# UNIVERSITY OF KERALA

REVISED SYLLABI FOR
FIRST DEGREE PROGRAMME IN

# PHYSICS

UNDER

CHOICE BASED-CREDIT & SEMESTER-SYSTEM (CBCSS)

**(2014 admission onwards)**

**I. General Structure for the First Degree Programme in Physics**

| Sem. No. | Course title | Instructional hours/week | | Credit | Uty.Exam duration | Evaluation | | Total credit |
|---|---|---|---|---|---|---|---|---|
| | | **L** | **P** | | | Internal | Uty. exam | |
| I | EN1111 English Lang I | 5 | | 4 | 3 hours | | | |
| | 1111 Addl Lang I | 4 | | 3 | „ | | | |
| | EN1121 Foun Course I | 4 | | 2 | „ | 25% | 75% | 16 |
| | PY1141 Core Course I | 2 | | 2 | „ | | | |
| | Core pract. I | - | 2 | - | - | | | |
| | MM1131.1 Compl. Course I | 4 | | 3 | 3 hours | | | |
| | Compl. Course II (CH1131.1/ST1131.2/EL1131) | 2 | 2 | 2 | „ | | | |
| II | EN1211 Eng Lang. II | 5 | | 4 | 3 hours | | | |
| | EN1212 Eng Lang. III | 4 | | 3 | „ | | | |
| | 1211 Addl Lang. II | 4 | | 3 | „ | 25% | 75% | 17 |
| | PY1221 Foun Course II | 2 | 2 | 2 | „ | | | |
| | MM1231.1 Compl. Course III | 4 | - | 3 | „ | | | |
| | Compl. Course IV (CH1231.1/ST1231.2/EL1231) | 2 | 2 | 2 | „ | | | |
| III | EN1311 Eng Lang. IV | 5 | | 4 | 3 hours | | | |
| | 1311 Addl Lang. III | 5 | | 4 | „ | | | |
| | PY1341 Core Course II | 3 | - | 3 | „ | 25% | 75% | 18 |
| | Core Pract I | - | 2 | - | - | | | |
| | MM1331.1 Compl. Course V | 5 | - | 4 | 3 hours | | | |
| | Compl. Course VI (CH1331.1/ST1331.2/EL1331) | 3 | 2 | 3 | „ | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| IV | EN1411 Eng Lang. V | 5 | | 4 | 3 hours | | |
| | 1411 Addl Lang. IV | 5 | | 4 | „ | | |
| | PY1441 Core Course III | 3 | | 3 | „ | 25% | 75% | 25 |
| | PY 1442 Core (Pract I) IV | - | 2 | 3 | „ | | |
| | MM1431.1 Compl. Course VII | 5 | - | 4 | 3 hours | | |
| | Compl. Course VIII | 3 | - | 3 | „ | | |
| | (CH1431.1/ST1431.2/EL1431) | | | | | | |
| | Compl. (Practical) IX | - | 2 | 4 | „ | | |
| | (CH1432.1/ST1432.2/EL1432) | | | | | | |
| V | PY1541 Core Course V | 4 | - | 4 | 3 hours | | |
| | PY1542 Core Course VI | 4 | - | 4 | „ | | |
| | PY1543 Core Course VII | 4 | - | 4 | „ | 25% | 75% | 18 |
| | PY1544 Core Course VIII | 4 | - | 4 | „ | | |
| | Core (PracticalII) | - | 4 | - | - | | |
| | Open Course | 3 | - | 2 | 3 hours | | |
| | (PY1551.1/PY1551.2/ | | | | | | |
| | PY1551.3/PY1551.4/ | | | | | | |
| | PY1551.5) | | | | | | |
| | Project | - | 2 | - | - | | |
| VI | PY1641 Core Course IX | 4 | - | 4 | 3 hours | | |
| | PY1642 Core Course X | 4 | - | 4 | „ | | |
| | PY1643 Core Course XI | 4 | - | 4 | „ | 25% | 75% | 26 |
| | PY1644 Core Course XII | 4 | - | 3 | „ | | |
| | PY1645 Core (Pract II) XIII | - | 2 | 2 | „ | | |
| | PY1646 Core (Pract III) XIV | - | 2 | 3 | „ | | |
| | Elective Course | 3 | - | 2 | „ | | |
| | (PY1661.1/PY1661.2/ | | | | | | |
| | PY1661.3/PY1661.4/ | | | | | | |
| | PY1661.5) | | | | | | |
| | PY1647 Project | - | 2 | 4 | - | | |

## II. Course structure:(1a). *Core Courses (theory)*

| Sem. | Title of paper | Number of hours per week | Number of credits | Total hours/ semester | UE Duration | Weightage | |
|---|---|---|---|---|---|---|---|
| | | | | | | IA | UE |
| 1 | PY1141 – Basic mechanics & Properties of matter | 2 | 2 | 36 | 3 hrs | 1 | 3 |
| 2 | PY1221- Classical Mechanics (Foundation course 2) | 2 | 2 | 36 | 3 | 1 | 3 |
| 3 | PY1341–Thermodynamics & Statistical Physics | 3 | 3 | 54 | 3 | 1 | 3 |
| 4 | PY1441-Electrodynamics | 3 | 3 | 54 | 3 | 1 | 3 |
| 5 | PY1541– Methodology in Physics & Relativistic Mechanics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1542–Quantum Mechanics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1543–Electronics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1544–Atomic & Molecular Physics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1551– Open course | 3 | 2 | 54 | 3 | 1 | 3 |
| | PY1641-Solid State Physics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1642–Nuclear & Particle Physics | 4 | 4 | 72 | 3 | 1 | 3 |
| 6 | PY1643- Classical & Modern Optics | 4 | 4 | 72 | 3 | 1 | 3 |
| | PY1644- Computer Science | 4 | 3 | 72 | 3 | 1 | 3 |
| | PY1661– Elective Course | 3 | 2 | 54 | 3 | 1 | 3 |

**(1b). COURSE STRUCTURE FOR PRACTICALS AND PROJECT WORK**

**FOR THE CORE COURSE:**

| Sem | Title of Paper | Duration of Exam | Number of credits | Weightage IA | Weightage UE | Allotted hours | |
|---|---|---|---|---|---|---|---|
| | | | | | | Per week | Per year |
| 4 | PY1442- Mechanics, Properties of mat ter, Error measurements, Heat and Acoustics | 3 | 3 | 1 | 3 | S1---2<br>S2---2<br>S3---2<br>S4—2 | 144 |
| 6 | PY1645–Optics, Electricity and magnetism | 3 | 2 | 1 | 3 | S5---2<br>S6—2 | 72 |
| 6 | PY1646-Electronics and Computer science | 3 | 3 | 1 | 3 | S5---2<br>S6—2 | 72 |
| 6 | PY-1647-Project | - | 4 | - | 4 | S5-2<br>S6-2 | 72 |

## 2(a). Complementary Courses (General structure)

| Semester | Theory | | | Practical | | Weightage (For both theory & practical) | |
|---|---|---|---|---|---|---|---|
| | Number of hours/week | Number of credits | Total hours/sem | number of hours/week | Number of credits | IA | UE |
| 1 | 2 | 2 | 36 | 2 | - | 1 | 3 |
| 2 | 2 | 2 | 36 | 2 | - | 1 | 3 |
| 3 | 3 | 3 | 54 | 2 | - | 1 | 3 |
| 4 | 3 | 3 | 54 | 2 | 4 | 1 | 3 |

**(2b). COMPLEMENTARY COURSES (Theory and Practical)**

**1. Physics for Mathematics B.Sc Programme**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | CE | UE |
| 1 | PY1131.1- Mechanics & properties of matter | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | PY1231.1- Heat and Thermodynamics | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | PY1331.1- Optics, magnetism & electricity | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | PY1431-Modern Physics & Electronics | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | PY1432-Practical | 2 | 4 | | 36 | | | |

**2. Physics for Chemistry and Polymer Chemistry B.Sc Programmes**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | IA | UE |
| 1 | PY1131.2-Rotational dynamics & properties of matter | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | PY1231.2- Thermal Physics | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | PY1331.2- Optics, Magnetism & Electricity | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | PY1431.2-Atomic physics, Quantum mechanics & Electronics | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | PY1432- Practical | 2 | 4 | | 36 | 3 | 1 | 3 |

**3. Physics for Statistics B.Sc Programme**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | IA | UE |
| 1 | PY1131.3- Mechanics & properties of matter | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | PY1231.3- Thermal Physics & statistical mechanics | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | PY1331.3- Physical and modern optics & electricity | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | PY1431.3- Modern physics & Electronics | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | PY1432- Practical | 2 | 4 | | 36 | 3 | 1 | 3 |

**4. Physics for Geology B.Sc Programme**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | IA | UE |
| 1 | PY1131.4- Mechanics & properties of matter | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | PY1231.4- Thermal Physics & Physics of the Earth | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | PY1331.4- Optics and electrodynamics | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | PY1431.4- Modern Physics, Electronics & crystallography | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | PY1432- Practical | 2 | 4 | | 36 | 3 | 1 | 3 |

**5. Physics for Home Science B.Sc Programme**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | IA | UE |
| 1 | PY1131.5- Mechanics & properties of matter | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | PY1231.5- Thermal Physics | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | PY1331.5- Optics and electricity | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | PY1431.5- Atomic physics & Electronics | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | PY1432- Practical | 2 | 4 | | 36 | 3 | 1 | 3 |

**6. Electronics for Physics B.Sc Programme**

| Semester | Title of the course | No. of hours/ week | No. of credits | Total credits | Total hours per sem. | UE duration | Weightage | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | IA | UE |
| 1 | EL1131- Electronics I | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 2 | EL1231- Electronics II | 2 | 2 | 2 | 36 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 3 | EL1331- Electronics III | 3 | 3 | 3 | 54 | 3 | 1 | 3 |
| | Practical | 2 | | | 36 | | | |
| 4 | EL1431- Electronics IV | 3 | 3 | 7 | 54 | 3 | 1 | 3 |
| | EL1432- Practical | 2 | 4 | | 36 | 3 | 1 | 3 |

## AIM AND OBJECTIVES OF THE PROGRAMME

In this programme, we aim to provide a solid foundation in all aspects of physics and to show a broad spectrum of modern trends in physics and to develop experimental, computational and mathematical skills of students. The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of physics by providing a more complete and logical framework in almost all areas of basic
physics.

The programme also aims

(i) to provide education in physics of the highest quality at the undergraduate level and generate graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.

(ii) to attract outstanding students from all backgrounds.

(iii) to provide an intellectually stimulating environment in which the students have the opportunity to develop their skills and enthusiasms to the best of their potential.

(iv) to maintain the highest academic standards in undergraduate teaching.

(v) to impart the skills required to gather information from resources and use them.

(vi) to equip the students in methodology related to physics.

### Objectives

By the end of the first year ($2^{nd}$ semester), the students should have,

(i) attained a common level in basic mechanics and properties of matter and laid a secure foundation in mathematics for their future courses.

(ii) developed their experimental and data analysis skills through a wide range of experiments in the practical laboratories.

By the end of the fourth semester, the students should have

(i) been introduced to powerful tools for tackling a wide range of topics in
Thermodynamics, Statistical Mechanics and Electrodynamics.

(ii) Become familiar with additional relevant mathematical techniques.

(iii) Further developed their experimental skills through a series of experiments which also illustrate major themes of the lecture courses.

By the end of the sixth semester, the students should have

(i) covered a range of topics in almost all areas of physics including quantum physics, solid state physics,

computational physics, electronics etc.

(ii)had experience of independent work such as projects, seminars etc. (iii) developed their understanding of core physics.

## PY1141:BASIC MECHANICS & PROPERTIES OF MATTER
**(36 HOURS-2 CREDITS)**

### MECHANICS (22 hrs.)

**Unit 1- Dynamics of Rigid Bodies (7 hrs)**

Equations of motion for rotating rigid bodies-angular momentum and M.I-Theorems on M.I- calculation of M.I of bodies of regular shapes- uniform rod, ring, disc, annular ring, solid cylinder, hollow cylinder and solid sphere-KE of rotating and rolling bodies-torque-Determination of M.I of a fly wheel (theory, experiment and applications).

**Unit 2- Conservation of energy (3 hrs)**

Conservation laws-Work –power- Kinetic Energy – Work Energy theorem-Conservative Forces -potential energy – Conservation of energy for a particle– energy function- Non Conservative forces- Friction- types of friction.

**Unit 3-Oscillations (12 hrs)**

Simple harmonic motion – Energy of harmonic oscillators-simple pendulum-mass on a spring-oscillation of two particles connected by a spring- compound bar pendulum - interchange ability of suspension and oscillation-four points collinear with C.G about which the time period is the same-conditions for maximum and minimum periods - Determination of g using symmetric bar pendulum.Mechanical and electromagnetic wave motion- General equation of a wave motion-expression for a plane progressive harmonic wave- energy density for a plane progressive wave- transverse waves in stretched string (expression)- longitudinal waves in rods- longitudinal waves in gas. Acoustics-reverberation-Sabines reverberation formula-Determination of absorption coefficient-acoustic Intensity-Factors affecting acoustics of buildings.

### PROPERTIES OF MATTER (14hrs)

**Unit 4- Elasticity (8 hours)**

Modulus of elasticity (revision)-Relations connecting the three elastic modulii- poisson's ratio- bending of beams- bending moment-cantilever-centrally loaded beams and uniformly bent beams-I section girders-torsion of a cylinder-expression for torsional couple -work done in twisting a wire-torsion pendulum-static torsion-theory and experiment.

**Unit 5– Surface Tension (3 hrs)**

Surface tension-molecular explanation of S.T-angle of contact (revision)-shapes of drops -expression for excess of pressure on a curved liquid surface -determination of surface tension by Jaeger's method-capillary rise method-variation of S.T with temperature.

**Unit 6 – Fluid Dynamics (3 hours )**

Streamline and turbulent flow-equation of continuity-Bernoulli's theorem-venturimeter-viscosity-Newton's law- Poisseulle's equation-derivation-flow of blood in human body-Stoke's formula-theory and experiment.

**Books for Study**

1. Mechanics – Hans H.S and Puri S.P, TMH: second edition.
2. Mechanics – J.C Upadhyaya (Ramaprasad)
3. Properties of matter – D.S.Mathur
4. Fundamentals of Physics- Halliday and Resnick

**References**

1. Properties of matter- Brijlal and Subramaniam
2. Principles of Physics- P.V.Naik, PHI.
3. Mechanics and Properties of matter – P.Vivekanandan

**Topics for assignments /discussion in the tutorial session (sample)**

1. Physics-The fundamental science-historical development of mechanics-some implications of the principle of mechanics-The scope of mechanics.
2. Life of eminent physicists- Newton, Einstein, C.V.Raman, Edison.
3. Study of Young's modulus for different types of wood.
4. Study of variation of surface tension for different detergents.

5. Study of viscosity of different types of ink and to arrive at knowledge of its fluidity.

6. Wide applications of Bernoulli's equation.

7. Variation of surface tension with temperature by Jaeger's method

## PY1221-CLASSICAL MECHANICS
**(36 HRS-2 CREDITS)**

**Unit 1 - Particle Dynamics (5 hrs): Book 2; Chapter 3**

Newton's laws of motion – mechanics of a particle – equation of motion of a particle – Motion of a charged particle in electromagnetic field – mechanics of a system of particles.

**Unit 2-Conservation laws and properties of space and time (6 hrs): Book 1; Ch. 5**

Linear uniformities of space and conservation of linear momentum – rotational invariance of space and law of conservation of angular momentum – homogeneity of flow of time and conservation of energy.

**Unit 3- Motion in central force field (10 hrs): Book 2; Chapter 5 & Book 3; Ch. 4**

Equivalent one body problem – motion in central force field – general features of motion – motion in an inverse square law force field – equation of the orbit – Kepler's laws of planetary motion and their deduction.

**Unit 4 - Collisions (6 hrs): Book 1; Chapter 7**

Conservation laws – laboratory and centre of mass systems – kinetic energies in the lab and CM systems – Cross-section of elastic scattering.

**Unit 5 - Lagrangian Dynamics (9 hrs): Book 3; Chapter 2**

Constraints – generalized coordinates – principle of virtual work — D' Alembert's principle, Lagrange's equation from D' Alembert's principle, – applications of Lagrange's equation in simple pendulum, Atwood's machine and compound pendulum (comparison of Lagrangian approach with Newtonian approach).

**Books for study** :

1. Mechanics – H.S.Hans and S.P.Puri (Tata-McGraw Hill).
2. Introduction to classical mechanics – R.G.Thakwale and P.S.Puranik (Tata-McGraw Hill).
3. Classical Mechanics – J C Upadhyaya (Himalaya Publishing House)

**Books for reference**:

1. Classical Mechanics – Goldstein.
2. Classical Mechanics- Vimal Kumar Jain (Ane Books Pvt Ltd)
3. Modern Physics – (Schaum's outlines)

4. Classical Mechanics - Systems of Particles & Hamiltonian Dynamics – Walter Greiner.
5. Concepts of Modern physics-Arther Bieser (Tata-McGraw Hill).
6. Classical Mechanics – N.C Rana and P.S.Joag

## PY1341-THERMODYNAMICS AND STATISTICAL PHYSICS
**(54 HOURS-3 CREDITS)**

**Unit 1.Transference of heat (8 hrs) chapter 8 Ref 3**

Thermal conductivity - determination by Lee's Disc method for bad conductor radial flow of heat, cylindrical flow ,thermal conductivity of rubber, Wiedmann-Franz law.Radiation of heat, Stefan's law, determination of Stefan's constant, solar constant, determination of solar temperature

**Unit 2 Thermodynamics (18 hrs) Ref 2**

Zeroth Law & First law of Thermodynamics, differential form-Thermodynamic processes-Expression for work done in isothermal and adiabatic processes. Application of first law to specific heat and latent heat. Reversible and irreversible processes.

Second law of thermodynamics- Clausius and Kelvin statements-Carnot engine - Principle refrigerator, working and efficiency Otto engine and Diesel engine – working and efficiency.

**Unit 3 Entropy (1 2 hrs .) chapter 6, Ref 3 & Ref 1**

Definition of entropy, change of entropy in reversible and irreversible cycle, Clausius inequality and second law of thermodynamics, entropy and available energy,. Entropy, probability and disorder. Nernst theorem and third law of thermodynamics. phase transition, phase diagram ,first order phase trans ition Clausius-Clepe yron Equation ,higher order phase transition (qualitative study) Liquid Helium, Gibb's Helmhol's

Functions Maxwell's Equations

**Unit 4 Statistical Physics (16hrs ) chapter 9 ,Ref 4**

Statistical probability, Macro& Microstates, Phase space, Statistical ensemble, Postulate of equal probability, Maxwell Boltzmann distribution, Velocity distribution. Indistinguishability of identical particles, Bose Einstein and Fermi Dirac distribution functions, comparison of three statistics, Application of BE & FD statistics, Bose-Einstein condensation.

**Books for study**

1. Thermal and Statistical Mechanics- S.K. Roy (NewAge International)
2. Heat and Thermodynamics –D. S. Mathur (S. Chand &Co)
3. Heat and Thermodynamics- Brijlal & Subrahmanyam (S. Chand &Co)
4. Concepts of Modern Physics – Arthur Beiser (TMH )

**Books for reference**

1. Elements of Statistical Mechanics- Kamal Singh & S. P. Singh (S. Chand & Co)
2. Thermal Physics, Statistical Physics and Solid state Physics – C. J. Babu (Calicut University Press)
3. Statistical mechanics – Sinha (TMH)
4. Heat and Thermodynamics- Zemansky, McGraw-Hill

## PY1441 – ELECTRODYNAMICS
## (54 HOURS-3 CREDITS)

**Unit 1-Electrostatic Field (10hrs)**

Electric field*: Introduction*, Coulomb's Law*, Electric field*, continuous charge distribution*Divergence and curl of electrostatic fields; Field lines, flux and Gauss' law, the divergence of E, applications of gauss's law, the Curl of E Electric potential: Introduction to potential, Comments on potential, Poisson's and Laplace's equations, Potential of a localized charge distribution, electrostatic boundary

Work and energy in Electrostatics: The work done to move a charge, the energy of a point charge distribution, The energy of a continuous charge distribution.

**Unit 2-Electrostatic fields in matter (10 hrs)**

Polarization: Dielectrics, induced dipoles, Polarization, The field of a polarized object: Bound charges, Physical interpretation of bound charges, and the field inside a dielectric

Electric displacement: Gauss's law in the presence of dielectrics, Boundary conditions

**Unit 3-Magnetostatics (8hrs)**

Introduction*, The Biot-Savart law*, Ampere's force law*, Magnetic torque, Magnetic flux and gauss's law for magnetic fields, Magnetic vector potential, Magnetic intensity and Ampere's circuital law, Magnetic materials.

**Unit 4-Electromagnetic Induction (8hrs)**

Electromotive force: Ohm's law

Electromagnetic induction: Faraday's law, the induced electric field Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions

**Unit 5-Electromagnetic waves (6hrs)**

Waves in one dimension: The wave equation Electromagnetic waves in vacuum: The wave equation for E and B, Monochromatic plane waves, Energy and momentum in electromagnetic waves

**Unit 6-Transient currents(4hrs)**

Growth and decay of current in LR and CR circuits-Measurement of high resisitance by leakage-Charging and discharging of a capacitor through LCR circuit.

**Unit 7-Alternating current (4 hrs)**

AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q- factor, Power in AC-power factor - AC bridges Maxwell's L/C bridge and Owens's bridge.

**Unit 8-Circuit Theory (4 hrs)**

Ideal voltage and current sources- Thevenin's and Norton's theorems, Maximum power transfer theorem, h parameters applied to two port networks

* Revision topics

**Books for study**

1. Electrodynamics - David J Griffith (PHI 3rd edition)
2. Electricity and Magnetism-Murugesan (S.Chand & Co.)
3. Electricity and Magnetism -_K.K.Tiwari (S.Chand & Co.)

**Reference Books**

1. Electromagnetic theory fundamentals- Bhag Guru and Huseyin Hizirogulu (Cambridge University Press 2nd edition)
2. Electricity and Magnetism – E.M. Purcell, Berkley Physics course, Vol.2 (MGH)
3. Electricity and Magnetism – J.H. Fewkes & John Yarwood (University tutorial press
4. Electricity and Magnetism- D.C.Tayal (Himalaya Publishing Co)
5. Electricity and Magnetism_ - Muneer H. Nayfeh & Norton K. Bressel (John Wiley & Sons)
6. Classical Electrodynamics- Walter Greiner (Springer International Edition)

7. Electromagnetic waves and radiating systems-Jordan & Balmain (PHI)
8. Electromagnetics, B.B.Laud (Wiley Eastern Ltd.2nd edition)
9. Introduction to electrodynamics-Reitz &Milford (Addison Wesley)

**Topics for discussion in Tutorial session/Assignments (sample)**

1. Comment on how electrostatic energy is stored in a field
2. Discuss the electrostatic properties of conductors
3. What is meant by electrostatic shielding? In what way it help us?
4. Discuss the peculiarities of electric displacement D and electric field E. How they are incorporated in Maxwell's Equations
5. Discuss the properties of linear dielectrics. What differentiates a dielectric to be linear or not
6. Discuss applications of Ampere's circuital law
7. Compare electrostatics and magnetostatics
8. Why magnetic forces cannot do work
9. Discuss about cyclotron motion & cycloid motion
10. Discuss whether there existed any stand-off between ohm's law and Newton's second law
11. A battery has an *emf*. Can this *emf*. is a 'force' ? How will you interpret electromotive force?
12. Discuss the role of motional *emf* in power generation
13. Discuss the orthogonality of E, B and propagation vector k
14. A wave function can have a sinusoidal representation. Solve the wave equation for this function and discuss the various terms related to a wave such as amplitude, frequency, phase, wave number, frequency etc.
15. Complex representation of wave function has good advantage. Why? Discuss the linearity of wave function. (use complex notation)
16. Discuss AC through LC, LR and CR circuits
17. Show that sharpness of resonance is equal to Q- factor
18. What is a choke coil? Discuss the advantage of using a choke coil instead of a resistor

## PY1541: METHODOLOGY IN PHYSICS & RELATIVISTIC MECHANICS

## (72 HRS.- 4 CREDITS)

**Unit 1 Introduction (10 hrs)**

Objectives and motivation in research, research approaches, significance of research, different methods of research, characteristic features of scientific method, different steps of scientific research, literature survey, purposes of literature survey, criteria of good research, features for selecting a problem, scientific researches in India.

**Unit 2 Experimentation & Analysis (12 hrs)**

Design of an experiment; experimentation; observation; data collection; interpretation and deduction, repeatability and replication; Documentation of experiments, Types of experiments. Types of analysis, Statistical testing of hypothesis, null hypothesis, Significance test; Statistics based acceptance or rejection of a hypothesis. Deduction of scientific correlation, patterns and trends.

**Unit 3 Error Analysis (10 hrs)**

Basic ideas of error measurement, uncertainties of measurement, importance of estimating errors, dominant errors, random errors, systematic errors, rejection of spurious measurements

Estimating and reporting errors, errors with reading scales, number of significant digits, absolute and relative errors, standard deviation, error bars and graphical representation.

**Unit 4 Familiarization in Thesis/dissertation writing and Publication of results in a Journal (8 hrs) (Book 1, 2 and 6)**

Thesis/dissertation writing:- Preliminary section (title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface, acknowledgement), main text (abstract, introduction, experimental section, results and discussion), conclusion, references, scope of future study. Paper writing:- general format for a science journal (title of the work- author/authors name- address of the author- abstract- key words- introduction- theory/experimental section- analysis/discussion of results- summary/conclusion- references- list of tables- list of figures).

**Unit 5 - Hamiltonian dynamics (7 hrs)**

Generalized momentum and cyclic coordinates -Hamiltonian function H – conservation of energy – Hamilton's equations –examples of Hamiltonian dynamics – one dimensional harmonic oscillator-two dimensional harmonic oscillator using Cartesian coordinates (comparison of Newtonian, Lagrangian and Hamiltonian approach

**Unit 6 – Frames of reference and Galilean transformation (5 hrs)**

Inertial frames of reference-Galilean transformation-non-inertial frames - reference frame with translational acceleration-uniformly rotating frame- fictitious forces-centrifugal forces and coriolis forces.

**Unit 7 - Special theory of relativity (20 hrs):**

Origin and significance of special theory of relativity – search for universal frame of reference – Michelson-Morley experiment – postulates of special theory of relativity – consequences – Lorentz transformation equations – kinematical consequences of Lorentz Transformation – length contraction – time dilation – twin paradox - transformation of velocity – causality and maximum signal velocity – relativistic optical shifts – space like and time like intervals – variation of mass with velocity – mass energy equivalence – transformation of relativistic momentum and energy – tachyons –four vector and their transformation – experimental evidence for special theory of relativity.

**Books for reference**

1. C.R.Kothari; Research methodology-methods and techniques, New age international publishers
2. Bass, Joel, E and et.al. Methods for Teaching Science as Inquiry, Allyn & Bacon, 2009
3. Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, Conceptual Integrated Science, Addison-Wesley, 2007
4. Newton RG. The Truth of Science: New Delhi, 2nd edition
5. John R. Taylor. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, Univ. Science Books
6. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.
7. Chopra S.C and Cande R.D, Introduction to computers for Engineers, TMH

8. Sanjay Saxena, A first course in computers, Vikas Publishing House Pvt Ptd.

9. http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/

10. Mechanics – H.S.Hans and S.P.Puri (Tata-McGraw Hill).

11. Classical Mechanics – J C Upadhyaya (Himalaya Publishing House)

12. Introduction to classical mechanics – R.G.Thakwale and P.S.Puranik (Tata- McGraw Hill).

**Topics for assignments (sample)**

1. Make a sample data and prepare a model of thesis (report) for an exercise (content can be blank paragraphs or with dashed lines).
2. Collect data based on a topic. eg."mobile use among the students in your college" and write a thesis model (strictly following the format of thesis writing).
3. Make a sample data and prepare a model paper for publication as an exercise (content can be blank paragraphs or with dashed lines).
4. Prepare a model article based on a topic, eg "internet use among the students in your college" for publication (strictly following the format of journal publication).

## PY1542- QUANTUM MECHANICS
**(72 HRS-42 CREDITS)**

**Unit 1–The Emergence of Quantum Mechanics (14 hrs) Book 1; Chapter 1**

Black body radiation- photoelectric effect- The Compton effect-wave properties of matter and electron diffraction-The Bohr atom -The Rutherford planetary model-The Bohr postulates-The correspondence principle.

**Unit 2–The Wave Function (8 hrs) Book 2; Chapter 1 & Book 3**

The Schrödinger equation- The statistical interpretation-probability-normalization-momentum-The uncertainty principle- postulates of quantum mechanics

**Unit 3– The Time -Independent Schrödinger Equation (30 hrs) Book 2; Chapter 2 & Book 3**

Stationary states-infinite square well- The harmonic oscillator-free particle-The Delta-Function potential-The finite square well

**Unit 4 – Formalism (20 hrs) Book 2; Chapter 3 & Book 3**

Linear algebra-Function spaces-The generalized statistical interpretation-The generalized uncertainty principle.

**Books for Study**

1. Quantum Physics (3/e) - Stephen Gasiorowicz, John Wiley and Sons (2003).
2. Introduction to Quantum Mechanics – D.J.Griffiths, PHI (1995).
3. Quantum Mechanics – G. Aruldhas, PHI.

**Books for Reference**

1. Quantum Mechanics: An Introduction (4/e), W. Greiner, Springler (2001)
2. Schaum's Outline of Theory and Problems of Quantum Mechanics, Y. Peleg, R.Pnini, E.Zaarur, Schaum's outline series, MGH (ISBN 0070540187)
3. A Text book of Quantum Mechanics, P.M.Mathews and S.Venkatesan, TMH.
4. A text book of Quantum Mechanics, Ghatak and Lokanathan.
5. Principles of Quantum Mechanics (2/e), R. Shankar, ISBN 0-306-44790-8, Plenum Press.

**PY1543-ELECTRONICS**
**(72 HOURS-4 CREDITS)**

**Unit 1. Diode Circuits: (14 hours); [Ref. 1: Chapter. 2, Ref. 2: Chapter 17, Ref. 3: Chapter 9]**

Extrinsic semi conductor – n-type and p-type semi conductors - PN junction –PN junction under forward and reverse biased conditions – rms value and peak inverse voltage – diode characteristics - ac and dc resistances - half wave and full wave rectifiers (average dc value of current, ripple factor and efficiency) - different types of filters (shunt capacitor, LC and CLC) - breakdown mechanism in diodes - Zener diode-voltage regulator- LED (theory and application)-solar cell-photodiode-Tunnel diode-theory, characteristics and working

**Unit 2. Transistor: (18 hours); [Ref. 1: Chapter 4, Ref. 2: Chapter18]**

Theory of BJT operation - CB, CE and CC characteristics - alpha and beta and gamma - relation between transistor currents - biasing circuits (CE configuration) - stability factors - selection of operating point - ac and dc load lines -Q point- collector feed back; base
resistor and potential divider methods - small signal BJT amplifiers - input and output resistances - graphical analysis of the small signal CE amplifier (frequency response, band width and gain in dB) - small signal CC amplifier (emitter follower) - h parameter - h parameter model equivalent circuit - effect of Q point on AC operation.

**Unit 3. Large signal (power) amplifiers: (6 hours);[Ref. 2: Chapter. 22]**

Amplifier classes and efficiency - class A operation - transformer coupled class A amplifier - class B amplifier - push pull amplifier - basic ideas of class AB and class C operation - multi stage amplifiers - frequency responses - distortion in amplifiers.

**Unit 4. Feedback & Oscillator circuits: (8 hours); [Ref. 1: Chapter. 6, Ref. 2: Chapter. 25]**

Feedback principles – negative feedback – emitter follower – advantages of negative feedback - positive feedback - principle of sinusoidal feedback oscillation - Barkhausen criterion for oscillations - RC phase shift, Wien bridge, Hartley, Colpitt's, and Crystal oscillators (derivations not required)

**Unit 5. Modulation: (6 hours); [Ref. 1: Chapter. 14]**

Fundamentals of modulation - AM, FM and PM -Analysis of AM- frequency spectrum of AM - power in AM - modulated class C amplifier - linear demodulation of AM signal - frequency spectrum for FM - super heterodyne AM receivers.

**Unit 6. Field Effect Transistor: (8 hours); [Ref. 2: Chapters. 15 & 16, Ref. 3, Ref. 4: Chapter. 4]**

JFET- Basic construction - Theory of operation - Static characteristics - Drain characteristics- Advantages - MOSFET – Depletion enhancement MOSFET – Construction – Static characteristics.

Uni-junction Transistor - Construction- operation Silicon Controlled rectifier - Construction-biasing - operation-applications.

**Unit 7. Operational amplifiers (IC741): (12 hours); [Ref. 1: Chapter. 7, Ref. 4: Chapter. 16]**

Introduction – Schematic symbol and pin configuration - circuit configuration and block diagram representation – ideal OP amp. - equivalent circuit – CMRR – dual input, balanced output differential amplifier - voltage gain, input and output resistances – differential mode and common mode – virtual ground principle – parameters of OP amp. - inverting amplifier - non inverting amplifier - differential amplifier - summing

and subtractor amplifiers.

**Books for study:**

1. Basic electronics- Santiram Kal
2. Basic electronics- B. L. Theraja
3. Principles of electronics- V. K. Mehta
4. A first course in Electronics- Anwar A. Khan, Kanchan K. Dey

**Books for references:**

5. Electronic Devices and Circuits- Theodore F.Bogart,Jr. – Universal book stall
6. Electronic devices and Circuit theory- Robert Boylestad & Louis Nashelski- Vth edition PHI
7. Electronic f u n d a m e n t a l s & applications- John D Ryder-Prentice Hall of India Pvt. Ltd.
8. Electronic Communications - Dennis Roddy, John Coolen, Fourth edition.

**Topics for assignments/discussion in the tutorial session (sample)**

1. Electronic projects using flip flops
2. Electronic projects using logic gates
3. Electronic projects using IC 741 OP amp.
4. Electronic projects using timer 555
5. Electronic projects using IC 311
6. Constant voltage power supplies
7. Constant current sources
8. Oscillators of different frequencies
9. Low range frequency generators
10. High range frequency generators
11. Voltage regulated dc power supplies with variable output
12. Voltage regulated dual power supplies with variable output
13. Instrument for the measurement of capacitance
14. Instrument for the measurement of dielectric constant of a liquid/ solid
15. Effect of temperature on electronic components

## PY1544- ATOMIC AND MOLECULAR PHYSICS
## (72 HRS-4 CREDITS)

**Unit 1- Vector Atom Model: (10hrs)(Ref: 2, art. 6.1 to 6.21, pages 98-112)**

Bohr's theory, correspondence principle. Somerfield's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom. Limitation of sommerfield atom model. Vector atom model- Various quantum numbers associated with vector atom model-, L.S andj.j couplings –application of spatial quantization- Pauli's exclusion principle – periodic classification of elements –some examples of electronic configuration with modern symbolic representations- magnetic dipole moment of electron due to orbital and spin motion - Stern and Gerlach experiment- Spin-Orbit coupling.

**Unit 2- Atomic Spectra (14hrs) (Ref: 2, art.6.22 to 6.28)**

Optical spectra-Spectral terms and notations - selection rules - intensity rule and interval rule - fine structure of sodium D lines – hyperfine structure-alkali spectra - Zeeman effect - Larmor's theorem – quantum mechanical explanation of normal Zeeman effect. Anomalous Zeeman Effect –Paschen-Back effect-Stark effect.

**Unit 3- X-ray Spectra (8 hrs) (Ref: 3, art.6.1 to 6.7, pages 147-158 & Ref: 2, art 26.6, pages 386-387)**

Introduction-production of X-ray-properties of X-rays-continuous and characteristics X- ray spectrum-Origin of X-rays-Moseley's law-absorption of X-rays-hydrogen like character of X-ray spectrum-X-ray absorption spectrum.

**Unit 4- Molecular spectra (2 8 hrs) (Ref: 1 appendix C& art. 9.1 to 9.12.5, pages 166-188, 417-419)**

Molecular orbital-hydrogen molecule ion-hydrogen molecule-hybridization electromagnetic spectra-molecular energies-classification of molecules-rotational spectra of diatomic molecules-rotational energy levels-selection rules-rotational spectrum-isotope effect- bond length and atomic mass. Diatomic vibrational spectra-vibrational energy levels-selection rule-vibrational transitions-Rotation-Vibration transitions-I.R spectrometer-electronic spectra sequences and progressions-Frank-Condon principle - Raman scattering-quantum\ theory of Raman scattering-classical description of Raman scattering-vibrational Raman spectra-diatomic molecules-polyatomic molecules- rotational Raman spectra- Raman spectrometer.

**Unit 5- Resonance Spectroscopy (12 hrs)(Ref: 1 art. 9.13.1 to 9.15.2, pages 189-200)**

NMR principle-Resonance condition-NMR spectrometer-chemical shift-indirect spin- spin interaction applications of NMR spectroscopy.ESR principle- Resonance condition - ESR spectrometer-hyperfine interaction-applications of ESR spectroscopy. Moss Bauer spectroscopy principle -isomer shift.

**Books for Reference:**

1. Modern Physics- G.Aruldas and P.Rajagopal, PHI, New Delhi, 2005.
2. Modern Physics by R.Murugesan, S.Chand& Co., Reprint, 2008.
3. Atomic and Nuclear Physics- N.Subramaniam&Brijlal, S.Chand& Co.
4. Atomic Physics - J.B.Rajam, S.Chand&Co.edition.
5. Concepts of Modern Physics by A. Beiser, Tata McGraw-Hill, New Delhi, 6th edition
6. Fundamentals of Molecular Spectroscopy - Banwell (TMH)
7. Spectroscopy- Walker & Straw, Chapman & Hill.
8. Molecular Spectroscopy- G.Aruldas.

**Topics for assignments/discussion in the tutorial session (sample)**

1. History of atom model
2. Rutherford experiment leading to atom model
3. Bohr model of atom and correspondence principle.
4. Molecular bond and electron sharing.
5. Width of spectral lines.
6. Spectroscopic techniques.
7. X-ray diffraction for identification of samples

## PY1551-OPEN COURSES
## (54 HOURS-2CREDITS) FOR EACH COURSES

## PY1551.1. BIO PHYSICS
## (54 HOURS)

**Unit 1 (18 hrs)**

Bio mechanics- biophysics and fluid flow—Gas transport—physics of audition Physics of vision (chapter 1 to 5 of Reference 3)

**Unit 2 Cellular – Molecular biophysics (18 hrs)**

Cell -components-proteins-nucleic acids—physics of bio-membranes -Thermodynamics of bio systems (Chapter 6 to 9 of reference 3 )

**Unit 3 (18 hrs)**

**Radiation biophysics (chapter 18 of reference 1)**

Bio –electronics and Bio Instrumentation (chapter 17 of reference 1) Bio –informatics - (chapter 6 of reference 1) Demonstration of biophysics experiments (reference 3)

**Reference books**

1. Essentials of Biophysics, P.Narayanan, 2nd edn. New Age publishers
2. A text book of biophysics, R.N.Roy, New central book agency Kolkata.
3. Elementary bio physics,P.K.Srivastava,Narosa publishing house ,New Delhi

4. Introduction to Biophysics ,Pranab kumar banerjee,S.Chand& co ,New Delhi
5. Biological science ,Green,Stout,&Taylor, Cambridge university press

## PY1551.2. ASTRONOMY AND ASTROPHYSICS
## (54 HOURS)

**Unit 1-Introduction 4 hrs (Book 2, Chapter 1, P 1 – 6)**
Astronomy and Astrophysics, Importance of Astronomy, Methods of Astronomy and Astrophysics**,** The Scientific Methods, Scope of Astronomy
**Unit 2** - Astronomy **15 hrs (Book 1, Chapter 4, 5, P 65-70, 78-101)**
Birth of the Universe, Ancient astronomy, Medieval Astronomy, Renaissance Astronomy, Modern Astronomy
**Unit 3-The Objects in the Sky 15 hrs ((Book 1, Chapter 6, P 102 -127)**
The Microwave background radiation, The Sun, The Stars, Neutron Stars and Black holes, Supernovae, Galaxies
**Unit 4 -The Solar System15 hrs (Book 1, Chapter 7, P 128-154)**
Sun and Planets, Formation of the Planets, Comets, Planets and Satellites, Asteroids,Meteorites
**Unit 5 -Earth in Space 5hrs (Book 1, Chapter 8 , P 155 -162)**
Motion of the Earth, The Calendar, The Seasons
**Books for Study**
1. Planet Earth, Cesare Emiliani , (Cambridge University Press, 1995)
2. Astrophysics - K. D. Abhayankar (University Press,2001)
**Books for reference**
1. Fundamentals of Geophysics William Lowrie( Cambridge University Press,1997)
2. Modern Physics- R. Murugeshan, Kiruthika Sivaprasath (2007), S.Chand &Company Ltd.
3. Introduction to Astrophysics – Baidyanadh Basu
4. Modern Trends in Physics Vol I , C. J. Babu
5. Space Science –Louise K. Harra& Keith O.Mason(Imperial College Press,London, 2004)

## PY1551.3. APPLIED PHYSICS
## (54 HOURS)

**Unit-1. Electric and Electronic Equipments (12 hrs)**
Electric motor – principles of working, Microwave oven – principle – technical specifications-applications – advantages, Public address system – Block diagram representation – function of each unit - CD player and drives – DVD player and drives – Telephonic communication ( Cable and

cellular ) – Principles (qualitative using block diagrams ) – Cell phone – SIM card - technical specifications – Radio –History of radio revolution – different types of radios – Television – working (qualitative) – Touch screens & ATM (Automatic Telling machine)

**Unit 2. Scientific Instruments (12 hrs)**

Tunneling Electron Microscope (TEM) – What is it – working principle- schematic representation – applications - technical specifications, Scanning Electron Microscope (SEM) - What is it – working principle - schematic representation –applications - technical specifications, Atomic Force Microscope (AFM) - What is it –working principle- schematic representation – applications - technical specifications XRD – Principle and applications – Spectrophotometer working and applications – Scanning Tunneling Microscope.

**Unit 3. Medical Instruments (10 hrs)**

CT Scan – basic principle – applications & advantages, MRI Scan – principle and applications & advantages – X ray - applications & advantages, Echo Cardio Gram (ECG), Ultra sound scan.

**Unit 4. Optical Instruments (10 hrs)**

Microscope, Electron microscope, Camera – History of evolution of camera – Digital camera, Holography, Optical communication net work- building blocks – Over head Projector (OHP), LCD Projector, OMR reader, radar

**Unit 5. Common Mechanical devices (10 hrs)**

Pumps – what is it – working – different types of pumps – Refrigerator – working principle - technical specifications – Heat engines- Automobile engines working (Qualitative description only) – Different types – Brakes – Different types of brakes

**References**

1. Audio and video Systems. R.G.Gupta, Technical Education Series.
2. Mobile Satellite Communication Network (Ch 1 & 2), Ray E Sherrif & Y.Funttu,Wiley India Edn.
3. Television Engineering & Video System, R.G.Gupta, TMH.
4. Electrical Technology (Vol I & II), B.L.Theraja.
5. A Text book of elements of Mech. Engg (page 105-114), S.Trynbaka Moorthy,I.K International Publishing house.
6. Physical principles of electron microscopy- An introduction to TEM, SEM, AFM, Springer, 2005.

## PY1551.4. ENVIRONMENTAL PHYSICS
## (54 HOURS)

**Unit 1 Essentials of Environmental physics (18 hrs)**

Structure and thermodynamics of the atmosphere; composition of air; Green house effect; Transport of matter; energy and momentum in nature; Stratification and stability of the atmosphere; Laws of motion; Hydrostatic equilibrium; General circulation of the tropics; Elements of weather and climate in India.

**Unit 2 Environmental pollution and Degradation :( 18 hrs)**

Factors governing air, water and noise pollution; Air and water quality standards;Waste disposal; Heat island effect; Land and sea breeze; Puffs and Plumes; Gaseous and particulate matter; Wet and dry deposition; Dispersal mechanism of air and water pollutants; Mixing height and turbulence; Gaussian plume models; Dispersion models; Environmental degradation; Thermal and radioactive pollution; Nuclear radiation; Health hazards and safety.

**Unit 3 Environmental Changes and remote sensing (18 hrs)**

Energy sources and combustion processes; Renewable sources of energy; Solar energy, Wind energy, Bio energy, hydro power; fuel cells; and nuclear energy;Forestry and bio-energy; Deforestation; Degradation of soils; Agriculture and land use changes; Changing composition of local and global environment; Remote sensing techniques.

**Books for Study**

1 The Physics of Monsoon:R.N. Kesavamoorthy and N Sankar Rao (Allied Pbl)
2 The Physics of Atmosphere :J.T.Houghton(Cambridge Uty)
3 Renewal Energy Resources:J.Twidell and J Weir (ELBS 1988
4 Numerical Weather Prediction:G.J.Haltiner and R.T.Williams (John Wiley)

## PY1551.5. ENERGY PHYSICS
## (54 HOURS)

**Unit I (7 hrs)**

Various forms of energy – renewable and conventional energy systems –comparison – coal, oil and natural gas – availability – applications – merits and demerits.

**Unit 2 (10 hrs)**

Solar energy - Solar radiation measurements, solar energy collector,principle of the conversion of solar radiation in to heat, Solar energy storage,solar heaters, space cooling, solar ponds, solar cookers, solar distillation, solar furnaces, solar green houses, photovoltaic generation basics, merits and demerits of solar energy.

**Unit 3 (9 hrs)**

Wind energy: Basic principle of wind energy conversion, basic components of wind energy conversion system, wind energy collectors. Energy storage, application of wind energy.

**Unit 4 (9 hrs)**

Biomass energy, classification, photosynthesis, biomass conversion process, gobar gas plants, wood gasification, ethanol from wood, merits and demerits of biomass as energy source

**Unit 5 (9 hrs)**

Energy from Oceans and Chemical energy resources: Ocean thermal energy conversion, energy from waves and tides – basic ideas, nature, applications, merits and demerits.

**Unit 6 (10 hrs)**

Patterns of energy consumption in domestic, industrial, transportation and agricultural sectors – energy crisis and possible solutions – energy options for the developing countries – energy storage and hydrogen as a fuel (basics) – impact due to non-conventional energy sources – global warming.

**Text books**.

1. Non – Conventional Energy Resources by G. D. Rai, Khanna Publishers,2008.
2. Solar energy by G.D. Rai, 5th edition, 1995.
3. Solar Energy Fundamentals and application by H.P. Garg and J. Prakash,
Tata McGraw - Hill Publishing company ltd, 1997.
4. Solar energy by S. P. Sukhatme, Tata McGraw- Hill Publishing company ltd,1997.

**References**

1. Energy Technology by S. Rao and Dr. B.B. Parulekar, 1997, 2nd edition
2. Power Plant Technology by A. K. Wahil. 1993.

## PY1641- SOLID STATE PHYSICS
## (72 HRS-4 CREDITS)

**Unit I- Crystal Structures and interatomic forces (18 hrs) (Book 1: Chapter 1)**

Introduction-crystalline state-basic definitions-Fourteen Bravais lattices and seven crystal systems-elements of symmetry-nomenclature of crystal directions and crystal planes-Miller indices-examples of simple crystal structures-amorphous solids and liquids-interatomic forces-types of bonding.

**Unit 2 – X-ray, Neutron and Electron diffraction (12 hrs) (Book 1: Chapter 3)**

Introduction-generation and absorption of X-rays-Bragg's law- reciprocal lattice and X-ray diffraction-diffraction condition and Bragg'slaw-experimental techniques-neutron diffraction-electron diffraction.

**Unit 3 – Conduction in metals – Free electron model (12 hrs) (Book 1: Chapter 5)**

Introduction-conduction electrons-free electron gas-electrical conductivity-electrical

resistivity versus temperature-heat capacity of conduction electrons -Fermi surface-electrical conductivity-effects of the Fermi surface-thermal conductivity in metals-Hall effect and magneto resistance (Book 2, ch.10 & Book 3, ch.9)-A.C conductivity and optical properties-failure of free electron model.

**Unit 4- Band Theory (5 hrs)(Book 2: Chapter 11, art.11.1, 11.2, 11.3, 11.11)**

Bloch theorem-The Kronig -Penney model-construction of Brillouin zones- conductors, semiconductors and insulators.

**Unit 5- Magnetic Properties of materials (8 hrs) (Book 1: Chapter 9, art.9.1 to 9.11)**

Introduction-review and basic formulae-magnetic susceptibility-classification of materials-Langevin diamagnetism-Para magnetism-magnetism in metals- ferromagnetism in insulators-antiferromagnetism and ferromagnetism-ferromagnetism in metals-ferromagnetic domains.

**Unit 6- Dielectric and Optical properties of materials (9hrs) (Book 1: Chapter 8, Book 2: Chapter 15, art. 15.1 to 15.6)**

Introduction-dielectric constant and polarisability-local field-sources of polarisability-dipolar polarisability- dipolar dispersion-dipolar polarization in solids-ionic polarisability-piezielectricity-ferroelectricity. Absorption processes-photoconductivity-photoelectric effect-photovoltaic effect- photolumonescece-colour centres.

**Unit 7-Superconductivity (8 hrs) (Book 1: Chapter 10)**

Introduction- Zero resistance-perfect diamagnetism or The Meissner effect-The critical field-electrodynamics of superconductors-Theory of superconductivity- tunneling and the Josephson effect-miscellaneous topics (intermediate state, Type I & II superconductors).

**Books for Study:**

1 Elementary Solid State Physics – Principles and Applications, M.A.Omar.

2 Solid State Physics – Structure and Properties of Materials, M.A.Wahab, 2nd edition, Narossa Publishing House.

**Books for Reference** :

1. Introduction to Solid State Physics, Kittel, Wiley & Sons, 7th edition.

2. Concepts of Modern Physics by Beiser, Tata McGraw Hill, 5th Edition, 1997.

3. Fundamentals of Solid State Physics, Saxena-Gupta-Saxena, 9th edition (2004-05), Pragathi Prakasan, Meerut.

4. Fundamentals of Physics, 6th Edition, by D.Halliday, R.Resnick and J.Walker, Wiley. NY, 2001.

5. Physic s, 4th Edition, Vols I, II & II Extended by D.Halliday, R.Resnick and K.S.Krane, Wiley, NY. 1994.
6. The Feynman Lectures on Physics, VoIs. I, II, and III, by R. P. Feynman, RB Leighton and M Sands, Narosa, New Delhi, 1998.
7. Introductory Solid State Physics by H.P.Myers, Viva books, New Delhi, 1998

## PY1642 – NUCLEAR AND PARTICLE PHYSICS
**(72 HOURS-4 CREDITS)**

**Unit 1 - Introduction to the nucleus (14 hrs)**

**(Book 2, art.17.1-17.13, pages 322-343 & Book 1, art. 27.1-27.12, pages 391-405)**

Constituents of nuclei- nuclear charge -binding energy-angular momentum of the nucleus-magnetic moment-nuclear quadrupole moment-nuclear stability-models of nuclear structure-The liquid drop model-shell model-collective model.

**Unit 2 - Radioactivity (10 hrs)**

**(Book 2, art. 18.1-18.10.1, p. 344-364 & Book 1, art. 31.1-31.36, p. 442-476)**

Alpha, beta and gamma rays - rate of decay-half life and mean life-units of radioactivity-conservation laws in radioactive series-decay series-radioactive equilibrium-secular and transient equilibrium -radioactive dating-range of alpha particles-Geiger-Nuttal law- alpha decay-Gamow's theory-alpha particle disintegration energy-beta ray spectra-magnetic spectrograph-origin of line and continuous spectrum -neutrino energy of beta decay-gamma decay-radio isotopes-applications.

**Unit 3 - Nuclear forces (8 hrs)**

**(Book 2 art. 17.11.1-17.13, pages 337-343)**

Two-nucleon system, deuteron problem-nucleon-nucleon potential-spin and magnetic moment-results of proton-proton and proton-neutron scattering experiments-meson theory of nuclear forces.

**Unit 4 - Nuclear radiation detectors and particle accelerators (8 hrs)**

**(Book 1 art. 30.1-30.8, pages 428-441 & Book 2 art. 20.1-20.2, pages 382-385)**

G.M Counter-scintillation counter-Van de Graf generator-cyclotron-synchrocyclotron-betatron.

**Unit 5 – Nuclear reactions (10 hrs)**

**(Book 1: art. 34.1-34.8, pages 483-491 & Book 2 art. 19.3-19.3.1, pages 368-369)**

The Q value equation for a nuclear reaction-threshold energy-nuclear reactions -conservation laws-energy balance in nuclear reaction and Q value-threshold energy of an endoergic reaction-scattering cross section-determination of cross section-reaction mechanism-compound nucleus.

**Unit 6 – Nuclear fission and fusion (12 hrs)**

**(Book 1 art. 35.1-35.9, pages 503-516 & Book 3, pages 566-577)**

Nuclear fission-energy released in fission-Bohr and Wheeler's theory-chain reaction-multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of nuclear reactors. Nuclear fusion-sources of stellar energy-thermonuclear reactions-hydrogen bomb-controlled thermo-nuclear reactions-magnetic bottle-Tokamak- inertial confinement-nuclear power in India.

**Unit 7 - Cosmic rays and elementary Particles (10 hrs)**

**(Book 1, pages 523-529 & Book 2, pages 394-412 & Book 3, pages 159-161)**

Discovery of cosmic rays -latitude effect-altitude effect- primary cosmic rays - secondary cosmic rays-cosmic showers-origin of cosmic rays. Fundamental interactions in nature-classification of elementary particles-conservation law s-lepton conservation-baryon conservation-strangeness-iso-spin-hyper charge-resonance particles-The quark model- Bremstrahling effect-Cerenkov radiations.

**Books for Study**

1. Modern Physics by R. Murugesan, S. Chand & Co., Reprint,2008.
2. Modern Physics- G. Aruldas and P. Rajagopal, PHI, New Delhi, 2005.
3. Nuclear Physics – D. C. Tayal, Himalaya Publishing House, 4th edition.

**References**

1. Concepts of Modern Physics by A. Beiser, Tata McGraw-Hill, New Delhi, 6th edition.
2. Atomic and Nuclear Physics – N.Subramaniam and Brijlal, S.Chand & Co.
3. Nuclear Physics – S.N.Ghoshal, S.Chand & Co.
4. "Nuclear Physics"- Kaplan (Narosa)
5. Atomic Physics – J.B.Rajam, S.Chand & Co.

**Topics for assignments/discussion in the tutorial session (sample)**

1. Fusion reactors.
2. History of the Universe (elementary particle).
3. Linear accelerator.
4. Ionization chamber and Wilson cloud chamber.

5. Solid state detectors and proportional counter.

## PY1643- CLASSICAL AND MODERN OPTICS

**(72 HRS-4 CREDITS)**

**Unit 1. Interference of light (12 hrs)**

**(Book 1: Chapter 14 & 15 and Book 3: chapter 12 & 13)**

The principle of superposition - coherent sources – Double slit interference (theory of interference fringes and band width) - Interference by division of wavefront and amplitude – Fresnel's biprism - interference in thin films – fringes of equal inclination- fringes of equal thickness - wedge shaped films- testing of optical flatness - Newton's rings (reflected system)- refractive index of a liquid - Michelson interferometer – determination of wavelength

**Unit 2. Diffraction (12 hrs)**

**(Book 1: Chapter 17, 18 & 19 and Book 3: Chapter 16 & 17)**

Fresnel diffraction: - Half-period zones - explanation of rectilinear propagation of light– diffraction at a straight edge-zone plate. Fraunhofer diffraction: - Diffraction at a single slit, double slits – plane transmission grating - Rayleigh's criterion for resolution - resolving power of diffraction grating.

**Unit 3. Polarisation (12 hrs) (Book 1: Chapter 20 and Book 3: chapter 19)**

Plane polarized light - polarization by reflection – Brewster's law - pile of plates - Malus law - Double refraction - Huygens explanation for double refraction in uniaxial crystals - Nicol prism - Nicol prism as a polarizer and analyzer – Theory of production and analysis of plane, circularly and elliptically polarized light - quarter and half wave plates.

**Unit 4. Dispersion (6 hrs) (Book 2: Chapter 11)**

Normal dispersion - Elementary theory of dispersion - Cauchy's and Hartmann dispersion formula - anomalous dispersion

**Unit 5. Fiber Optics (8 hrs) (Book 1: Chapter 24 and Book 3: chapter 24)**

Introduction, optical fiber, the numerical aperture, coherent bundle, pulse dispersion in step index fiber, graded index fiber, single mode fiber, multimode fiber, Fibre optic sensors (qualitative), fiber optic communication (qualitative), Advantages of fiber optic communication system.

**Unit 6. Holography: (8 hrs) (Book 1: Chapter 23)**

Principle of holography, recording of holograms, reconstruction of images (Theory not needed), application of holography, different types of holograms, transmission and reflection types.

**Unit 7. Laser: (14 hrs)**

**(Book 2: Ch. 12, Book 1: Ch. 22, Book 3: chapter 23 and Book 4: Ch. 6)**

Basic principle of laser operation Einstein coefficient, light propagation through medium and condition for light amplification population inversion by pumping and cavity threshold condition, line shape function- optical resonators (qualitative) Q factor various laser systems –Ruby laser - He-Ne laser, Dye laser, semiconductor laser, (working principle only) Application of lasers- characteristics of laser beams -spatial coherence - Temporal coherence and spectral energy density Nonlinear optics : Nonlinear Polarization –second harmonic generation – phase matching.

**Books of Study**

1. Text Book of Optics. Subramaniam & Brijlal, M.N.Avadhanulu, 23rd edition (2006)
2. Optics and spectroscopy -R.Murugesan.
3. Optics - Ajoy Ghatak
4. Lasers: Principles, Types and applications – K.R.Nambiar

**References**

1. Optics P.Vivekanandan
2. Fundamentals of Optics - Jenkins and White
3. Modern Classical Optics – Geoffrey Brooker.
4. Principles of Optics - B. K. Mathur
5. Fundamentals of Optics - Khanna and Gulati
6. Lasers &Non-Linear Optics - B. B. Laud
7. Electronic Communications- Dennis Roddy & John Coolen

**Topics for assignments/discussion in the tutorial session (sample)**

1. Michelson's interferometer-Standardization of metre.
2. Diffraction at a rectangular aperture and circular aperture
3. Optical activity-Fresnel's theory of optical rotation.
4. Resolving power of prism and telescope
5. Constant deviation spectrometer.
6. Laurent's half shade polarimeter.
8. Harmonic generation.
9. Laser applications.
10. Study of Fraunhofer lines using spectrometer.
11. Study of absorption spectra of KMnO4.
12. Determination of refractive index of liquid by Newton's rings method.
13. Comparison of radii of curvature by Newton's rings method.

## PY1644-DIGITAL ELECTRONICS AND COMPUTER SCIENCE (72HRS-4 CREDITS)

**Unit-1 (20 hours)**

**1. Number systems** :-Decimal number system-binary number system-conversion of binary number to decimal and decimal number to binary-binary addition and subtraction-1'scomplement- 2's complement-binary subtraction using 2's complement- signed arithmetic operation-conversion of real numbers-conversion of decimal fraction to binary fraction-binary coded decimal- hexa decimal number system- conversion of hexa- decimal number to decimal, decimal to hexadecimal, binary to hexa- decimal and hexa-decimal to binary-ASCII code.**(Textbook1)**

**2. Boolean algebra and logic gates**: - Logic gates AND, OR, NOT, NAND,NOR And Ex-OR gate-realization of other logic functions using NAND / NOR gates-tri state logic gate-Boolean laws- Demorgan's theorem-Simplification of Boolean equations using Boolean laws. Karnaugh map **(Textbook1)**

**3. Arithmetic circuits**:-Half adder-full adder-controlled inverter-binary adder- subtractor. **(Textbook2)**

**4. Sequential circuits**:- Flip-Flop, S-R Flip Flop, J-K Flip-flop, Master slave JK Flip- Flop **(Textbook1)**

**Unit-2 (10hours)**

**5. Basics of computers**:-Hardware- input and output units- memory unit-ALU-control unit–basic operational concepts-Software – operating systems **(Textbook3 and 4)**

**6. The memory systems**- Basic concepts-semiconductor RAM- internal organization memory chips-static memories-asynchronous and synchronous DRAMs-structure of large memories–ROM,PROM,EPROM, EEPROM–flash memory-speed size and cost-Basic concepts of cache memory and virtual memories. Secondary storage-magnetic hard disks-optical disks-magnetic tape systems.**(Textbook3)**

**Unit-3 (24hours)**

**7. Programming in C**:-Importance of C-basic structure of C program-C constants and variables-data types-declaration of variables-assigning values to variables-defining symbolic constants-operators and expressions-input and output functions-reading and writing a character-formatted input-formatted output-control statements-simple IF statement-IFELSE statement-nested IFELSE-SWITCH statement-GOTO statement-loop control structures-WHILE loop-DO loop-FOR loop-jumps in loops- arrays and subscripted variables-functions in C-user defined functions-the form of C function-callinga function-category of functions-recursion-standard library functions-basics of structures and pointers (introduction only)-sequential file management-defining and opening a sequential file-input and output operations on files-closing a file. Simple C programs for solving problems in physics. **(Textbook5)**

**Unit-4(18hours)**

**8. Computer oriented numerical methods**) (Including algorithms):- :-Iterative methods-method of successive bisection to find the roots of an equation-Newton– Raphson iterative method-polynomial equation–interpolation-Lagrange interpolation-least square approximation of functions-linear regression-regression coefficients-algorithm for linear regression-polynomial regression-fitting exponential functions-numerical differentiation and integration-Simpson's rule-Trapezoidal rule-algorithms for integrating tabulated function and known function–numerical solution of differential equations-Euler's method-Runge-Kutta method(second order method only) **(Text book6)**

**Text books:-**

1. Fundamentals of microprocessors and micro-computers by B. Ram, Dhanpat Rai Publications (p) Ltd, NewDelhi (sixth edition)
2. Digital principles and applications by Albert.P. Malvinoand P.Leach,TMH,New Delhi (Fourthedition)
3. Computer organization by Carl Hamcher,ZvonkoVranesicandSafwatZaky(Fifth International edition Indian print)McGraw-Hill
4. Fundamentals of computers by V. Rajaraman, PHI, New Delhi(Fourth edition)
5. Programming in ANSIC by E. Balagurusamy, TMH Publishing company Ltd, New Delhi (Fourthedition).
6. Computer oriented numerical methods by V. Rajaraman, PHI, New Delhi(Third edition)

**Books for reference:-**

1. Introduction to digital electronics-NIIT-PHI.
2. A first course in Computers- Sanjay Saxena-Vikas publishing house PvtLtd
3. Theory and problems of programming with C-Schaumseries-Byron S Gottfried.
4. Graphics under C-Yashavant Kanetkar- BPB Publications-NewDelhi
5. Beginning Linux programming-Neil Mathew and Richard Stones-Wiley India Pvt Ltd.
6. Computational Physics-V K Mittal, RC Vermaand SC Gupta-Ane Books India
7. Numerical methods with Computer programs in C++-Pallab Ghosh-PHI

## PRACTICALS

### PY1442- MECHANICS, PROPERTIES OF MATTER, HEAT AND ACOUSTICS

**(Minimum 16 experiments to be done)**

1. Simple pendulum-Study of variation of period with length, mass and amplitude.
2. Spring mass system-spring constant
3. Fly Wheel - Moment of Inertia
4. Compound Bar Pendulum – Symmetric
5. Compound Bar Pendulum – Asymmetric
6. Uniform Bending---Y---Pin and Microscope
7. Uniform bending—Y- optic lever method
8. Non-uniform bending-Y-Optic lever& telescope
9. Rigidity modulus –Static torsion
10. Torsion pendulum-Rigidity modulus

11. Kater's pendulum-Acceleration due to gravity
12. Melde's string-----Frequency of fork
13. Phase transition-determination of M.P of wax.
14. Determination of thermal conductivity of rubber
15. Lee's disc-determination of thermal conductivity of a bad conductor
16. Viscosity of a liquid-----Stoke's method
17. Viscosity-Continuous flow method using constant pressure head.
18. Viscosity-Variable pressure head arrangement
19. Surface tension-Capillary rise
20. Sonometer-frequency of A.C
21. Kundt's tube-determination of velocity of sound.
22. Comparison of least counts of measuring instruments.
23. Evaluation of errors in simple experiments.

**References**

1. Yarwood and Wittle; Experimental Physics for Students, Chapman &Hall Publishers.
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S.Viswanathan & Co., Chennai.
4. Advanced Practical Physics, B.L.Worsnop and H.T.Flint, Khosla Publishers, Delhi.

## PY1645-OPTICS, ELECTRICITY AND MAGNETISM

**(Minimum 20 experiments to be done )**

1. Spectrometer-A, D and n of a solid prism.
2. Spectrometer –Dispersive power and Cauchy's constants
3. Spectrometer Grating—Normal incidence- N & wavelength
4. Spectrometer-i-d curve
5. Spectrometer- Hollow prism
6. Liquid lens-refractive index of liquid and lens
7. Newton's Rings—Reflected system
8. Air wedge-diameter of a wire
9. Potentiometer-Resistivity.
10. Potentiometer-Calibration of ammeter
11. Potentiometer –Reduction factor of T.G

12. Potentiometer –Calibration of low range voltmeter
13. Potentiometer – Calibration of high range voltmeter
14. Thermoemf-measurement of emf using digital multimeter.
15. Carey Foster's bridge-Resistivity
16. Carey Foster's bridge-Temperature coefficient of resistance.
17. Mirror galvanometer-figure of merit.
18. BG- Absolute capacity of a condenser
19. Conversion of galvanometer into ammeter and calibration using digital Multimeter
20. Conversion of galvanometer into voltmeter and calibration using digital Voltmeter.
21. Circular coil-Calibration of ammeter.
22. Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem.
23. Circular coil-Study of earth's magnetic field using compass box.
24. Absolute determination of m and Bh using box type and Searle's type vibration magnetometers.
25. Searle's vibration magnetometer-comparison of magnetic moments.

**References**

1. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S.Viswanathan & Co., Chennai.
4. Advanced Practical Physics, B.L.Worsnop and H.T.Flint, Khosla Publishers, Delhi.

## PY1646—ELECTRNICS AND COMPUTER SCIENCE
**(Minimum 20 experiments to be done – 5 from Computer Science)**

### ELECTRONICS

1. PN junction Diode (Ge & Si) characteristics-To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.
2. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to calculate the ripple factor with and without shunt filter (10 readings for $R_L$ 100 Ω to 5000Ω).

3. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to study effect of L,C, and LC filters on the ripple factor (for different $R_L$).

4. Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for $R_L$ 100 Ω to 5000Ω).
5. Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.
6. Zener diode characteristics-To draw the I-V characteristic of a Zener diode and to find the break down voltage and the dynamic resistance of the diode.
7. Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same $R_L$.
8. Transistor characteristics-CE-To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance.
9. Transistor characteristics-CB-To draw the characteristic curves of a transistor in the CB configuration and determine the current gain, input impedance and output impedance.
10. Single stage CE amplifier-To construct a single stage CE transistor amplifier and study its frequency response.
11. OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and determine its voltage gain.
12. OP amp. IC741- Non inverting amplifier
To construct a non inverting amplifier using IC741 and determine its voltage gain.
13. OP amp. IC741- Differentiator-To construct an OP amp. Differentiator, determine its voltage gain and study the output response to pulse and square wave.
14. OP amp. IC741- Integrator-To construct an OP amp. Integrator, determine its voltage gain and study the output response to pulse and square wave.
15. Phase shift oscillator-To construct a phase shift oscillator using transistor and measure the frequency of the output waveform.
16. Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.
17. Logic gate- NOT-To verify the truth tables of NOT gate using a transistor.
18. Network theorems (Superposition, Thevenin's & Norton's theorems)
To verify the (i) Superposition, (ii) Thevenin's & (iii) Norton's theorems
19. RC-Filter circuits (Low pass)
To construct an RC –low pass filter circuit and to find the upper cut off frequency.
20. RC-Filter circuits (High pass)-To construct an RC –high pass filter circuit and to find the lower cut off frequency.

**COMPUTER SCIENCE (C- Programs)**

1. Program to find the roots of a quadratic equation (both real and imaginary root)

2. Program to sort a given list containing the name of students and their total marks and print the rank list.
3. Programs to plot the functions Sin x, Tan x and $e^{-x}$ .
4. Program to find the product of two n×n matrices.
5. Program to find the dot product and cross product of vectors

6. Program to simulate the trajectory of the projectile thrown (a) horizontally and (b)at an angle.
7. Program to study the motion of a spherical body in a viscous fluid.
8. Program to study the motion of a body under a central force field.
9. Program to fit a straight line through the given set of data points using least square fitting algorithm.
10. Program to integrate a given function using Simpson's rule.
11. Program to integrate a given function using Trapezoidal rule.
12. Program to find the solution of differential equation by RK2 method.

**References:**

1. Basic electronics and linear circuits; N.N. Bhargava, D.C. Kulshreshtha, S.C.Gupta
2. OP- Amps and linear integrated circuits; Ramakant A. Gayakwad
3. Basic electronics; Santiram Kal
4. Basic electronics; B. L. Theraja
5. Principles of electronics; V. K. Mehta
6. A first course in Electronic s; Anwar A. Khan, Kanchan K. Dey

## PY1661. ELECTIVE COURSES
## (54 HOURS-2CREDITS) FOR EACH COURSES

### PY1661.1 ELECTRONIC INSTRUMENTATION

**Unit 1 (10 hrs) (Ref: 1, Ch.1 & 3; Ref 2, Ch. 1; Ref 3, Ch. 13.1 to 13.4)**

Basic Concept of Measurement- measurement errors- standards of measurement functional elements of an instrument- standard in quality management.

**Unit 2 (10 hrs ) (Ref: 4, Ch.3, 4, & 5)**

Instruments for measuring basic parameters-ammeter-voltmeters-multimeter digital voltmeter-accuracy and resolution of DVM.

**Unit 3 – Oscilloscopes (10 hrs) (Ref: 1, Ch.7; Ref 4, Ch. 7**

Cathode ray tubes- CRT circuits- vertical deflection system- delay line- horizontal deflection system- multiple trace- oscilloscope probes and transducer- storage oscilloscopes.

**Unit 4 – Transducers (10 hrs) (Ref: 4, Ch.13; Ref 5)**

Basic principles- classification of transducers- strain gauges- temperature measurements- thermistors- photosensitive devices- radiation detectors- basic idea of instrumentation amplifier.

**Unit 5 – Signal Generation and Analysis (14 hrs)**

**(Ref: 1, Ch.8 & 9.1 to 9.4.1; Ref 3, Ch.8.1 to 8.4.2)**

Sine wave generator- frequency synthesizer- sweep generator- astable multivibrator- laboratory pulse generator- function generator- wave analysers harmonic distortion analyzer- wave meter- spectrum analyzer (qualitative idea only).

**References**

1. Modern Electronic Instrumentation and Measurement Techniques, Albert D.Helfrick & William D.Cooper, PHI Ltd.
2. Instrumentation-Devices and Systems, C.S.Rangan, G.R.Sarma, V.S.V.Mani, TMH Publishers.
3. Electronic Instruments and Instrumentation Technology, M.M.S.Anand, PHI Ltd.
4. Electronic Instrumentation, 2nd edition, Kalsi H.S, TMH Publishers.
5. Sensors and Transducers, D.Patranabis, Wheeler Publishing Co. Ltd.
6. Industrial Electronics and Control, S.K.Bhattacharya & S.Chatterjee,TMH Publishers.
7. Electronic measurement and Instrumentation, K.B.Klaassen,Cambridge University Press.
8. Measurement Systems-Applications and Design, 5th edition, Ernest O.Doebelin & Dhanesh N.Manik, TMH Publishers.
9. Principles of Measurement systems, John P.Bentley, 3rd edition,(Longman), Pearson Education Publishers.

## PY1661.2. SPACE SCIENCE
## (54 HRS)

**Universe (12 hrs)**

Large Scale Structure of the Universe: Astronomy and Cosmology, Our Galaxy,Galaxy types, Radio sources, Quasars, Structures on the largest scale, Coordinates and catalogues of astronomical objects, Expansion of the Universe

*Ref; Introduction to Cosmology- J. V. Narlikar (1993), Cambridge University Press,Art. 1.1 to 1.8 (Pages 1 to 26)*

**The evolution of Stars (9hrs)**

Introduction, Classification of Stars: The Harvard classification, Hertzsprung –Russel diagram, Stellar evolution, White dwarfs, Electrons in a white dwarf star,Chandrasekhar limit, Neutron stars, Black holes, Supernova explosion, Photon diffusion time, Gravitational potential energy of a star, Internal temperature of a star,Internal pressure of a star.

*Ref; Modern Physics- R. Murugeshan, Kiruthika Sivaprasath, S.Chand & Company Ltd. (2007), Art. 78.1 to 78.15(Pages 963 to 976)*

**The active Sun (10 hrs)**

Introduction, Sunspots and Solar storms, Sunspots and Solar activity, Cosmic rays of Solar origin, The Solar wind, Solar corona and the origin of the solar wind, Disturbed Solar wind.

Ref; Earth's Proximal Space- Chanchal Uberoi (2000), Universities Press (India) Limited, Art. 3.1 to 3.6 (Pages 36 to 55)

**The earth's Atmosphere (15 hrs)**

Introduction, Nomenclature and temperature profile, Temperature distribution in the troposphere, Temperature of stratosphere, temperature of mesosphere and thermosphere,Temperature variability, The pressure profile, Scale height, Density variation.The Ionosphere: Effect on scale height, Ionospheric electric fields, Ionization profile,Layer of charge, Ionospheric hydrogen and Helium.

*Ref; Introduction to Space Science- Robert C. Haymes (1971) John Wiley & Sons Art. 3.1 to 3.9 and 3.12 to 3.17 (Pages 54 to 65 and 69 to 78)*

**Magnetosphere (8 hrs)**

Introduction, The magnetic field of Earth, Earth's variable magnetic field, Solar activity and Earth's magnetic weather, solar wind interaction, The Chapman-Ferraro closed magnetosphere, Dungey's open magnetosphere, Structure of the magnetosphere: Magneto tail and Plasma sheet, Plasma sphere, Earth's radiation belts.

*Ref; Earth's Proximal Space- Chanchal Uberoi (2000), Universities Press (India) Limited, Art. 4.1 to 4.6 and 4.8 to 4.8.3 (Pages 56 to 67 and 71 to 74*

**Books for Study**

1. Introduction to Space Science – Robert C Hymes (1971), John Wiley & Sons Inc.
2. Earth's Proximal Space- Chanchal Uberoi (2000), Universities Press (India)
3. Introduction to Cosmology- J. V. Narlikar (1993), Cambridge University Press
4. Modern Physics- R. Murugeshan, Kiruthika Sivaprasath (2007), S.Chand & Company Ltd.

**Books for reference**

1. Space Physics and Space Astronomy – Michael D Pappagiannis (1972), Gordon and Breach Science Publishers Ltd.
2. Introductory Course on Space Science and Earth's environment-Degaonkar (Gujarat University, 1978)
3. Introduction to Ionosphere and magnetosphere- Ratcliffe (CUP, 1972)
4. The Physics of Atmospheres-Houghton (Cambridge University Press)
5. Introduction to Ionospheric Physics-Henry Rishbeth &Owen K. Garriot (Academic Press, 1969)
6. Space Science –Louise K. Harra& Keith O. Mason(Imperial College Press,London, 2004)
7. Introduction to Space Physics- Kivelson and Russel

8. Introduction to Astrophysics – Baidyanadh Basu
9. Astrophysics - K. D. Abhayankar (University Press)

## PY1661.3. PHOTONICS
## (54 HOURS)

**Unit 1: (7 hrs)**

Photons in semiconductors-semiconductors-energy band and charge carriers-semi conducting materials-electron and hole concentrations -generation, recombination and injection-junctions-hetero junctions-quantum wells and super lattices

**Unit 2: (6 hrs)**

Semiconductor photon sources -light emitting diodes-injection-electroluminescence- LED characteristics- internal photon flux-output photon flux and efficiency-responsivity spectral distribution-materials-response time-device structures.

**Unit 3: (8 hrs)**

Semiconductor laser amplifiers-gain-amplifier band width-optical pumping-electrical current pumping-hetero structures -semiconductor injection lasers-amplification-feedback and oscillators-resonator losses -gain condition-internal photon flux-output photon flux and efficiency-spectral distribution-spatial distribution-single frequency operation quantum well lasers (qualitative).

**Unit 4: (8 hrs)**

Semiconductor photon detectors-The external photo effect-photo electron emission-The internal photo effect-semiconductor photo detection-quantum efficiency-responsivity devices with gain-response time-photoconductors- photo diodes-PIN photo diodes-hetero structure photo diode- Schotky barrier photodiodes - array detectors-avalanche photodiodes-gain and responsivity- response time.

**Unit 5: (8 hrs)**

Electro optic, Pockels and Kerr effects- electro optic modulators and switches –scanners directional couplers-spatial light modulators-electro optics of liquid crystals-wave retarders and modulators-spatial light modulators.

**Unit 6: (7 hrs)**

Non linear optics-second order and third order optical non linearity-intensity dependent refractive index-optical Kerr effect-self focusing.

**Unit 7: (10 hrs)**

Photonic switching and computing-opto mechanical, electro optic, acousto-optic and magneto optic switches-all optical switches- bistable systems-principle of optical bistability- bistable optical devices - optical inter connectors-optical computing-digital optical computing-analog optical processing.

**Book of Study**

1. Fundamentals of Photonics: BFA Saleh and M.C.Teich, John Wiley &Sons, Inc.

**Reference books**

1. Semiconductor optoelectronic devices: Pallab Bhattacharya, Printice Hall of India.
2. Optics and Photonics- An introduction: F. Graham Smith and Terry A.King, John Wiley & Sons, Inc.
3. Lasers and Non linear Optics: B.B.Laud, New Age International Pvt Ltd.

## PY 1661.4 NANOSCIENCE AND TECHNOLOGY

**(54 HOURS)**

### Unit 1 Introduction to Nanoscience and Nanotechnology (10 Hours)

Nanoscience and nanotechnology- Definition-Historical development, scope and applications

**[Book 1, Chapter 1].**

Comparison of bulk and nanomaterials-, classification of nanostructured materials: one, two and three dimensional confinement, size and dimensionality effects - size effects, conduction electrons and dimensionality, Fermi gas and density of states, Potential wells, Partial confinement, Properties dependent on density of states,excitons**.**

**[Book 2 Chapter 9.1, 9.3, 9.4]**

### Unit 2 Properties of nanomaterials and scaling laws (6 Hours)

Introduction, size dependent properties, Properties of nanomaterials-chemical reactivity, solubility, melting points, electronic energy levels, electrical conductivity, Super-paramagnetism, Electron confinement, Integrated optics, Optical properties, Mechanical properties, Thermodynamic properties, scaling laws.

**[Book 1 Chapter 3.1 to 3.4]**

### Unit 3 Synthesis and characterisation (16 Hours)

Synthesis of nanoscale materials and structures, Zero Dimensional materials-Inert gas condensation, Inert gas expansion, Sonochemical processing, Sol-gel deposition, Molecular self assembly, 1D and 2D- Foil beating, Electro-deposition, PVD, CVD, 3D- Rapid solidification, Equiangle extrusion, Milling and Mechanical alloying, Micromachining, Consolidation of nanoclusters and milled powders, Methods for nanoprofiling.

**[Book 3 chapter 8.1]**

Electron microscopy, Scanning probe microscopy, Optical microscopy, XRD **[Book 4, Chapter 2.1 to 2.4, 2.6]**

IR and Raman Spectroscopy, Photoemission and X-ray spectroscopy

**[Book 2 Chapter 3.4]**

**Unit 4 Carbon nanostructures (10 Hours)**

Carbon nanostructures-carbon molecules, carbon clusters, Fullerene-structure of C-60 and its crystal-larger and smaller fullerenes-other bucky balls. Carbon nanotubes-fabrication-structure-electrical properties-vibrational properties-mechanical properties. Applications of carbon nano tubes-Field Emission and shielding- computers-fuel cells-chemical sensors-catalysis-mechanical reinforcement.

**[Book 2, Chapter 5]**

**Unit 5 Nanomachines and nanodevices (12 Hours)**

Resonant Tunneling diode, quantum cascade lasers, single electron transistors- operating principles and applications.

**[Book 5, Chapter 9.1 to 9.4]**

**Books for study**

1 Nanotechnology, An Introduction to synthesis, Properties and Applications of Nanomaterials, Thomas Varghese and KM Balakrishna, Atlantic Publishers and Distributors (P) Ltd, New Delhi
2 Introduction to Nanotechnology, Charles P. Poole Jr and Frank J Ovens, Wiley Interscience, USA
3 Nanomaterials, Nanotechnologies and design, Michael F Ashby, Paulo J Ferreira and Daniel L Schodek, Elsevier Publishers, UK
4 Nano, The Essentials, T. Pradeep, Tata Mc Graw Hill, New Delhi
5 Nanotechnology and Nanoelectronics, W.R. Fahrner, Springer, Newyork.

**References**

1 Encyclopedia of Nanoscience and Nanotechnology, H.S.Nalwa (Ed), American Scientific Publishers, Los Angels
2 Nanotubes and Nanowires, C.N.R. Rao and Govindraj, RSC Publishing
3 Nanotehnology, An Introduction, Jeremy J Ramsden, Elsevier Publishers, UK
4 Nanotechnology, Mick Wilson, Kamali Kannagara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Overseas Press, New Delhi

## PY1661.5. COMPUTER HARDWARE & NETWORKING
## (54 HRS)

**Unit 1 -** 3 hrs

P.C. Architecture Functional block diagram of a computer.ProcessorsIntroduction to Microprocessor.CISC, RISC processors Type of Processors and their specification.(Intel: Celeron, Pentium family-PII, PIII, PIV, dual core, core 2duo - AMD-K5,K6 series

**Unit 2 -**10 hrs

Motherboards:Motherboard components Types, Form factor, Different components of Motherboard (BIOS, CMOS,BICMOS, RAM, CMOS Battery, I/O slots, I/O connectors), Riser architecture, Main Memory (SIMM, DIMM, RIMM), extended/expanded/cache memories. Chipsets (Intel & AMD)-ROM, DRAM, SDRAM, CDRAM, RDRAM, WRAM. Bus standards: Types of Buses (PC, ISA, MCA, AGP, PCI, USB, IEEE FireWire).Add on Cards Different latest Add on Cards (TV Tuner Card, DVR card, Video Capture,Internal Modem, Sound Card)

**Unit 3 -**9 hrs

Drivers:

1. Floppy Disk Drive- Floppy Drive Components( overview only)
2. Hard Disk Drive (HDD)

Types, Capacity, Hard Disk Components (Media, Read/Write Head, Spindle Motor Head Actuator), Connector, Jumper setting, trouble shooting in HDD.Hard Disk Controller (HDC) – Block diagram, Working, Interfacing (IDE,SCSI, ATA and SATA series) Configuration of HDD- Installation, Formatting, File Format (FAT, NTFS).Pen drive, i-pods

2. Optical Disk Drive

Types (ROM, R/W, DVD ROM, DVD R/W), Capacity, Difference between CD &DVD (capacity, format)-trouble shooting.

**Unit 4 -**5 hrs
Peripherals . Keyboard and Mouse- operation
Types of VDU (CRT, LCD, and TFT), Resolution, and Dot pitch -Printers – Types (dot matrix, inkjet, laser) Scanner- operation.Power conditioning Device:SMPS- Block diagram, operation-UPS- Types (online, off line, Hybrid)-trouble shooting in all these devices.

**Unit 5-** 4 hrs
Viruses & Vaccines-Virus- Introduction, infection methods,Types of viruses, Different symptoms of virus attack, precautions.Vaccine- Method of vaccine, Different types of Antivirus used in PC,Firewalls

**Unit 6-** 7 hrs
NETWORKING ESSENTIALS

Introduction-Need for networking-Network Topology-OSI Model-Types of networks (LAN, WAN, MAN)
Protocols-LAN Protocols- Classification, Examples, Ethernet networking-WAN Protocols- PPP, X .25, PPTP, L2TP, ISDN

**Unit 7--** 8 hrs
LAN Connectivity Devic es- NIC, Repeater, Hub, Switch, Bridge.Internet Connectivity Device-Routers, Gateways, CSU/DSU-TCP/IP Protocol Suite-What is TCP/IP, Importance, OSI vs TCP/IP

**Unit 8-** 6 hrs
IP Addressing-Overview, Address classes, Network ID, Host ID and Subnet Mask,Addressing guidelines, Reserved IP Address, Subnetting and Supernetting(overview)

**Unit 9 -**2 hrs
Emerging Technologies-Wireless Technology - Bluetooth, WAP-Mobile Technology- GSM, CDMA, GPRS

**Books for Study**:

1. D. Balasubramanian, "Computer Installation & Servicing", Tata McGraw Hill.
2. Rom Gilster, Black book, "PC Upgrading and Repairing", Dream tech, New Delhi.
3. Street Smart, James Pyler, "PC Upgrading and Repairing", Wiley Publishing, Inc.
4. Stephen.J.Bigelow,"Bigelow's Troubleshooting, Maintenance & Repairing PCs",Tata McGraw Hill
5. Craig Zacker, "The Complete Reference- Networking", Tata McGraw Hill
6. Douglowe, "Networking All in One Desk Reference"-3Edn, Wiley India Pvt Ltd

**References:**

1. Mark Minasi, "The Complete PC Upgrade & Maintenance Guide" BPB Publication
2. C.A. Schmidt, "The Complete Computer Upgrade & Repair Book", Dreamtech
3. Craig Zacker, John Rourke, "The Complete Reference- PC Hardware"Tata McGraw Hill
4. Scott Mueller, "Upgrading & Repairing PC's", Pearson Education
5. Vishnu Priya Sing & Meenakshi Singh, "Computer Hardware Course", Computech
6. Manahar Lotia, Pradeep Nair, Payal Lotia, "Modern Computer Hardware Course",BPB Publication.
7. Richard Mc Mohan, "Introduction to Networking", Tata McGraw Hill.

***Internet Resources:***

www.edugrid.ac.in/webfolder/courses/cn/cn_resourses.htm
www.howstuffwork.com
www.e-tutes.com
www.learnthat.com
www.intel.com
www.amd.com
http://en.wikipedia.org