St. Xavier's College (Autonomous),
Mumbai

Syllabus of the courses offered by the Department of Physics

BSc Physics

(2015-2016)

St. Xavier's College – Autonomous
Mumbai

Syllabus
For 1st Semester Courses in PHYSICS
(June 2013 onwards)

Contents:

F.Y. B.Sc.: PHYSICS **Course: S. PHY.1.01**
Title: Mechanics, sound and optics
Learning Objectives:
1. To learn working principles of simple mechanical systems and their applications
2. To understand sound and light as wave phenomena
Number of lectures: 45
UNIT 1: **(15 lectures)**

1. One dimensional motion of single particle
Revision of energy and momentum theorems
Discussion of general problem of one dimensional motion
Applied force depending on time
Damping force depending on velocity
Conservative force depending on position, concept of potential energy
Falling bodies
Simple harmonic oscillator (Self study)

2. Effect of Elasticity in mechanical Systems
Relations connecting elastic constants
Couple per unit twist in a wire
Bending moments
Cantilever, depression
Shape of girders,
Experimental determination of elastic constants of material of beam (Self study)
Experimental determination of elastic constants of material of wire (Self study)

3. Compound pendulum

Periodic times

Centre of oscillation and suspension, interchangeability

Kater's Pendulum.

UNIT 2 : Sound and its effects **(15 lectures)**

1. Wave Equation

Derivation of equation of transverse wave on a string.

Derivation of equation of longitudinal waves on a rod and in gas

General solution of wave equation,

2. Sound effects in Auditorium

Loudness

Reverberation

Absorption coefficients, Derivation of Sabine's formula

Requirements for a good architectural acoustic

3. Ultrasonic waves

Piezoelectric effect,

Production of Ultrasonic waves : Piezoelectric Crystal method ,

Magnetostriction method .

Detection ,

Properties and applications of Ultrasonic waves

UNIT 3 :Optics **(15 lectures)**

1. Systems with lenses

Combination of thin lenses,

Cardinal points

Simple and compound microscope,

Telescopes reflecting and refracting,

Cameras (self study)

2. **Light as an electro-magnetic wave**

Equation of electromagnetic wave,

Equation for E, equation for B,

Light as a transverse Wave,

Energy and momentum in an electromagnetic wave.

Poynting vector,

Irradiance, inverse square law.

Light in bulk matter (self study)

3. Applications of Optical Interference

Fundamentals of interference of light

Interference over thin film,

Wedge shaped film,

Newton's ring ,

Applications of thin film interference

List Of Recommended Reference Books

1. Mechanics - K.R. Simon
2. Elements of properties of matter- D.S. Mathur

Fundamentals of vibration and waves - S.P. Puri (TMH)

3. Properties of matter and Acoustics – R. Murugesan and K. Shivprasath , S. Chand & Co. Ltd.
4. A textbook of optics(Revised edition) - Subramaniam and Brijlal
5. Optics(4th Edition) - Eugene Hecht

F.Y. B.Sc. : PHYSICS **Course: S.PHY.1.02**

Title: - Electrical Technology

Learning Objectives:

1. To acquire mathematical tools required to make physics simple.

2. To study the working of D.C. and A.C. circuits with applications

Number of lectures: 45

UNIT 1: Mathemetical tools for Electrical Engineers (15 Lectures)

1.Differential Equations:

First order ODEs, Separable variables,
Exact Differential equations,
Linear First Oder ODEs,
ODEs of special type,
Second Order ODEs: Inhomogeneous Linear ODEs and particular solutions,
Inhomogeneous Euler ODE, Inhomogeneous ODE with constant coefficients,
Linear Independence of Solutions. Singular points**.**

2.Fourier Series:

General Properties**:** Completeness, Behaviour of Discontinuities**,**
Advantages and uses of Fourier Series**,**
Periodic Functions, Change of Interval,
Complex Fourier Series, Abel's Theorem,
Properties of Fourier Series, Convergence, Integration, Differentiation.

UNIT 2: Methods to Simplify DC circuits (15 Lectures)

1.Theorems simplifying Electrical networks:

Superposition Theorem,
Thevenin's Theorem,
Norton's Theorem,
Maximum Power Transfer Theorem.

2.Circuits with active elements:

Circuits with junction diodes, inductance and capacitance,
Audio Visual clippings to learn their applications.

UNIT 3: AC circuit analysis (15 Lectures)

1.Simplified method to analyze A.C. circuits:

Phasor Diagrams (j operator method) ,
Working of LR, CR and LCR circuits,
Series and parallel resonance.
Applications of ac circuits in various home appliances with the help of AV clippings.

2. AC bridges:

General A.C. Bridge Circuit,
Maxwell, deSauty and Wien Bridge circuits and their applications.

List Of Recommended Reference Books

1. Physics for degree students - C. L. Arora, P.S. Hamne
2. Electrical Technology - B. L. Theraja,
3. Electricity and Magnetism - Chattopadhyay and Rakshit
4. Mathematical Physics - A.B. Gupta
5. Mathematical Physics - H. K. Dass
6. Waves and Oscillations - A.P. French

Practicals

F.Y.B.Sc Physics **Course: S.PHY.1.PR**

Paper 1:

1. Flywheel
2. Torsional Oscillations
3. Bifilar Pendulum
4. Viscosity by Poiselle's method
5. Bar Pendulum
6. Y by Vibration

Paper2:

1. Thevenin's theorem
2. Maximum Power transfer theorem
3. Superposition theorem
4. LR circuit
5. CR circuit
6. LCR series resonance
7. Frequency of AC mains

Demonstration Experiments:

1. Angular momentum conservation (Rotating platform)
2. Charging and discharging of a capacitor
3. Use of PC for graphs, demonstration experiments

SKILL EXPERIMENTS

1. Use of Vernier Callipers , Micrometer Screw Gauge and Travelling Microscope
2. Graph plotting
   (Exponential , Straight line with intercept , Resonance curve etc.)

St. Xavier's College – Autonomous
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Syllabus
For 2nd Semester Courses in PHYSICS
(June 2013 onwards)

Contents:

F.Y. B.Sc. PHYSICS **Course: S.PHY.2.01**

Title:Heat and Thermodynamics

Learning Objectives:

(i) To study the fundamentals of Heat and Thermodynamics

(ii) Elements of the Kinetic Theory of Gases

Number of lectures: 45

Unit I: Basics of Thermodynamics [15 lectures]

1. The thermal equilibrium and variables of state. Extensive thermodynamic quantities. The first law of thermodynamics, equivalence of heat and energy and its applications.
2. Reversible and irreversible processes, The second law of thermodynamics:- Carnot cycle , Carnot's theorem and applications (Refrigerator).
3. Clapeyron's Latent heat equation using Carnots cycle and its applications
4. Phase changes in water: first order transitions at normal pressure. Triple points. High pressure phases of ice and new triple points. (only qualitative).

Unit-II:Entropy and Engines[15 lectures]

1. Basic concept of entropy, Entropy and second law, Maxwell's demon and entropy, Change in entropy in different types of processes.
2. Temperature entropy diagram and its Physical Significance, Entropy of perfect gas.
3. Thermodynamic scale of temperature. Comparison of thermodynamic scale and absolute scale. Third Law of Thermodynamics , Zero Point energy , Negative temperatures.
4. Steam engine (Rankin cycle) ,Otto engine (Petrol Engine) , Diesel Engine, Comparison of T-S diagrams of heat engines.

Unit III: Kinetic theory of matter [15 lectures]

1. Review of kinetic theory of gases:
   Mean free path and transport phenomenon: viscosity, thermal conductivity & diffusion.
   Brownian motion with examples and determination of Avogadro's number.
2. Real gases and equations of state. Free expansion and the Joule-Thompson effect. Gas-liquid phase transitions and Andrew's experiments. Law of corresponding states and critical exponents, Virial expansion, Van der Waals equation of state and its virial coefficients.

References

(i) Heat ,Thermodynamics and Statistical Physics - Brijlal , Subramaniyam , Hemne
(ii) Heat and Thermodynamics - Zemansky
(iii)

C.I.A. Problem Solving /Multiple Choice Questions

F.Y. B.Sc. PHYSICS **Course: S.PHY.2.02**

Title:Motion of Charges and Basic Engineering Electronics

Learning Objectives:

1.To understand the effect of charge motion

2.To understand the Basics of Analog and Digital electronics

Number of lectures: 45

Unit I: Motion of Charges [15 lectures]

(i) Charge and charge conservation, Coulomb's law, electric field. Concept of current, magnetic field due to variation of current.

(ii) Motion of charges in pure electric field

(iii) Motion of charges in pure magnetic field

(iv) Motion of charges in presence of both, electric and magnetic, fields

(v) Applications: cyclotron, synchrotron, velocity filter, energy filter, momentum filter, colliders, LHC, mass spectrograph, mass spectrometer.

Unit I: Simple analog electronics [15 lectures]

(i) Applications of Diodes: Clipper, Clamper, voltage doubler, Wave shaper, Bridge rectifier, Filters: capacitor filter, inductor filter (choke). Their applications with the help of AV clippings.

(ii) Voltage stabilization: Zener diode as a voltage stabilizer, Regulated power supply.

(iii) Transistor as a basic device for signal amplification: Definitions of current gains α and β, input impedance, output impedance. Different modes of its operation (CE, CB, and CC) and their comparison.

(iv) Working of transistor in CE mode, the concepts of dc load line and operating point. Use of transistor as a switch.

Unit II: Basic tools to learn Digital electronics [15 lectures]

(i) Binary, octal and hexadecimal number systems. Intersystem conversion of numbers.

(ii) Boolean algebra and the basic operations: unary operation of NOT, binary operations of AND, OR and XOR.

(iii) Combinational logics NAND, NOR and XNOR.

(iv) De Morgan's Laws, Binary Identities, Simplification of Boolean expressions. (Boolean equations for biological processes).

References:

(i) Electricity and Magnetism: Berkeley Physics Course Vol 2 – E.M. Purcel

(ii) Fundamentals of Physics Vol II – Resnick and Halliday

(iii) Electronic Principles - A. P. Malvino

(iv) Electronic Devices and Circuits - Mottershed

(v) Semiconductor Electrronics - A. K. Sharma

(vi) Digital Electronics - Malvino and Leach,

(vii) Modern Digital Electronics - R. P. Jain,

(viii) Physics for Degree Students - C. L. Arora, and P. S. Hemne

C.I.A.: Problem Solving /Multiple Choice Questions

F.Y.B.Sc. PHYSICS **COURSE : S.PHY.2.PR**

Group I

1. Spectrometer (determination of angle of prism , angle of minimum deviation and hence refractive index of material of Prism) With Schuster's method
2. Spectrometer (determination of dispersive Power of material of prism) With Schuster's method
3. Combination of lenses
4. Newton's rings
5. Wedge Shaped Film
6. Viscosity by Stokes method

Group II

1. LDR Characteristics
2. Bridge Rectifier (to study load regulation)
3. Zener as a regulator
4. Transistor (CE) Characteristics
5. Verification of NAND, NOR , EXOR gates and De Morgan's theorem

DEMONSTRATION EXPERIMENTS

1. Single slit Fraunhoffer diffraction
2. Brewster's law
3. Laser beam divergence, intensity
4. Charging and discharging of a capacitor

REFERENCES:

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

Note: Minimum four experiments from each group, all the demos and skills have to be performed and written in the journal to appear for the practical examination

St. Xavier's College – Autonomous
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Syllabus
For 3rd Semester Courses in PHYSICS
(June 2015 onwards)

Contents:

S.Y. B.Sc. PHYSICS **Course: S.PHY.3.01**

Title: Physical and Quantum Optics

Learning Objectives: To understand the interaction of light with matter.

Number of lectures: 45

Unit I:Interferometry and Resolving power (15 Lectures)

1. Michelson Interferometer :

Principle , Construction , Working.Circular fringes, Localized fringes, White light Fringes, Visibility of Fringes.

Applications of Michelson Interferometer: a) Measurement of wavelength, b)Determination of the difference in the wavelength of the two waves,c) Thickness of a thin transparent sheet, d) Standardization of the meter scale.

2.Fabry –Perot Interferometer &Etalon :

Formation of fringes, Determination of Wavelength, Measurement of difference in wavelength.

3.Resolving Power:-

Introduction, Rayleigh's criterion, Resolving Power of optical instruments, Criterion for resolution according to Lord Rayleigh, Resolving Power of a telescope, microscope, prism, plane transmission grating .

UnitII :D**iffraction (15 Lectures)**

1. Fresnel's Diffraction:

Introduction, Huygens-Fresnel's theory, Fresnel's assumptions, Distinction between Interference and diffraction, Fresnel and Fraunhoffer diffractions, Diffraction due to straight edge,Position of maximum and minimum intensity, Intensity at a point inside a geometrical shadow, Diffraction due to narrow slit & due to narrow wire (qualitative), Diffraction at a circular aperture and qualitative discussion of opaque circular disc.

2.Fraunhoffer diffraction :

Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to single slit (Review), Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction patterns, Plane diffraction grating, Theory of plane transmission grating, Width of principal maxima, Prism and grating spectra.

Unit III : (15 Lectures)

1.Polarization:

Introduction, Polarization by reflection, Polarization by double refraction, Malus' law Superposition of two disturbances, mathematical analysis, Phenomenon of double Refraction, Quarter wave plates and half wave plates. LCD , 3D TV.

2.Lasers:

Properties of Laser, Different types of Laser (History), Semiconductor GaAs Laser, Application of Lasers to Holography, DVDs, Laser printer .

List Of Recommended Reference Books

A text book of Optics -Subramanyam, BrijLal,Avadhanulu
Fundamentals of Optics - Jenkins and White
Lasers - Avadhanalu
Lasers - Freeman , Sears &Zemanski
Lasers - Ghatak
Optics - Eugene Hecht

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

S.Y. B.Sc. PHYSICS **Course: S.PHY.3.02**

Title: Relativity, Astronomy and Cosmology
Learning Objective:
1)To understand the concept of change in the paradigm: from Newtonian Mechanics to Relativistic Mechanics.
2)To understand physics of stellar astronomy and cosmology.
No. of Lectures:45

Unit I : Special Theory of Relativity (15 Lectures)

The Michelson- Morley experiment, The Principle of Relativity , The Lorentz transformation , Transformation of time , The Lorentz contraction , Simultaneity , Four – vectors , Relativistic dynamics , Equivalence of mass and energy , Transformation of velocities , Relativistic mass , Relativistic energy, The twin paradox, Geometric representation of Space and Time.
Ref: The Feynman Lectures on Physics Vol-I- R. P. Feynman, R.B Leighton, M. Sands
Add. Ref: R. Resnick - Introduction to Special Theory of Relativity.

Unit II: An Introduction to Stellar Astronomy (15 Lectures)

Basic Properties of a Star: The brightness of the star, Star colour, magnitude, Effective temp of a star, its size, mass, and luminosity.
Internal Structure of a star: The Hydrostatic Equilibrium, The Radiative transfer, The Thermal Equilibrium, Energy Generation in Stars, The Sun as a Star.
Evolution of Stars
Proto stars, The Main Sequence (HR Diagrams), End stages of a star: White Dwarf, Neutron Stars and Black Holes.
Ref: The Physical Universe, An Introduction to Astrophysics by Frank Shu,
Introduction to Stellar Astrophysics: Volume 1 and 3, By Erika Bohm-Vitense, Cambridge University Press.
Additional References: Website of NASA, Wikipedia and other sources on the internet.

Unit III: Cosmology (15 Lectures)

The large scale structure of the Universe, Types of galaxies, Radiation background, Doppler shift of galaxies and the Hubble's Law, The expanding Universe.
From Relativity to cosmology, Newtonian Cosmology, Weyl's Postulates, Cosmological Principal, Red Shift, Introduction to cosmological models.
The Big Bang Hypothesis: Relics of the big bang, Inflation, Radiation dominated universe, matter versus radiation, neutrino decoupling of neutrinos, Synthesis of light nuclei, Microwave background, The Dark Matter.
Ref: An Introduction to Cosmology, By J. V. Narlikar, Cambridge University Press.
Elements of Cosmology: By J. V. Narlikar, Cambridge University Press.
Additional References: Website of NASA, Wikipedia and other sources on the internet.

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

S.Y. B.Sc. PHYSICS **Course: S.PHY.3.03**

Title: Electronics

Learning Objectives: Understandingworking of basic electronic gadgets.

Number of Lectures: 45

UNIT I: Analog Electronics (15 Lectures)

1.Transistor in CE mode: Review of CE configuration, load line, operating point**,** Transistor biasing ,dc& ac analysis, load line, Inherent variations of transistor parameters, Essentials of transistor biasing circuits , stability factor, Various methods of transistor biasing, Silicon versus Germanium.

2.General Amplifier Characteristics :

Concept of Amplification, Amplifier notations , Current gain , Voltage gain, Power gain, Input and Output resistance, Frequency Response,Decibels.

Classification of Amplifiers Class A, B, AB, C and Push-pull

Unit II :OPAMPs and linear circuits (15 Lectures)

1. **Feedback and its applications.**

Introduction to feedback:Positive and negative feedback, Oscillators (loop gain, Barkhausen Criterion) Collpitts Oscillator, Wein Bridge Oscillator, RC Phase Shift Oscillator .

2. **Differential Amplifier and OP AMP**

Differential Amplifier, Introduction to OP AMP, Inverting mode, Non inverting mode, Voltage Follower mode, OP AMP with positive feedback: comparator, square wave generator.

Unit III: Digital Electronics (15 Lectures)

1. **Number System:**

Binary Arithmetic: Addition and subtraction using 2's complement

Half adder and Full adder

2. **Logic circuits**

Implementation ofLogic circuit from truth tables, Sum of Product method, Product of sum method.

3. **Flip Flops and their Applications**

Flip Flops and Counters, R-S flip flop, Clocked R- S flip flop, D flip flop, Edge triggered J-K flip flop, Master Slave flip flop, T flip flop, 4-bit binary ripple counter (up - down mode)

Shift Register : Serial in Serial out , Serial in Parallel out , Parallel in Serial out, Parallel in Parallel out and Universal.

List Of Recommended Reference Books

1. Digital Principles and Aplications (4th Ed) - Malvino and Leach
2. Modern Digital Electronics - R.P. Jain
3. OPAMP and Applications - RamakantGayakwad.
4. Operational amplifiers and Linear integrated Circuits -Coughlin and Driscoll
5. Electronics Devices and Circuits - Allan Mottershead
6. A text book of electronics - SantanuChattopadhyay
7. Electonic Principles -7th Edition - A.P.Malvino
8. Electronics devices and circuit theory - Boylestad ,Nashelsky

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

Practicals
S.Y. B.Sc. PHYSICS COURSE : S.PHY.3.PR

Group I
1) Constant Volume Air Thermometer.
2) Thermocouple
3) 'J' by Electrical Method.
4) Bifilar pendulum
5) Y- By Koenig's Method

Group II
1) Optical lever: Determination of μ.
2) Determination of Cauchy's constants.
3) Cylindrical obstacle – Determination of λ.
4) Resolving Power of Telescope.
5) Diffraction Grating: Determination of λ.

Group –III
1) CE Amplifier: DC load line, AC load Line.
2) CE Amplifier: Determination of Bandwidth, Variation of Gain with Load.
3) CE Amplifier: R_i and R_o.
4) Collpitts' Oscillator.
5) OP AMP: Inverting Amplifier, Non inverting Amplifier, Voltage Follower.

Demonstration Experiments:
1) Proto-lab.
2) Optical fiber communications.
3) Diffraction experiments with Laser.

Skill Experiments:
1) Component testing
2) Spectrometer- Schuster's method.
3) Transistor as a switch.

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.

St. Xavier's College – Autonomous
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Syllabus
For 4th Semester Courses in PHYSICS
(June 2015 onwards)

Contents:

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 ,ηand 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.

St. Xavier's College – Autonomous
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Syllabus
For 5th Semester Courses in PHYSICS
(June 2015 onwards)

Contents:

T.Y. B.Sc. PHYSICS **Course: S. PHY. 5.01**

Title: Classical Mechanics

Number of lectures: 60

Learning objective: To understand physical phenomena of mechanical systems

UNIT-I **(15 LECTURES)**

1. Motion under a central force. The central force inversely proportional to the square of the distance. Parabolic orbits, Elliptical orbits. The Kepler problem. Hyperbolic Orbits: The Rutherford problem- Scattering cross section.
2. Newton's laws in non inertial frames-Moving origin of co-ordinates, Rotating co-ordinate systems, Laws of motion on the rotating earth, Foucault pendulum, Larmor theorem.

UNIT- II **(15 LECTURES)**

Lagrange's equations: Generalized coordinates, Lagrange's equations, examples, Systems subject to constraints, examples of system subject to constraints, constants of motion and ignorable coordinates.

UNIT- III **(15 LECTURES)**

The rotation of a rigid body: Motion of a rigid body in space, Euler's equations of motion for a rigid body, Euler's angles, Heavy symmetrical top (without nutation).

UNIT- IV **(15 LECTURES)**

1. Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow.
2. Non linear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation, Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior.

References:

1. Mechanics - Keith Simon
2. Classical Mechanics - Herbert Goldstein
3. Classical Mechanics - Takawale & Puranik
4. Classical Mechanics - Adarsh Shroff
5. Mechanics - Barkely Physics course vol.I- – Kittel, Knight & Ruderman.
6. Fluid mechanics - Raymond.
7. Non-Linear dynamics & chaos - Persiwal & Richards.

CIA: **Problem solving/ assignments**

T.Y.B.Sc Physics **COURSE:S.PHY.5.02**

Title: Mathematical Physics
Number of Lectures: 60
Learning Objective: To understand the mathematical concepts related to physics

UNIT-I **(15 LECTURES)**

1. **Matrices**:. Basic definitions of Matrices, Equality and Rank, Matrix Multiplication, Inner product, Dirac bra-ket, Transposition, Multiplication (by a scalar), Addition, Product theorem, Direct product, Diagonal matrices, Trace, Matrix inversion. Orthogonal Matrices: Direction cosines, applications to vectors, orthogonality conditions : Two dimensional case, Euler angles, symmetry properties and similarity transformations, Hermitian Matrices and unitary matrices: Definitions, pauli matrices**.** Diagonalisation of matrices**:** Moment of inertia matrix, Eigen vectors and Eigen values, Hermitian matrices, anti-hermitian matrices, normal modes of vibrations, Ill conditioned systems, Functions of matrices.
2. **Functions of a complex variable I:** Complex Conjugation, Functions of a Complex Variable, Cauchy-Riemann Conditions, Analytic Functions. Cauchy's Integral Theorem: Contour Integrals, Stokes's Theorem Proof of Cauchy's Integral Theorem, Multiply connected regions. Cauchy's Integral Formula: Derivatives, Morera's Theorem. Mapping: Translation, Rotation, Inversion, Branch Points and Multivalent Functions, Conformal Mapping.

UNIT-II **(15 LECTURES)**

1. **Functions of a complex variable II:** Laurent Expansion: Taylor Expansion, Schwarz Reflection Principle, Analytic Continuation, Laurent series. Singularities**,** Poles, Branch Points**,** Calculus of Residues: Residue Theorem, Evaluation of definite integrals, Cauchy Principle value.
2. **Differential Equations:** Review of first order ODEs, Second Order ODEs: Inhomogeneous Linear ODEs and particular solutions, Inhomogeneous Euler ODE, Inhomogeneous ODE with constant coefficients, Linear Independence of Solutions.

UNIT-III **(15 LECTURES)**

1. **Fourier Series and Transforms:** Review of Fourier series, Complex Fourier Series, Abel's Theorem, Properties of Fourier Series, Convergence, Integration, Differentiation.
2. **Integral Transforms**: Definitions and Linearity. Fourier Transforms,

Development of the Inverse Fourier Transform**,** Inverse Fourier-Transform Exponential Form, Dirac Delta Function Derivation from Fourier transform. Laplace Transforms, inverse Laplace transforms, solving differential equations using Laplace transforms.

UNIT-IV **(15 LECTURES)**

1. **Legendre Polynomials :** Physical Basis, power series, differential equations, Generating function, Recurrence relations, upper and lower bounds for Pn(cosϴ)**,** Orthogonality**,** applications to electrostatics.
2. **Bessel Functions of the first kind, Jn(x):**, Bessel's Differential Equations, Generating Function for Integral Order, Recurrence Relations and its applications. Integral Representations, Orthogonality, Normalization.

Main Reference: - Mathematical Physics - H.K. Dass..
Additional Ref:

1. Introduction to Mathematical Physics - Charlie Harper.
2. Mathematical Physics - A. K. Ghatak
3. Mathematical Physics - Arfken & Weber
4. Complex Variables- M.Spiegel, Schaum series
5. Laplace's Transforms- M.Spiegel, Schaum series

CIA: **Problem solving/ assignments**

T. Y. B.Sc: Physics **COURSE:S.PHY.5.03**

Title: Electronics

Number of lectures: 60

Learning objective: To understand the technology of different electronic devices

UNIT-I **(15 LECTURES)**

1. **Transistor multivibrators:** Astable, Monostable and Bistable Multivibrators, Schmitt trigger.
2. **555 Timer:** Block diagram, Astble operation (with VCO)
   Self Study: Monostable and Triggered linear ramp generator.
3. **Field effect transistor:** JFET: Basic ideas, Drain Curve, The transconductance curve, Biasing in the ohmic and the active regions, calculation of transconductance, common source amplifier, analog switch multiplexer, voltage controlled resistor, Current sourcing. MOSFET : Depletion and enhancement mode, operation and characteristics, digital switching. CMOS-Introduction.

UNIT-II **(15 LECTURES)**

1. **Differential Amplifier using transistors:** The differential Amplifier, DC and AC analysis of a differential Amplifier, Input characteristics, effect of bias and offset current and voltage on output, comman mode gain, CMRR, current mirror modification for improvement of parameters, Transistorised circuit of 741 OPAMP IC.
2. **Op Amp applications:** Comparator, Schmitt trigger, Integrator, Differentiator, Log amplifier, square wave generator, active filters.

UNIT-III **(15 LECTURES)**

1. **Thyristors:** SCR-Working, Equivalent circuit, important terms, I-V Characteristics, SCR as a switch, Half wave rectifier and Full wave rectifier.
2. **Optoelectronic Devices :** Photoresistance (LED, LDR), Photo-diode, Photo transistor, Optocoupler.
3. **Logic families :** Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, , CMOS characterictics, CMOS NAND and NOR gates.
4. Self Study: DIAC , TRIAC and their applications.

UNIT-IV **(15 LECTURES)**

1. **Electronic communication techniques :**Radio broadcasting, Transmission and reception, Modulation, Amplitude modulation, Modulation factor, Analysis of amplitude modulated wave, Side band frequencies in AM wave, Transistorised amplitude modulator, Power in AM wave, Limitations of AM, Frequency modulation (qualitative), Pulse modulation (qualitative), Digital Modulation (qualitative).
2. **Optical communication:** principle and application of of fiber optics.

References :

1. Electronics Principles.- A.P. Malvino and D.J. Bates
2. Digital Principles and Applications(4th ed.) - Malvino and Leach
3. Electronic communication systems-Kennedy
4. Functional Electronics. - K.V. Ramanan
5. Integrated Electronics - Millman and Halkias
6. Roddy and Collen
7. Principles of Electronics - V. K. Mehta and Rohit Mehta.

CIA: **Problem solving/ assignments**

T.Y.B.Sc.: Physics **COURSE:S.PHY.5.04**
Title: Electrodynamics
Number of Lectures: 60

Learning objectives: To understand the fundamentals and applications of classical electrodynamics

UNIT-I **(15 LECTURES)**

1. Laplace's equation in one, two and three dimensions. Boundary conditions and Uniqueness theorems (without proof), conductors. The classic image problem, Induced surface charge, force and energy.
2. Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics. A deceptive parallel, Susceptibility, Permittivity, Dielectric constant, Energy in dielectric systems.

UNIT-II **(15 LECTURES)**

1. Diamagnets, Paramagnets and Ferromagnets, Magnetization, Bound currents and their physical Interpretation, Ampere's law in magnetized material's, A deceptive parallel, Magnetic susceptibilityand permeability.
2. Energy in magnetic fields, Electrodynamics before Maxwell, Maxwells correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter , Boundary conditions.

UNIT-III **(15 LECTURES)**

1. The continuity equation, Poynting's Theorem , Newton's third law in Electrodynamics.
2. The wave equation for **E** and **B**, Monochromatic Plane waves, Energy and Momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of em waves at normal and oblique incidence.

UNIT-IV **(15 LECTURES)**

1. Relativity and electrodynamics
2. Electromagnetic waves in conductors, Reflections at a conducting surface, The frequency dependence of permitivity, wave guides.
3. Potentials and Fields: The potential formulation, Scaler and vector potentials, Gauge transformations, Coulomb gauge and Lorentz gauge.

References:

1) Introduction to Electrodynamics - A.Z. Capria and P.V. Panat
2) Engineering Electrodynamics - William Hayt Jr. & John H. Buck
3) Electricity and Magnetism - Navina Wadhwani
4) Feynman lectures, vol II – Lorrain and Corson
5) Berkely Physics Vol II, Electricity and Magnetism – Purcell
6) Introduction to Electrodynamics 3rd Edition - David J. Griffiths

CIA- Problem Solving / assignments

Practicals

T.Y.B.Sc. Physics **Course: S.PHY.5.PR**

Minimum four experiments to be performed from each group

Group I: Mechanics and optics

1. Determination of 'g' by Kater's Pendulum
2. Measurement of surface tension of mercury by Quincke's method
3. Flat spiral spring: Determination of Y, η, and σ
4. Resolving power of prism with the skill of optical levelling
5. Biprism

Group II: Electricity and Magnetism

1. Determination of Mutual inductance using moving coil galvanometer
2. Hysteresis using magnetometer
3. Maxwell's bridge
4. FET characteristics and its use as VVR
5. SCR characteristics

Group III: Electronics

1. Transistorised Astable multivibrator with the skill of circuit designing
2. Astable multivibrator using OPAMP with the skill of using Bread Board
3. Transistorised Bistable multivibrator or Schmitt trigger
4. 555 timer: Astable mode and VCO using AC signal with the skill of soldering
5. To Fourier analyse a Square/Triangular waveform

Group IV: Project

One project equivalent to 10 lab turns

References:

1. Advanced course in practical physics – D. Chattopadhyay, P.C. Rakshit& B. Saha
2. B. Sc. Practical physics – Harnam Singh
3. B. Sc. Practical physics – C. L. Arora
4. Practical physics – C. L. Squires
5. University Practical physics – D. C. Tayal

T.Y. B.Sc. PHYSICS **Course: S. PHY.DIP. AC. 5**

Title: Digital Image Processing-I

Number of lectures: 60

Learning objective: To study the mathematical modeling of digital images

UNIT I **(15 LECTURES)**

Introduction,

What Is Digital Image Processing?
The Origins of Digital Image Processing
Gamma-Ray Imaging
X-Ray Imaging
Imaging in the Ultraviolet Band
Imaging in the Visible and Infrared Bands
Imaging in the Microwave Band
Imaging in the Radio Band
Examples in which Other Imaging Modalities Are Used
Fundamental Steps in Digital Image Processing
Components of an Image Processing System
Problems

Digital image fundamentals

Elements of Visual Perception
Light and the Electromagnetic Spectrum
Image Sensing and Acquisition
Image Sampling and Quantization
Some Basic Relationships between Pixels
An Introduction to the Mathematical Tools Used in Digital Image Processing
Problems

UNIT II **(15 LECTURES)**

Image enhancements in spatial domain

Background
Some Basic Intensity Transformation Functions
Histogram Processing
Smoothing Spatial Filters
Sharpening Spatial Filters
Combining Spatial Enhancement Methods
Problems

UNIT III **(15 LECTURES)**

Image enhancements in frequency domain

Background
Preliminary Concepts
Sampling and the Fourier Transform of Sampled Functions
The Discrete Fourier Transform (DFT) of One Variable
Extension to Functions of Two Variables
Some Properties of the 2-D Discrete Fourier Transform
The Basics of Filtering in the Frequency Domain
Image Smoothing Using Frequency Domain Filters
Image Sharpening Using Frequency Domain Filters
Selective Filtering
Implementation
Problems

UNIT –IV **(15 LECTURES)**

Image restoration

Image Restoration and Reconstruction
A Model of the Image Degradation/Restoration Process
Noise Models
Spatial and Frequency Properties of Noise
Some Important Noise Probability Density Functions
Periodic Noise
Estimation of Noise Parameters
Restoration in the Presence of Noise Only-Spatial Filtering
Mean Filters
Order-Statistic Filters
Adaptive Filters
Periodic Noise Reduction by Frequency Domain Filtering
Linear, Position-Invariant Degradations
Estimating the Degradation Function
Inverse Filtering
Minimum Mean Square Error (Wiener) Filtering
Constrained Least Squares Filtering
Geometric Mean Filter
Image Reconstruction from Projections
Problems

Reference:
1. Digital image processing, third edition
-Gonzalez and woods
2. . Digital image processing, third edition
-A. K. Jain
3. . Digital image processing using MATLAB
-Gonzalez and woods

Practicals

T.Y.BSc Digital Image processing-I **COURSE: S.PHY.DIP.AC.5.PR**

Digital processing of given images using software
Tutorials on image processing

St. Xavier's College – Autonomous
Mumbai

Syllabus
For 6th Semester Courses in PHYSICS
(June 2015 onwards)

Contents:

T.Y. B.Sc. PHYSICS **Course: S.PHY.6.01**

Title: Statistical Mechanics

Learning Objectives:

To study statistical behaviour of many particle systems.

Number of lectures: 60

UNIT I **(15 Lectures)**

1. **Probability**: Set theory, introduction to probability, conditional probability, Random walk problem, discrete Random variables, combining probabilities of events, probability distribution moments, the moment generating function, the characteristic function, binomial distribution, the central limit theorem.
2. **Introduction to Statistical Mechanics**: description of a system, thermal and adiabatic interaction, classical gas.

UNIT II **(15 Lectures)**

1. **Kinetic theory**: phase space formulation, the Boltzmann transport equation, the postulate of molecular chaos, the H theorem, the Maxwell-Boltzmann distribution (emphasize the connection with the proof of the central limit theorem), the most probable distribution, Liouville's theorem and its connection to the H theorem.

UNIT III **(15 Lectures)**

1. **The methods of statistical mechanics:** the postulate of equal a priori probability in phase space, the microcanonical ensemble, entropy, the equipartition theorem, classical ideal gas, Gibbs paradox. The canonical ensemble, the partition function, the Helmholtz free energy, energy fluctuations in the canonical ensemble.

UNIT IV **(15 Lectures)**

1. The grand canonical ensemble, density fluctuations in the grand canonical ensemble, first order phase transitions, the meaning of the Maxwell construction.
2. Quantum Statistics of ideal geases: Bose – Einstein statistics, black-body radiation, The Rayleigh-Jeans formula, The Planck radiation formula, Fermi – Dirac statistics, comparison of results, Transition between states.

References:

1. Statistical and thermal physics – S. Loknathan, R. S. Gambhir
2. Statistical Mechanics - Kerson Huang (Indian edition exists)
3. Statistical Mechanics (Berkeley Physics Course, vol 5) - E. Reif
4. Statistical and thermal physics - F. Reif
5. Mathematical Methods of Physics - J. Mathews and R. L. Walker

CIA: Problem solving/ MCQs

T.Y.B.Sc. PHYSICS **COURSE:S.PHY.6.02**

Title: Atomic& Molecular Physics
Learning Objectives: To study atomic structure and atomic and molecular spectra.
No. of Lectures:60

UNIT I : Structure of atom **(15 lectures)**

1. Review of Hydrogen atom problem, Role of rotation symmetry
2. Pauli's Exclusion Principle**,** Hund's Rule, Symmetric &Antisymmetric Wave Function
1. Vector Atom Model , Spin Orbit Coupling, LS Coupling, JJ Coupling.

Unit II: Atomic spectra **(15 lectures)**

1. Review concepts of quantum mechanics , Origins of Spectral Lines & Selection Rules.
2. Visible spectra, Alkali Spectra, Physics of LASERs (3level system).
3. X-ray spectra: Characteristic, Continuous, Mosley's Law, K, L, M Series.
4. Atoms in External magnetic field: Normal Zeeman Effect, Lande's Factor, Anomalous Zeeman Effect,
5. Paschen Back Effect:-Theory, selection rules, application to Principal Series Doublet.

UNIT III: Molecular Spectra (Diatomic Molecule) **(15 lectures)**

1. Rotational Spectra, Microwave Spectrometer.
2. Vibrational Spectra, Vibrational - Rotational Spectra, Infrared Spectrometer.
3. Electronic Spectra, Born Oppenheimer Approximation, Intensity of Vibration Electronic Spectra, Frank – Condon Principle.
4. Raman Effect: Classical Theory, Quantum Theory, Pure Rotational Raman Spectra, Vibrational Raman, Raman Activity of CO_2 and H_2O, Experimental Techniques.

UNIT IV: Resonance Spectroscopy **(15 lectures)**

1. Electron spin resonance, theory, experimental method, applications
2. Nuclear magnetic resonance, theory, experimental method, applications
3. Solid state surface spectroscopy.

References: -

1.Perspective of Modern Physics – A.Bieser.
2. Atomic Spectra - White.
3. Molecular spectra - C. M. Banwell & McCash.

CIA: PROBLEM SOLVING/MULTIPLE CHOICE QUESTIONS/ ASSIGNMENT

T.Y.B.Sc. PHYSICS **COURSE:S.PHY. 6.03**
Title:NUCLEAR PHYSICS
No of Lectures:60

Learning Objectives:-To Understand the constituents of the nucleus, their properties, detection and reactions.

UNIT-I: **(15 LECTURES)**

1.Properties of the nucleus: Rutherford scattering & measurement of nuclear size, Measurement of nuclearradius by Hofstadter experiment, Nuclear forces and their properties, Meson theory of nuclear forces, Yukawa Potential.

2. The Q equation:- Types of nuclear reactions, the balance of mass and energy in nuclear reaction , the Q equation and solution of Q equation

3. Radioactive decay: Decay chains.**Alpha decay :** Range of alpha particles, Disintegration energy, Alpha decay paradox: Barrier Penetration, Gamow's theory of alpha decay and Geiger-Nuttal law. Velocity and energy, Absorption of alpha particles: Range, Ionization and stopping power, energetics, energy levels & decay schemes. **Beta decay:** Introduction, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Velocity and energy of beta particles, energetics, energy levels and decay schemes. **Gamma decay:** internal conversion, nuclear isomerism.

UNIT-II **(15 LECTURES)**

1.Binding Energy and Mass formula: (Review of Liquid drop model &Weizsacher's semi-empirical mass formula), Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Qualitative predictions of shell model & Magic numbers.

2. Nuclear energy : Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, energy release in fission, Nature of fission fragments, Energy released in the fission of U^{235}, Fission chain reaction, Fusion of lighter nuclei, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Comparison of fission and fusion processes.

UNIT-III **(15 LECTURES)**

1. Applications of nuclear energy :- nuclear reactors:- pressurized water reactors, boiling water reactors, breeder reactors, fusion reactors.**Nuclear detectors**:- Ionization chamber, Proportional counter, G.M. Counter, Scintillation counter, Solid State detectors , Cloud and Bubble chamber, **Mossbauer effect, Detection of neutrino**, nuclear power generation, nuclear safety and hazards.

UNIT-IV **(15 LECTURES)**

1.Accelerators:-Introduction, the LINAC, cyclotron, synchrocyclotron, betatron synchrotron, proton synchrotron, Electrostatic Accelerators.

2. Elementary particles : Introduction, Classification of elementary particles based on conservation laws, particles and antiparticles, The Fundamental interactions, elementary particle quantum numbers, conservation laws and symmetry, quark model,.

References:

1. Concepts of modern physics Arthur Beiser (6th edition, TMH)
2. Nuclear Physics S.B. Patel (Wiley Eastern Ltd.).
3. Nuclear Physics Irving Kaplan (2nd Ed.) (Addison Wesley).
4. Nuclear Physics S. N. Ghoshal (S. Chand & Co.)
5.Nuclear Physics D. C. Tayal (Himalayan Publishing House)
6. Modern Physics Murugesan&KiruthigaSivaprasath (S. Chand & Co.)
7. Nuclear physics Kakani & Kakani

Additional References.

1. Atomic & Nuclear Physics A B Gupta &DipakGhosh(Books & Allied (P) Ltd.)
2.Nuclei and particles E.Segre. (W.A. Benjamin, Inc.)

CIA: PROBLEM SOLVING/MULTIPLE CHOICE QUESTIONS/ ASSIGNMENTS

T.Y.B.Sc. PHYSICS **COURSE:S.PHY.6.04**
Title:Solid State Physics
No of Lectures:60
Learning objective: To understand the fundamental properties of materials and devices

UNIT I : **(15 lectures)**

Crystal physics: Introduction, lattice, basis, crystal structure, unit cell & primitive cell, crystal classes & crystal systems in two & three dimensions, Bravais lattices, atomic packing factors in cubic system and hexagonal lattice. Crystal structures of diamond, ZnS, Nacl, CsCl, Miller indices, Inter-planar spacing. Experimental diffraction methods, derivation of scattered wave amplitude, Brillouin zones , - Kittle 5thed

UNIT - II **(15 lectures)**

Theory of metals : Classical free electron theory of metals, Relaxation time, Collision time and mean free path, Drawbacks of classical theory, Quantum theory of free electrons, Fermi-Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Hall effect. Ch.6 – Kittle 5thed

UNIT - III **(15 lectures)**

1. **Band theory of solids:** The Kronig- Penney model Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors.

2. **Band theory of Semiconductors:** Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations, Donor and Acceptor impurities, Charge densities in a Semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation.
Ch. 7, 8 – Kittle 5thed

UNIT - IV **(15 lectures)**

1. **Magnetic properties of Matter:** Diamagnetism and Paramagnetism, The origin of permanent magnetic dipoles, Diamagnetism and Larmor precession, The static paramagnetic susceptibility. Quantum mechanical theory of paramagnetism, Ferromagnetism- the Weiss molecular field, Comparison of the Weiss theory with experiment, the Weiss field, the anisotropy energy, the Bloch wall, coercive force and hysteresis. Ch. 18, 19 – Dekker
2. **Superconductivity** : concept, achievement at low temp, attempts at room temp. Examples.

References :

(i) Introduction to solid state physics - Charles Kittel
(ii) Solid State Physics - A. J. Dekker
(iii) Solid State Physics (Problems and solutions) - S. O. Pillai
(iv) Solid State Physics - S. O. Pillai
(v) Solid State Physics - S.P.Kakani and AmitKakani

CIA:PROBLEM SOLVING/MULTIPLE CHOICE QUESTIONS

T.Y.B.Sc. PHYSICS **Course: S.PHY.6.PR**

Minimum four expts to be performed from first three groups

Group – I

1) Double Refraction.
2) Log Decrement.
3) Velocity of Ultrasonic waves in a liquid.
4) Rydberg's Constant – H_2 Spectrum.
5) Wavelength of spectral lines of Hg using Grating.

Group – II

1) Energy band gap of semiconductor using diode / thermistor.
2) Semiconductor diode as a temp. sensor.
3) Determination of Planck's constant with the help of a photoelectric cell.
4) Absolute Capacitance using B.G
5) Conversion of micrometer to a multirange milliammeter and voltmeter (Ohmmeter only Calculations.)

Group – III

1) JFET Amplifier.
2) Wien's Bridge Oscillator using OpAmp.

3) Log Amplifier – using OpAmp.
4) Active Integrator & Differentiator (learning skill of soldering).
5) Monostable multivibrator& Ramp generator using 555 timer.
6) First Order – Active filter (Low Pass / High Pass) with phase shift measurement (with skill of use of Breadboard).

Group – IV
One Project equivalent to 10 practical turns under the guidance of a teacher.

References:

1. Advanced course in practical physics – D. Chattopadhyay, P.C. Rakshit& B. Saha
2. B. Sc. Practical physics – Harnam Singh
3. A text book of practical physics – Samir Kumar Ghosh
4. B. Sc. Practical physics – C. L. Arora
5. Practical physics – C. L. Squires
6. University Practical physics – D. C. Tayal
7. Advanced Practical physics – Worsnop& Flint

CIA: MCQs on Conceptual understanding/ experimental skills for first three groups
Planning, designing and preparation of synopsis of the project

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COURSE:S.PHY.DIP.AC.6

DIGITAL IMAGE PROCESSING -II [60 LECTURES]

Learning objective: To study the mathematical modelling of digital images

UNIT I (15 LECTURES)

Color image processing
Color Fundamentals
Color Models
Pseudocolor Image Processing
Basics of Full-Color Image Processing
Color Transformations
Smoothing and Sharpening
Image Segmentation Based on Color
Noise in Color Images
Color Image Compression
Problems

Wavelets and multi-resolution processing
Background
Multi-resolution Expansions

Wavelet Transforms in One Dimension
The Fast Wavelet Transform
Wavelet Transforms in Two Dimensions
Wavelet Packets
Problems

UNIT II **(15 LECTURES)**

Image compression

Fundamentals
Some Basic Compression Methods
Digital Image Watermarking

UNIT III **(15 LECTURES)**

Morphological image processing

Preliminaries
Erosion and Dilation
The Hit-or-Miss Transformation
Basic Morphological Algorithms
Gray-Scale Morphology

UNIT –IV **(15 LECTURES)**

Image segmentation

Fundamentals
Point, Line, and Edge Detection
Thresholding
Region-Based Segmentation
Segmentation Using Morphological Watersheds
The Use of Motion in Segmentation

Reference :

1. Digital image processing, third edition
-Gonzalez and woods
2. . Digital image processing, third edition
-A. K. Jain
3. . Digital image processing using MATLAB
-Gonzalez and woods

Practicals

T.Y.BSc Digital Image processing-II **COURSE: S.PHY.DIP.AC.6.PR**

Digital processing of given images using software
Tutorials on image processing