

Problems: Ref – 1,2,3

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.

Problems: Ref- 1,3,2

4. Spherically symmetric potentials: (06 L)

1. Schrodinger's equation in spherical polar co-ordinate system.

2. Rigid rotator (free and fixed axis).

3. Hydrogen atom: Qualitative discussion on the radial and angular parts of the bound state energy, energy state functions, Quantum numbers n, l, m_l, m_s – Degeneracy.

Problems: Ref- 1, 2, 4.

5. Operators in Quantum Mechanics: (05 L)

1. Hermitian operator.

2. Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian).

3. Commutator brackets- Simultaneous Eigen functions.

4. Commutator algebra.

5. Commutator brackets using position, momentum and angular momentum operator.

6. Raising and lowering angular momentum operator.

7. Concept of parity, parity operator and its Eigen values.

Problems: Ref- 2, 7.

Reference Books:

1. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles.
   - By R. Eisberg and R. Resnik Published by Wiley.
2. Quantum Mechanics.
   - By Gupta, Kumar and Sharma Published by J. Prakash Nath and Co. Meeral.
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

Ph-343: Thermodynamics and Statistical Physics

1. Kinetic Theory of Gases: (6L+2P)

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

2. Maxwell Relations and Application: (8+2)

Thermodynamical functions, 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: (8+2)

Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Probability distribution for large-scale N, Guassian probability distributions.

4. Statistical Distribution of System of Particles: (6+2)

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

5. Statistical Ensembles: (4+2)

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: (4+2)

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

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

PH 344: Nuclear Physics

1. **Basic Properties of Nucleus: (06 L)**

   Composition, charge, size, density of nucleus, Nuclear Angular momentum, Nuclear magnetic dipole moment, Electric quadrupole moment, parity and symmetry, Mass defect and Binding energy, packing fraction, classification of 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: (09 L)**

   Radioactivity disintegration (concept of natural and artificial radioactivity, Properties of α, β, γ-rays, laws of radioactive decay, half-life, mean life, specific activity and its units, successive disintegration and equilibriums and 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: (07 L)**

   Meson theory of nuclear forces, Properties Of nuclear forces, properties of deuteron system, Elementary particles, Quarks model for elementary particles.

   Ref:1- ch (2, 3), Ref: 2 - ch (10), Ref: 3 - ch (3)

   Problems: Ref: 4 - ch (26)

4. **Nuclear Models: (08 L)**

   Introduction to various nuclear Models,

   1. Liquid drop model: Assumptions, semi-empirical mass formula, limitations.

   2. Shell Model: Assumptions, Evidences, Spin and Parity limitations.

   Ref: 1- ch (6), Ref: 2 (11), Ref: 3 ch (4, 5)

   Problems: Ref: 4 - ch (28)

5. Particle Accelerator and Detectors: (05 L)

Introduction to particle Accelerators,

1. Linear (electron/proton Linac)
2. Cyclic (Cyclotron)

Classification of Nuclear Detector

1. Gas filled Detectors (G. M. counter)
2. Solid state detectors (scintillation counter)

Problems: Ref: 1- ch(7,12)

6. Nuclear Reactions: (05 L)

Introduction to Nuclear reactions, compound nuclear Q-value equation, Exothermic and Endothermic, reaction Threshold energy, Conservation laws, nuclear cross-section.

Problems

Ref: 1- ch(13), Ref: 2- ch(12)

Problems: Ref: 4- ch (30)

7. **Nuclear Energy: (07 L)**

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: 2- ch(14),

Problems: Ref: 4- ch (31)

Reference Books:

1. Introduction to Nuclear Physics- H.A.Enge (Addition Wesley co.)
2. The Atomic Nucleus- R.D.Evans (Tata McGraw Hill co.)
3. Concepts of Nuclear Physics – B.L.Cohen (Tata McGraw Hill co.)
4. Schaum's Outline Series: Modern Physics- R.Gautrearu (McGraw Hill co.)

Additional References:

1. Atomic and Nuclear Physics- Shatendra Sharma (Pearson Education, 1st Edition)
2. Nuclear Physics- Kaplan (Narosa Publishing House)
3. Introduction to Nuclear Physics- Y.R. Waghmare (Oxford IBH.)

PH-345: Electronics

1. Special Purpose Diodes: (4L)

LED and Photodiode, Varactor (working and characteristics), Optocoupler.

Problems

Ref. 1: Article-5.8

2. Transistor amplifier: (8L)

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

Problems

Ref. 1: Article-11.3, 11.4, 11.5, 11.6, 12.5, 17.1

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

Introduction, classification, principle, working and I-V characteristics of JFET, MOSFET (depletion and enhancement mode), CMOS (P-channel and N-channel).

Application of FET:-Variable resistor, electronic switch and analogue multiplexer.

Problems

Ref. 1: Article-13.1 to 13.9, 14.1to 14.5

4. Operational Amplifier: (4L)

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

Problems

Ref. 1: Article-20.4, 20.5, 22.1 to22.3, 22.5, 22.10

5. Timer (IC-555): (4L)

Block diagram, Astable, monostable and bistable multivibrator (working and design)

Problems

Ref. 1: Article-23.7, 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 IC-723 circuits and design of basic low voltage (2 to7 volt) and high voltage (7 to 28volt) regulator.

Problems

Ref. 1: Article-24.4, for IC-723 refer data book.

7. Combinational Circuits: (6L)

Introduction to SOP and POS techniques, reduction of Boolean expression using K-map 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: Article-5.1 to 5.8.1, 6.1, and 6.2

8. Sequential Logic Circuits:

Flip-flops:

RS-flip flop using NAND/NOR clocked RS, D, JK, Master-Slave, JK and T-flip flops, preset and clear inputs.

Counters:

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

Block diagram of IC-7490 and its uses as modulo counter (modulus 2,5,7 and 10)

Registers:

Buffer registers (SISO, SIPO, PISO, PIPO) IC-7495(Block diagram and working), use of register as a memory.

Ref. 2: Article-7.1 to7.9, 8.1, 8.2, 8.4, for IC-7490 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)

PH-345: 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**)**

Sensors: (08 L)

Introduction

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:

Introduction

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.

Ref: 01

2. Signal Conditioning: (10 L)

Introduction

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

Digital signal conditioning

Introduction

Data acquisition systems

DAS hardware, DAS software

Characteristics of digital data

Digitized values, sampled data systems, linearization

Ref: 01

3. Introduction To Process Control: (08 L)

Introduction

Control systems: Process control principles, servo mechanism, and 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

Analog and Digital processing:

Data representation, ON/OFF Control, Analog control, Digital control.

Ref: 01

4. Discrete State Process Control: (10 L)

Introduction

Definition of Discrete state process control,

Characteristics of the system

Discrete state variables, process specifications, Event sequence description

Relay controller and Ladder diagram

Background, Ladder diagram elements, Ladder diagram examples

Programmable Logic Controllers

Relay sequencers, Programmable Logic Controller design, PLC operations, programming, and PLC software functions

(You can use trilogy as software package for understanding PLC programming. This is freely available on the web.)

Ref: 01

2. Water Treatment Plant (04 Lectures)

Numerical Problems On Above Lectures (06 Lectures)

Ref: 02

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)

Ph-346 Elective II - F : Renewable Energy Sources

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

1. Conventional and non-conventional sources of energy.
2. Structure and characteristics of sun.
3. Solar constant.
4. Electromagnetic energy spectrum
5. Solar radiations outside earth atmosphere.
6. Solar radiation at the earth surface.

Ref. 1: page no. 1 to 11and 15 to37

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

2. Photothermal Applications: (10L)

1. Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis)
2. Concentrating collectors.
   Advantage and disadvantage.
3. Solar distillation.
4. Solar drying.
5. Solar cooker(box type)
6. 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)

1. Introduction
2. Photovoltaic principle.
3. Power output and conversion efficiency
4. Limitation to photovoltaic efficiency
5. Basic photovoltaic system for power generation
6. Advantages and disadvantages
7. Types of solar cells
8. 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)

1. Introduction
2. Bio -mass conversion technologies
3. Bio-gas generation
4. Factors affecting bio-digestion (list of factors)
5. Working of biogas plant
6. Advantages and disadvantage of floating and fixed dome type plant
7. Bio-gas from plant wastes
8. Methods for obtaining energy from biomass
9. Thermal gasification of biomass
10. Working of downdraft gasifier
11. 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 and Energy Audit: (06L)

5.1 Introduction

5.2 Classification and description of wind machines

5.3 Wind data

5.4 Introduction to energy audit

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.

PH-346 Elective II-G: Physics of Nanomaterials

1. Introduction to Nanomaterials: (10 L)

Introduction to nano-sized materials and structures

Brief history of Nanomaterials and challenges in Nano Technology

Effect of reduction of dimensions, quantum size effect.

Particle in a box, density of states for a zero one, two and three dimensional box.

2. Methods of Synthehsis of Nanomaterial: (12 L)

Bottom-up and Top-down approaches

Physical Methods: High Energy Ball Milling, Physical Vapour Deposition, Ionized Cluster Beam Deposition, Sputter deposition

Chemical Methods: Colloidal Method and Sol-gel Method

Hybrid Method: Electro-chemical Method and Chemical Vapour Deposition

3. Characterization Technique: (11 L)

X-ray diffraction

UV – Visible – NIR spectroscopy

Transmission Electron Microscopy

Scanning electron microscopy.

4. Properties of Nanomaterials: (05 L)

Mechanical, Thermal, Electrical, Optical and Magnetic properties

Concept of Surface Plasmon Resonance

5. Special Nanomaterials: (06 L)

Carbon Nanotubes, Porous Silicon, Aero gels Core Shell structure

6. Applications: (04 L)

Nanoelectronics, Medical, Biological, Quantum Dots and Quantum Well device, Pasmon Wave guides (Optical Device), Automobiles, Space, Defence, Sports, Cosmetics, Cloth Industry.

Reference Books:

1. Nanotechnology: Principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi.
2. Introduction to Nanotechnology, C.P. Poole Jr. and F.J. Ownes, Wiley Publication.
3. Origin and Development of Nanotechnology, P.K.Sharma, Vista International Publishing House
4. Under Nanotechnology by P.K. Sharma, Vista International Publishing House
5. Nano structure and Nanomaterials Synthesis, Properties and Applications, Guozhong Cao, Imperials College Press, London.

List of experiments:

1. Synthesis of metallic nanoparticles by wet chemical method.
2. Preparation of porous silicon by electrochemical etching method.
3. Study of optical absorption of nanoparticles.
4. Determination of nanoparticle size from x-ray diffraction spectra.

PH-346 Elective II - H: Microcontrollers

1. Introduction to Microcontroller (μC): (04 L)

Introduction, Overview of Microprocessor (μP) and Microcontroller (μC)

2. The 8051 Architecture: (10 L)

8085 block diagram, 8051, Registers, Flags, Memory, Oscillators, Clock and Timing, Program Counter, Data Pointer, A and B CPU Registers, Stack and Stack Pointer, Special function Registers, PSW, Internal Memory, Internal RAM, Internal ROM, Serial Data I/O, Pin descriptions of 8051.

1. Addressing Modes, Instructions and Programs: (12 L)

8051 Addressing Modes: Immediate, Register, Direct, Register Indirect, Indexed.

Bit Address for I/O and RAM, Jump, Loop and Call Instructions, Arithmetic, logic Instructions and Programs, Signed Number Concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate and Swap, BCD to ASCII and ASCII to BCD Programs.

2. 8051 Timer Programming in Assembly Language: (06 L)

Programming 8051 Timer, Various modes of 8051 Timer, Programming 8051 Timer to generate time delays, C/T bit in TMOD registers, TCON registers, Interrupts in 8051.

3. 8051 Serial Programming: (06 L)

Basics of Serial Communication, 8051 Connection to RS 232, 8051 Serial Port Programming in Assembly. (6 L)

4. Interfacing and Applications: (10 L)

LCD Interfacing, Keyboard Interfacing, ADC 0808 Interfacing, Temperature Sensor Interfacing (LM 35)

Reference Books:

1. 8051 Microcontroller and Embedded systems, Mazidi, Prentice Hall (Second Edition)

2. 8051 Microcontroller Architecture, Programming and Applications, Kemetn J. Ayala. Thompson Learning (Third Edition)

List of Experiments

Group A (Any-3)

1. Addition of two 16 bit numbers
2. Multiplication of two 8 bit numbers.
3. Write a program to find largest/smallest number in given block (M 6.24)
4. Arrange given number in ascending/descending order.
5. Write a program to toggle bits of port 1 with delay which depends on value of number in R0 (M 3.1)
6. Memory block transfer from one location to another.
7. Find two's complement of given number.
8. Use of Keil/Pinacle software.

Group B (Any-2)

1. LCD Interfacing (M 12.1)
2. Keyboard Interfacing (M 12.2)
3. ADC Interfacing (M 13.1)
4. Temperature Sensor Using LM 35 (M 13.3)
5. DC motor (m 17.3) / Stepper Motor Interfacing (M 17.2)

PH-346 Elective II - I: 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. (**8L)**

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. (**9L)**

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. (**8L)**

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 (**8L)**

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 (**10L)**

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

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).

PH-346 Elective II - J: 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 Life-times, 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 co-efficient

   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)**

   Line-shape broadening:

   - Life-time 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 – He-Ne 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 He-Ne 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 He-Ne 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.

PH-347: Laboratory Course I

GROUP I

GENERAL PHYSICS (ANY EIGHT)

1. Viscosity by Rotating cylinder method
2. Moment of Inertia by Bifilar suspension
3. Y by Newton's rings
4. Y by koeing method
5. Michelson's interferometer
6. Surface tension by Fergusson method
7. Surface tension by Quincke's method
8. Hall Effect
1. Energy gap of a semiconductor
10. Study of XRD spectra of any matter
11. Four probe method
12. Platinum resistance thermometer

GROUP II

ATOMIC AND MOLECULAR PHYSICS AND OPTICS (ANY TWO)

1. Rydberg's constant
2. Zeeman Effect
3. Llyod's mirror
4. R.P. of grating
5. Constant deviation spectrometer

STATISTICAL PHYSICS AND THERMODYNAMICS (ANY TWO)

1. Verification of Stefan's law
2. Forbes Method.
3. Thermal conductivity of rubber tubing

NUCLEAR AND QUANTUM MECHANICS (ANY TWO)

1. Characteristics of G.M. tube

2. Inverse square law (γ-rays)
3. e/m by Thomson method
4. 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.

PH-348: 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 astable multivibrator using IC 555/IC 741
3. IC 723 as regulated power supply

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

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 (Water and alcohol)
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: <u>Four practicals</u> will be from **<u>optional course I and II</u>** (two each).

GROUP II

COMPUTER INTERFACED PHYSICS EXPERIMENTS/INSTRUMENTATION (ANY THREE)

1. RC time constant
2. Measurement of g
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
8. Schmitt trigger

C-PROGRAMMING (ANY THREE)

1. Factorial of a number
2. To find out the first 100 prime numbers
3. Matrix operation
4. Graphics (line, circle, arc, ellipse, bar, draw poly)
5. Sorting using file pointer

COMPUTATIONAL PHYSICS (NUMERICAL BASED) (ANY TWO)

1. Roots of an algebraic equation (Bisection)
2. Roots of polynomial (Newton Raphson)
3. Curve fitting (Linear and exponential)
4. Trapezoidal and Simpson's 1/3 rule
5. Newton's Interpolation (forward and backward)
6. Numerical differentiation (Euler and modified Euler)

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.

IMPORTANT NOTE:

- The use of computers is involved in practical syllabus of S.Y.B.Sc. and T.Y.B.Sc. Hence every Physics Laboratory must have minimum five Pentiums and two printers with necessary UPS and battery back-up. The computers must be kept in the Physics Laboratory and not elsewhere or shared with other departments in the college or outside the college campus.
- The Internet facility must be available with all computers. Also the relevant study material of various Physics courses in the form of ICT must be made available for easy access to students. (e.g. Physics based CD-ROM'S, CD'S etc.)

PH 349 Laboratory Course III: PROJECT

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. 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.

THE ART AND SCIENCE OF WRITING PROJECT REPORTS:

Introduction: Writing project reports is considered an artistic as well as a scientific activity because it must satisfy the authorities about the utility of the work carried out in a convincing manner. Authorities, being humans, cannot be one hundred percent objective while assessing the work. They too have their likes and dislikes which is why it is necessary to create a report that reflects the truth but avoids negative impressions, if any, that might be generated. This demands the development of certain skills in communications (presentation) as well as data analysis from the report writer. This paper aims to give the participants some insight in this direction.

Title: Writing the title of a project is not a trivial task. It requires serious deliberation on not only the contents but also the priorities of various factors on part of the researcher. The title should give the correct idea as to what the authorities could expect the report to contain. It should neither be too short nor too lengthy. The words used in the title would depend upon the nature of work carried out but highly technical jargon should be avoided, wherever possible.

Purpose of producing report: Different reports have different purposes- e.g. writing a report after completing a research scheme is different than writing a report for a progressing Ph.D. work to the University. In any case it is essential to state clearly what is the purpose of writing the report for the knowledge of its reader – whosoever it might be. The writer must also have sufficient understanding about the expectations from the authorities. Many times, they provide a format for your guidance. It is often very useful in developing a complete report. If no format is recommended, the writer should seek clarification from them in person. If this is not feasible, he can contact someone who has submitted a similar report to the authorities earlier before he undertakes the task to avoid wastage of time and energy later.

Acknowledgement: No project can be completed without timely support from a number of individuals or institutions. Their contributions may not always be direct. It is essential to acknowledge all of them. If your project is a sponsored one, this is most important. In such a case, it is worth a mention even on the

front cover or immediately thereafter. Raw data, diagrams, references to quotations and such other material what helps you in developing a good report but which has been borrowed, must be duly referred to. If this is not done, it reflects negatively on the researcher's honesty.

Organization of contents of the report: There are many ways to organize the contents of a report. For example, it might be according to chronology of the main events. It might be according to the scientific method used for testing a system or constructing a system of several modules. It could be based on classification of the data collected, say, through a number of surveys conducted at different places and so on. Thus, a universal style of writing a project report is a myth. However, this is not to suggest that the report writer should write it like his personal diary. Perhaps the HCF (highest common factor) of all reports is that all styles must possess a common feature. The author must select a style that permits him to provide a sufficiently comprehensive view of his philosophy, problem/task, procedure, data, the product (if any), its characterization, data analysis and the logical conclusions that follow naturally. No report can be complete without justifying the course of action taken by the author of the report. If the course of action is presented properly (and proved the best under the given constraints), the authorities might even accept the failure of the report writer to achieve his goals completely or in time. A standard format is enclosed herewith for bringing some uniformity in the T.Y. B.Sc project reports.

Data presentation and analysis: Most of the times, the authorities are not interested in the raw data. They are interested in it only to the extent of ensuring that the report is founded on methodical hard work done with all sincerity. In such cases, the author should not waste time in discussing the efforts he took in collecting the raw data. Rather he should skip it and provide only samples and the method used for analysis leading to inferences. Many authors (particularly students) have the notion that their proper evaluation essentially demands a thick report from them. This belief is ill founded. Another common dilemma a reporter suffers from is about honesty. There are instances in all types of projects where everything does not happen as expected

and the observations are disturbing in some cases. This is perfectly natural and the writer should not have any guilt feeling in either reporting it or not reporting it. The decision to report or otherwise should be based on the frequency of recurrence of the 'failure' rather than anything else. It must also be remembered that a researcher is always free to check and recheck the conditions under which an observation is made and to decide whether to accept the observed data or to reject it. There is nothing unethical or dishonest about it.

Schedule for project work:

1. Allotment of Internal Guide by 30th July.
2. Submission of Synopsis by 14th August.
4. Project Work Review- Every Week.
5. First Draft of Report by 15th February.
6. Final Report Submission by 5th March.

FORMAT FOR PREPARATION OF PROJECT REPORT FOR B.Sc.

ARRANGEMENT OF CONTENTS:

The material in the project report should be arranged and bound as per the following order:

Cover Page and Title Page
Bonafide Certificate
Acknowledgement
Abstract
Table of Contents
List of Tables
List of Figures
List of Symbols, Abbreviations and Nomenclature
Chapters
Appendices
References

The table and figures shall be introduced at appropriate places.

PAGE DIMENSION AND BINDING SPECIFICATIONS:

The dimension of the project report should be in A4 size (210mm X 297 mm) Paper used should be 75 GSM or higher quality. The project report should be spiral bound using flexible cover of the thick white art paper. The cover should be **printed in black letters** and the text should use only one font style viz. Times New Roman.

PREPARATION FORMAT:

3.1 Page Set-Up : The recommended margins are as follows: top 1", bottom 1.5", left 1.5" and right 0.75". All text pages should be numbered after the page of contents.

3.2 Cover Page and Title Page – A specimen copy of the Cover page and Title page of the project report are given in **Appendix 1.**

3.3 Bonafide Certificate – The Bonafide Certificate shall be printed in double line spacing using Font Style Times New Roman and Font Size 14, as per the format in **Appendix 2.**

The certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department, name of the college, city/town and PIN code where the supervisor has guided the student. The term **'SUPERVISOR'** must be typed in capital letters between the supervisor's name and academic designation.

3.4 Acknowledgement – A student should acknowledge the following authorities:

(i) Principal of the college (ii) Head and the faculty members including non-teaching staff of the Physics department /college (iii) Guide (iv) Sponsoring organization (if any) (v) Funding agency (if any) (vi) Organisation where the work is carried out (if external to the college) (vii) classmates (viii) Others who helped directly/indirectly. The acknowledgement must have the full signature of the student, his/her name, class, academic year and date as shown in the **Appendix 3.**

3.5 Abstract – Abstract should be one page synopsis of the project report typed in 1.5 line spacing, Font Style Times New Roman and Font Size 12.

3.6 Table of Contents – The table of contents should list all material following it as well as any material which precedes it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents of the project report is given in **Appendix 4.**

3.7 List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head.

3.8 List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head.

3.9 List of Symbols, Abbreviations and Nomenclature – One and a half spacing should be adopted or typing the matter under this head. Standard symbols, abbreviations etc. should be used.

3.10 Chapters – The chapters may be broadly divided into 3 parts (i) Introductory chapter, (ii) Chapters developing the main theme of the project work (iii) and Conclusion.

The main text will be divided into several chapters and each chapter may be further divided into several divisions and sub-divisions.

Each chapter should be given an appropriate title.

Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.

Footnotes should be used sparingly. They should be typed single space and placed directly underneath the very same page, which refers to the material they annotate.

3.11 Appendices – Appendices are provided to give supplementary information, which if included in the main text, may serve as a distraction and cloud the central theme.

Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc.
Appendices, Tables and References appearing in appendices should be numbered and referred to at appropriate places just as in the case of chapters.

Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

3.12 List of References –The listing of references should be typed 4 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. The reference material should be listed in the alphabetical order of the first author. The name of the author/authors should be immediately followed by the year and other details.

A typical illustrative list given below relates to the citation example quoted above.

REFERENCES [<Book, journal, Web resources>]

1. William Stallings , Data and Computer Communications, prentice Hall, 2000, pp 203-07

2. Barnard, R.W. and Kellogg, C. (1980) 'Applications of Convolution Operators to Problems in Univalent Function Theory', Michigan Mach, J., Vol.27, pp.81–94.

3. http://www.compadre.org/PSRC/items/Load.cfm?ID=143

Table and figures - By the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non-verbal materials used in the body of the project work and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures.

4. TYPING INSTRUCTIONS:

The impression on the printed (computer typed) copies should be black in colour.

One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style 'Times New Roman' and Font size 14.

* * * * *

APPENDIX 1

(A typical Specimen of Cover Page and Title Page)
<Font Style Times New Roman – Bold>

TITLE OF PROJECT REPORT

<Font Size 18><1.5 line spacing>

A PROJECT REPORT

<Font Size 14>

Submitted by

<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)

<Font Size 16>

in partial fulfillment for the award of the degree

of

<Font Size 14><1.5 line spacing><Italic>

NAME OF THE DEGREE

<Font Size 16>

IN

BRANCH OF STUDY
<Font Size 14>

NAME OF THE COLLEGE

<Font Size 14>

UNIVERSITY OF PUNE, PUNE 411 007

<Font Size 16><1.5 line spacing>

MONTH and YEAR

<Font Size 14>

SPECIMEN

THE STUDY OF SOME CHARACTERISTICS OF AN ELECTRET MICROPHONE

A PROJECT REPORT

Submitted by

MANGESH PATIL

SHIVANI G.

In partial fulfillment for the award of the degree

Of

BACHELOR OF SCIENCE

In

PHYSICS

ABC COLLEGE OF SCIENCE , TIMBAKTOO

UNIVERSITY OF PUNE, PUNE 411 007

MARCH 2010

APPENDIX 2

Examination Seat No:

(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

UNIVERSITY OF PUNE, PUNE 411 007

<Font Style Times New Roman – size -18>

BONAFIDE CERTIFICATE

<Font Style Times New Roman – size -16>

<Font Style Times New Roman – size -14>

Certified that this project report **"…….TITLE OF THE PROJECT……..."**

is the bonafide work of "**……..NAME OF THE CANDIDATE(S).……"** of T.Y.B.Sc (Physics) during the academic year 20<<XX-XX>> who carried out the project work under my supervision.

<<Signature of the Guide >>
SIGNATURE WITH DATE

<<Name>>

GUIDE

<<Department>>

<<Signature of the Head of the Department >>
SIGNATURE WITH DATE

<<Name>>

HEAD OF THE DEPARTMENT

<<Academic Designation>>

<<Department>>

<< College, city and PIN code >>

Internal Examiner

<<Signature>>

<< College, city and PIN code >>

date: << >>

External Examiner

<<Signature>>

APPENDIX 3

(A typical specimen of the acknowledgement)

<< Font Times New Roman, Case UPPER, Bold 16>>

ACKNOWLEDGEMENT

I wish to thank the Principal << correct initials and surname >> of my college for permitting me to use all the facilities available in the institution for my project work. I would also like to thank the Head of the Physics department << correct initials and surname>>, the teaching faculty and all the non-teaching staff of my college for their support in completing the work successfully.

I am grateful to my Guide << correct initials and surname>> for his encouragement, guidance and supervision of my project work during the year. I was fortunate to have received sponsorship for my project work from << name of agency>>. I express my thankfulness to them. I must acknowledge the financial support given to this project by << name>> without which it would have been difficult to complete the work in time.

My classmates have been of great help to me during the project work. My ideas were shaped and refined progressively through my discussions with them from time to time. I cannot miss to thank them all. There were some persons like << name(s)>> who were not directly but indirectly involved in my preparatory/practical work. I heartily appreciate their contribution and thank them too.

Date: 12 March 2010

<<Signature of the student>>

<<Full name of the student>>

<<Class:>>

<<Year: >>

APPENDIX 4

(A typical specimen of table of contents)

<Font Style Times New Roman>

TABLE OF CONTENTS

BOOKS ON EXPERIMENTAL PHYSICS

1. Laboratory Physics, Parts A and B – Berkeley Physics Laboratory
2. Laboratory Physics (laser Expt) – Berkeley Physics Laboratory
3. University Practical Physics with Viva Voce – C K Bhattacharya (C B S Publications, Delhi)
4. A Textbook of Practical Physics – Brijlal and Subramanyam
5. Introduction to Experimentation – B J Brinkwork (The English University Press Ltd.)
6. Advanced Practical Physics, Vol I and II – M S Chauhan and S P Sinha
7. Experimental Physics – C Daish (Hodder and Sons, 1970)
8. Practical Physics for B.Sc. Major – A Dhanalaxmi and A Williams (Popular Book Depot, Madras)
9. Experiments in Electronics – Panik S Jabbar
10. Digital Electronics Practice using – Jain and Anand Integrated Circuits (Tata Mc Graw Hill)
11. Radiation Detectorss – S S Kapoor, V S Rama Moorthy
12. A Laboratory Manual of Physics for Undergraduate Classes - D P Khandelwal (Vani Publishing House, New Delhi)
13. Instrumentation - Franklin Kirk, Nicolu Hombai
14. Designing with TTL Integrated Circuits – Robert L Morris, John R Miller (Texas Instruments)
15. Advanced Level Practical Physics – M Nelson and J M Ogborn
16. Experiments in Modern Physics – Olon
17. Understanding Circuits and Opamps – Concepts, experiments and troubleshooting Dale R Patrick, (Prentice Hall, Englewood Cliffs) and Stephen W Faxlo
18. B.Sc. Practical Physics – K Hanumantha Rao (Maruthi Book Dept, Guntur) D P Siva Ramrah and V Krishna Murthy
19. Physics Through Experiments, 1-B L Saraf EMF-Constant and Varying and D P Khandelwal (Vikas Publishing House, New Delhi)

20. Physics Throught Experiments, 22-B L Saraf Mechanical Systems and D P Khandelwal (Vikas Publishing House, New Delhi)
21. Electronic Circuits, II Ed- L Schilling and Velove (Mc Graw Hill)
22. Digital Integrated Circuits – M C Sharma (Business Promotion Bureau, Delhi)
23. Advanced Practical Physics – S S Sharma (Ratan Prakashan Mandir)
24. B.Sc. Practical Physics – Harnam Singh (S Chand and Co)
25. Advanced Practical Physics – S P Singh (Pragati Prakashan, 1985)
26. Experimental Nuclear Physics – R M Singru (Wiley Eastern, 1972)
27. Experiments in Mechanics – R S Sirohi
28. A Course of Experiments with He-Ne Laser – R S Sirohi (I.I.T. Madras)
29. Practical Physics – E M Somekh (Chatto Window Educational Ltd. London) and F C Brown
30. Practical Physics, III Ed. – G L Squires Cambridge University Press, Cambridge)
31. Electronic Devices: Circuits and Application – W D Stanley (Prentice Hall, New Jersey, USA)
32. A Textbook of Practical Physics – M N Srinivasan (Sultan Chand and Sons. New Delhi)
33. Experiments in Electronics – S.V.Subramanyam (Macmillan India Ltd. 1983)
34. Practical Physics for B.Sc. Physics Main – N.Sundaresan Parts I and II (Eswari Publications, Tiruchy)
35. Laboratory Notes on Electrical and Galvanomagnetic Measurements, Materials Science Monographs 2 (Elsevier, 1979) – H H Wieder
36. Advanced Practical Physics for Students – B.L.Worsnop and (Asia Publishing House, 1961) H T Flint
37. Experimental Crystal Physics – W A Wooster (Claredon Press, 1970) A Breton
38. Kaye and Laby Talks of Physics and Chemical Const. (Longman, London)

39. Manual for Practical Physics – I, II and III years prepared by Association of Physics Teachers of Mangalore University
40. Instrumentation – Rangan, Sarma and Mani
41. Instrumentation – Nakra and Choudhari
42. Beyond Agricultural Electronics – American Society of Agri. Engg.
43. Process Control System – F.G.Shinsky (McGraw Hill)
44. The Complete book of the Green House – Ian g Walls (Ward Lock Ltd, London)
45. Treatise on Agrophysics and agroelectronis – G.N.Acharya, D.G. Hapse (Vasantdada Sugar Institute, Manjari, Pune)
46. The Art of Electronics – Paul Horowitz, Winfield Hill (Cambridge Univ. Press)
47. Principles of Electronics – A.P. Malvino
48. Modern Digital Electronics – R.P. Jain (Tata Mc Graw Hill)
49. Electrical and Electronic Instrumentation – A W Sawhney
50. Electronic Instrumentation – Kalsi
51. Microprocessor Programming – Leventhol
52. Microprocessor Principles and Applications – Ajit Pal
53. Programming with C – Schaum Series
54. Let us C – Yashwant Kanitkar
55. Computer Oriented Numerial Methods – V Rajaraman
56. C Programming Language – Keveningham and Ritchie
57. Experiments in Solid Status Physics – Pune University Manual
58. High Vacuum Technology – J Yarwood (Chapman and Hills)
59. Motion Picture Technology – L.B.Happe
60. A Course in regrigeration and air-conditioning – S.Domkundwar (DhanpatRai and Sons)
61. Introduction to biomedical Electronics – Joseph Bovy (Mc Graw Hill)
62. Handbook of biomedical Instrumentation – R.S. Khandpur
63. An Introduction to atmospheric Physics – Fleagle and Businger (International Geophysics series vol iii the upper atmosphere)

64. Radioisotope application engineering – J.Kohl, R.Zenter, H.Lukens (Van Nostrand Co. New York)
65. Martial Science and Engineering – Raghvan
66. Elements of Material Science and Engg. – L.H.Van Vlack
67. Electronic Fundamentals and Application – John Ryder
68. Acoustics – Seto (Schaum series)
69. Acoustic Measurements – L.Beranek
70. Fundamentals of acoustics – Kinsler and Frey
71. Solar Energy – Fundamentals and Engg. Applications – Greg and Prakash (Tata Mc Graw Hill)
72. Solar Cells – M A Green
Solar Energy conversion – S.P. Sukhatme
73. Solar Thermal Engineering – J A Duffie (Academic Press)
74. Terrestrial Photovoltaics – T.Bhattacharya
75. Electronic communication – Roddy Coolen

LIST OF MAJOR EQUIPMENTS/INSTRUMENTS REQUIRED FOR UNDERGRADUATE LABORATORY:

1. Signal generators
2. Function generators
3. D.C. and A.C. voltmeters
4. D.C. and A.C. ammeters
5. D.C. power supplies – 0-30 V, 1 amp continuously variable
6. D.C. power supplies: 5 V, 1 amp; +/-12 V, 500 mA
7. Single and dual trace oscilloscopes
8. Graphic equalizer
9. Loundspeakers 250 mW, 5 W and 20 W
10. Sound pressure level meter
11. Public address system
12. Microphones (carbon, condenser, dynamic etc,)
13. Loudspeaker horns
14. Spectrometers
15. Gratings – of varying number of lines per unit length
16. Prisms – ordinary glass, double refracting
17. Lasers – pointers, He-Ne > 2 mW power output
18. Small boilers for heat experiments
19. Half degree resolution thermometers
20. Retort stands
21. Metal rods of various compositions
22. Electronic components commonly required such as resistors of different values

(quarter/half watt), capacitors of different values and working voltages, transformers (6,9,12 volts 250/500/1000 mA), zener diodes, rectifier diodes, general purpose and power transistors, integrated circuits including logic gates, opamps and timers etc.

23. Made to order apparatus for various experiments such as study of Hall Effect:

Electromagnets, Gaussmeter, probes etc.

Essential glassware like beakers, measuring cylinders, capillaries etc.

24. A good quality balance (physical or electronic) Pan balance

25. Vernier calipers, micrometer screws gauges etc.

26. Optical benches, sources of light for white light, monochromatic light along with ballast etc. Discharge tubes (neon/hydrogen etc), luxmeter

Radioactive sources for nuclear physics experiments, absorption plates, G.M. tube apparatus.

27. Electronic timers with display or stop watches/stop clocks

28. Complete set of tools including pliers, cutter, soldering iron, screwdrivers of various types

29. Copper clad for making printed circuit boards, chemicals such as HCL, $FeCl_3$ etc.

30. Heating arrangement (electrical or gas burners)

31. Aspirators or similar water reservoirs, pinch cocks, rubber tubing etc.