St. Xavier's College – Autonomous
Mumbai

Syllabus
For 4th Semester Courses in PHYSICS
(June 2015 onwards)

Contents:

Theory Syllabus for Courses:

S.PHY.4.01: Mechanics and Thermodynamics
S.PHY.4.02: Quantum Mechanics
S.PHY.4.03: Electricity and Magnetism

Practical Course Syllabus for: **S. PHY.4. PR**

S.Y.B.Sc. PHYSICS   **Course: S.PHY.4.01**
Title: Mechanics and Thermodynamics
Learning Objective:Understanding Mechanics of systems around us

Number of lectures:45
Unit I   **(15 Lectures)**
(i)   Mechanics of System of particles:
Concept of Centre of Mass of system of particles, Conservation of Linear momentum and applications, Conservation of Angular momentum and applications, Conservative and non-conservative forces, Conservation of Mechanical Energy , Motion of systems with variable mass . Example :   Rocket Motion , Conveyer belt as a numerical problem.
(ii)   Collisions :
Introduction, types of collisions, Laboratory and center of mass system,Relationship between displacements and velocities, relationship between angles.

Unit II   **(15 Lectures)**
(i)   Damped Oscillations:
       Damped Vibrations : Decay of free vibrations of a simple harmonic oscillator due to the damping force proportional to the first power of velocity, types of damping,Energy of a damped oscillator, logarithmic decrement (discuss Ballistic Galvenometer as an example), relaxation time and Quality factor.
(ii)   Forced Oscillations
 Forced VibrationsAnd Resonance:Forced damped harmonic oscillator, Special cases: low driving frequency, high driving frequency, Resonance, Quality factor of a driven oscillator.
(iii)   Error analysis
       Estimation of Errors, Propagation of Errors, Peter's formula, Gaussian Distribution.Introduction to the concept of 'significant figures'.

Unit III   **(15 Lectures)**
Thermodynamic Potential and Maxwell's relations
Review of Thermodynamic Potential, Maxwells thermodynamic relations and its applications.Ist order and II nd order phase transitions . Liquefaction of Oxygen, Hydrogen, Helium and Adiabatic demagnetization .

Ref :(i) Mechanics - Keith Simon (3rd Edition)
(ii) Mechanics – H.S. Hans and S.P. Puri   Tata Mc. GrawHill(2nd Ed.)
(iii)Introduction to Error Analysis - Taylor
(iv)The Feynman Lectures on Physics Vol-I- R. P. Feynman, R.B Leighton, M.Sands
     (v) Brijlal ,Subramanyam, Hemne – Heat , Thermodynamics and Statistical Physics .
(vi) Evelene and Guha – Basic Thermodynamics
     (vii) Saha and Srivastava –Treatise of Heat .

Additional Ref:(i)ClassicalDynamics - Thornton and Marion
                    (ii)Waves and oscillations – Pain
                    (iii)Practical Physics - Squares.
                    (iv)Theory of Errors in Physical Measurements - J.C. Pal.
C.I.A. Problem Solving / Multiple Choice Questions , Assignments, presentations

S.Y.B.Sc. **PHYSICS**   **Course: S.PHY.4.02**

Title: Quantum Mechanics

Learning Objectives:
1) Learning Theoretical aspects at Quantum Level .
2) To know more about the insight of the atomic world.
Number of lectures:**45**

UNIT I   **(15 Lectures)**
Introduction to Quantum Mechanics
    (i)Why Quantum Mechanics? Black body radiation, Photoelectric effect and atomic spectra.Review of matter wave and wave particle duality, De Broglie's hypothesis,Davisson &GermerExperiment .
Uncertainty Principle and its consequences. Properties of matter wave and wave packet
(ii)Operators, Commutation of operators, Schrodinger's wave equation (TDSE),Steady state form (TISE). Max Born interpretation of wave function, Expectation value, Propertiesof eigen Function,Energy quantization in Schrodinger's theory. Probability density.

UNIT II   **(15 Lectures)**
Applicationsof Time-Independent Schrodinger Equation
 Complete solutions of Time-Independent Schrodinger Equation for the zero potential, The step potential: Energy less than Step Height, Energy greater than Step Height, The Barrier Potential, Examples of Barrier penetrations by Particles, The square wave potential. The infinite square well potential.The Simple Harmonic oscillator(operator
method)

Unit III   **(15 Lectures)**
Further developments in Quantum Mechanics
Solving Schrodinger's equation in 3-dim by separation of variables method.Particle in
a box (3-dim), Hydrogen atom,
Space quantization of **L** , Stern Gerlack Experiment, Space quantization of **S**. Electron probability density & shapes of orbitals .
Unresolved problems in quantum mechanics.

Ref : 1) Concepts of Modern Physics - Arthur Beiser
2) Quantum Physics - Iceberg &Resnick

Additional Ref :
1) Quantum Mechanics - Ghatak,Loknathan2nd Edition
2) Feymann lecture series vol III- R. P. Feynman, R.B.Leighton ,M. Sands
3) WichmannEywind -Berkley Physics Course Quantum Physics Volume 4
4) Emperors New mind -Roger Penrose
5) Quantum Mechanics - Pauling & Wilson
6) Wickepedia Stanford encyclopedia of philosophy – Quantum Measurement. (google search)

C.I.A. Problem Solving / Multiple Choice Questions, Assignments, Presentations

S.Y.B.Sc. **PHYSICS**   **Course: S.PHY.4.03**
Title:ELECTRICITY AND MAGNETISM
Learning Objectives:
(i)   To Study Applications of mathematical tools in Physics
(ii)   To Study interaction of charged particles with fields

Number of lectures:**45**
Unit I   **(15 Lectures)**
Vector Analysis:
Triple products, the ∇operator , The gradient , divergence and the curl, product rules. The fundamental theorem of gradient divergence and curl, Spherical polar coordinates, Cylindrical coordinates , One dimensional and Three dimensional Dirac – delta function.
    The theory of vector fields : Helmholtz theorem,potentials,second order derivatives

UNIT II   **(15 Lectures)**
Electric Field:- Coulombs law , The electric field , Continuous charge distribution , Divergence and curl of Electrostatic fields, Field lines, Flux and Gauss's law, The divergence of E, Applications of gauss's law, The curl of E, Electric potential ,Introduction to potential , Comments on Potential ,Summary.
Electrostatic Boundary conditions : Work and energy in Electrostatic; Work done to move a charge, The energy of the point charge distribution . Comments on Electrostatic energy. Conductors, Basic properties, Induced Charges, Surface Charge and the force on a conductor, capacitors.
UNIT III   **(15 Lectures)**
Magnetostatics:-
Charge conservation, Current continuity equation. The Lorentz Force law, Magnetic fields, Magnetic forces,currents .
    The Biot – Savart Law:- Steady currents, The magnetic field of a steady current.
The Divergence and Curl of Straight – Line Currents , The Divergence and Curl of B, Applications of Ampere's law. Comparision of Magnetostatics and Electrostatics.

Ref : Introduction to Electrodynamics -David J. Griffiths, 3 rd Edition

Additional Ref :(i) Feymann lecture series vol II
                         (ii) Electricity and Magnetism -Purcell-Berkley Physics Course Vol-2

C.I.A. Problem Solving / Multiple Choice Questions, Assignments, Presentations

S.Y.B.Sc PHYSICS   **Course :S.PHY.4.PR.**

Group –I
1) Resonance Pendulum.
2) Searle's Experiment : Determination of σ ,η and Y .
3) 'Y' by bending and To determine specific gravity of a solid
4) Lee's Method
5) Verification of Stefan's Law (Electrical Method)

Group - II
1) Figure of merit of a Mirror Galvanometer.
2) High Resistance by Mirror Galvanometer and G by half deflection method.
3) Passive Filters : Low pass , High Pass
4) To design a Band Pass filter and study it's working .
5) LCR transients .
6) C_1 / C_2 by de Sauty's method (with three ratios).

Group –III
1) Half adder and Full adder .
2) Study of MS –JK flip flop and divideby 2 counter
3) Mod 2 , Mod 5 Mod 10 Counter .
4) OP AMP Difference Amplifier .
5) Adder /Subtractor.

Demonstration Experiments:
1) Coupled oscillations and Resonance
2) Conservation of Linear momentum.
3) Shift Register.

Skill Experiments:
1) Use of Bread-board – connecting Simple Circuit.
2) Soldering simple circuits.
3) Designing an experiment to minimize errors.
4) Measurement of charge with B.G.(C_1 / C_2)

REFERENCES:

1.Advanced Practical Physics –Worsnop&Flint .
2.Advanced course in Practical Physics -D.Chattopadhyay, P.C. Rakshit& B.Saha .
3. B.Sc. Practical Physics –C.L. Arora

NOTE: Minimum Four experiments from each group, two demos and all the skills have to be performed per semester and written in journal to appear for the practical examination.