St. Xavier's College (Autonomous),
Mumbai

Syllabus of the courses offered by the Department of Physics

BSc Physics

(2017-2018)

St. Xavier's College – Autonomous
Mumbai

Syllabus
For 1st Semester Courses in PHYSICS
(Academic Year 2016 - 2017 onwards)

Contents:

F.Y. B.Sc. PHYSICS Course: S.PHY.1.01

Title: Mechanics

Learning Objectives:
To study the fundamentals of Mechanics
Number of lectures: 45

Unit 1. Force, Work and Energy (15 lecture)

NEWTON'S LAWS OF MOTION
Force and Interactions, Newton's First Law, Newton's Second Law , Mass and Weight, Newton's Third Law , Free-Body Diagrams Questions/Exercises/Problems

APPLYING NEWTON'S LAWS
Using Newton's First Law: Particles in Equilibrium, Using Newton's Second Law: Dynamics of Particles, Frictional Forces, Dynamics of Circular Motion, The Fundamental Forces of Nature, Questions/Exercises/Problems

WORK AND KINETIC ENERGY
Work, Kinetic Energy and the Work–Energy Theorem, Work and Energy with Varying Forces, Power Questions/Exercises/Problems

Unit 2. Potential energy, Momentum and Rotation (15 lecture)

POTENTIAL ENERGY AND ENERGY CONSERVATION
Gravitational Potential Energy, Elastic Potential Energy, Conservative and Non conservative Forces , Force and Potential Energy, Energy Diagrams Questions/Exercises/Problems

MOMENTUM, IMPULSE, AND COLLISIONS
Momentum and Impulse, Conservation of Momentum, Momentum Conservation and Collisions, Elastic Collisions, Center of Mass, Rocket Propulsion Questions/Exercises/Problems

ROTATION OF RIGID BODIES
Angular Velocity and Acceleration, Rotation with Constant Angular Acceleration, Relating Linear and Angular Kinematics, Energy in Rotational Motion, Parallel-Axis Theorem, Moment-of-Inertia Calculations, Questions/Exercises/Problems

Unit 3. Rotation, Fluids and Gravitation (15 lecture)

DYNAMICS OF ROTATIONAL MOTION
Torque, Torque and Angular Acceleration for a Rigid Body Rigid-Body Rotation About a Moving Axis Work and Power in Rotational Motion, Angular Momentum, Conservation of Angular Momentum, Gyroscopes and Precession, Questions/Exercises/Problems

FLUID MECHANICS
Density, Pressure in a Fluid, Buoyancy, Fluid Flow, Bernoulli's Equation, Viscosity and Turbulence, Questions/Exercises/Problems

GRAVITATION
Newton's Law of Gravitation, Weight, Gravitational Potential Energy, The Motion of Satellites, Kepler's Laws and the Motion of Planets, Spherical Mass Distributions, Apparent Weight and the Earth's Rotation, Black Holes, Questions/Exercises/Problems

Reference University Physics, Sears &Zemansky, Young and Freedman, Pearson
Fundamentals of Physics, Halliday and Resnick

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

Title: Electricity and Magnetism

Learning Objectives:

To study the fundamentals of Electricity and Magnetism

Number of lectures: 45

Unit I: ELECTROSTATICS [15 lectures]

Charges and fields

Electric Charge, Conservation of Charge Quantization of Charge, Coulomb's Law, Energy of a System of Charges, Electrical Energy in a Crystal Lattice, The Electric Field, Charge Distributions, Flux, Gauss's Law , Field of a Spherical Charge Distribution, Field of a Line Charge, Field of an Infinite Flat Sheet of Charge, The Force on a Layer of Charge, Energy Associated with the Electric Field, Problems

The electric potential

Line Integral of the Electric Field, Potential Difference and the Potential Function, Gradient of a Scalar Function, Derivation of the Field from the Potential, Potential of a Charge Distribution, Potential of Two Point Charges, Potential of a Long Charged Wire, Uniformly Charged Disk, Divergence of a Vector Function, Gauss's Theorem and the Differential Form of Gauss's Law, The Divergence in Cartesian Coordinates, The Laplacian, Laplace's, Distinguishing the Physics from the Mathematics, The Curl of a Vector Function, Stokes' Theorem, The Curl in Cartesian Coordinates, The Physical Meaning of the Curl, Problems

Unit-II: Capacitors, Electric current and magnetic field [15lectures]

Electric Field around conductors

Conductors and Insulators, Conductors in the Electrostatic, The General Electrostatic Problem; ,Uniqueness Theorem, Some Simple Systems of Conductor, Capacitance and Capacitors, Potentials and Charges on Several, Energy Stored in a Capacitor, Other Views of the Boundary-Value Problem, Problems

Electric current

Electric Current and Current Density, Steady Currents and Charge Conservation, Electrical Conductivity and Ohm's Law, The Physics of Electrical Conduction, Conduction in Metals, Semiconductors Circuits and Circuit Elements, Energy Dissipation in Current, Electromotive Force and the Voltaic Cell, Networks with Voltage Sources, Variable Currents in Capacitors and Resistors, Problems

The Magnetic field

Definition of the Magnetic Field, Some Properties of the Magnetic Field, Vector Potential, Field of Any Current-Carrying Wire, Fields of Rings and Coils, Change in B at a Current Sheet, How the Fields Transform, Rowland's Experiment, Electric Conduction in a Magnetic Field: The Hall Effect, Problems

Unit III: EMI and AC circuits [15 lectures]

Electro-Magnetic Induction

Faraday's Discovery, A Conducting Rod Moving through a Uniform, Magnetic Field, A Loop Moving through a Non uniform, Magnetic Field , A Stationary Loop with the Field Sources Moving, A Universal Law of Induction, Mutual Inductance, A Reciprocity Theorem, Self-inductance , A Circuit Containing Self-inductance , Energy Stored in the Magnetic Field , Problems,

Alternating Current circuit

A Resonant circuit**,** Alternating Current, Alternating-Current Networks, Admittance and Impedance, Power and Energy in Alternating-Current Circuits, Problems

References:

Electricity and Magnetis - EDWARD M. PURCELL**,** CAMBRIDGE UNIVERSITY PRESS

University Physics, Sears &Zemansky, Young and Freedman, Pearson

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

In the First Semester each batch of students will come to Physics lab for 8 weeks (excluding all the holidays) that is 16 lab sessions of 2 and half hour each. Out of these we plan to utilize 4 lab sessions (8 periods of 50 min each or 10hrs) to train them for learning Physics through Scientific Inquiry.

Objectives:

1. Understanding of the concepts of knowledge and inquiry
2. Ability for rational inquiry
3. Mindset for Rational Temper

Understanding of the concepts of knowledge and inquiry,

In these sessions student would learn,

- Appreciation for knowledge and its justification,
- Concepts of rational vs. irrational and subjective vs. objective inquiry,
- Types of reasoning, predictions/conjectures, theoretical frameworks, laws, and models, Observational inquiry and inquiry

Ability for rational inquiry

In these sessions student would enhance their ability to,

- Careful, systematic and relevant observations and making observational reports,
- Design and conduct experiments,
- Notice and formulate patterns in observations and experiments,
- Establish observational generalizations based patterns,
- Explore and establish the causal factors of observational generalizations, with an awareness of the distinction between causes and correlations,
- Explain the generalizations in (4) and (5) either within an existing theory, or by creating a novel theory.
- Think through concepts and ideas, clarify and define them, and evaluate the definitions;
- Unearth, explicitly articulate, and critically evaluate hidden assumptions and biases.
- Create abstract entities and processes, with clear and precise definitions
- Set up imaginary worlds in which these entities exist by formulating axioms that govern them.
- Notice the patterns in (12) and formulate them as conjectures.
- Reason in a wide range of domains, using appropriate modes of reasoning.
- Identify logical consequences and detect logical contradictions, if any.
- Prove and refute (justify, with evidence and arguments).
- Participate in rational debates without the desire to win and the fear of 'loss of face' when one is proved wrong,
- Ability to make connections across diverse domains, notice similarities and differences and at the same time apprehend the unity underlying diversity, and to integrate what is otherwise fragmented.

Mindset for Rational Temper

- Intellectual curiosity: the desire to find out about things
- The joy of learning and of finding things out on one's own

- Openness to criticism: the predisposition to accept and seek criticism in the spirit of self-correction
- Intellectual scepticism: the habit of doubting and questioning the values, norms, beliefs, and practices of authorities and peers, as well as one's own; unwillingness to accept assertions unless supported by adequate reasons
- Open-mindedness: willingness to modify one's beliefs and practices when confronted with good reasons to do so
- Commitment to the epistemic values of truth, rationality, and rigour, and to clarity and precision of thought and expression;
- Commitment to the ethical values of truthfulness and integrity; and
- Commitment to the well-being of the earth and all its creatures, and the avoidance of harm
- Readiness to pursue what is demanded by the above commitments
- Sequencing Problem

Reading and viewing

- Einstein, A & L, Infeld (1935) *The Evolution of Physics* , downloadable at https://archive.org/details/evolutionofphysi033254mbp
- Videos of Feynman on youtube (e.g., The Pleasure of Finding things Out)
- Mohanan, K P and T Mohanan (2015) "Region of Inexactness and related concepts
- Mohanan K P & T Mohanan (2015) Observational Inquiry

Rest of the experiments will be selected from the following list and will be conducted with skills obtained in above sessions

List of Experiments:

Paper 1:

1. Measurement Length, Mass, Time
2. Measuring Tension/breaking tension
3. Measurement of angle
4. Measurement of angular velocity/angular momentum
5. 'Y' by bending
6. 'Y' by Searls method
7. Bifillar suspension
8. Determination of gravitational acceleration
9. Fly wheel

Paper2:

1. Static Electricity (Demo).
2. Capacitor designing and measurement of capacitance with DMM.
3. Inductor designing and measurement of inductance with DMM.
4. Mutual induction.
5. Helmholtz Coil.
6. Capacitor charging.
7. Determination of internal resistance and pure "L" by LR circuit.
8. Determination of internal resistance and pure "C" by CR circuit.
9. Change in reactance of L or C with frequency of input signal.
10. LCR resonance.
11. Study of voltage divider and current divider circuits.
12. Determination of specific resistance of a conductor.

Syllabus

For 2nd Semester Courses in PHYSICS
(Academic Year 2016 - 2017 onwards)

Contents

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

Title: Mechanics and Thermodynamics

Learning Objectives:

To study the fundamentals of Mechanics and thermodynamics

Number of lectures: 45

Unit 1. Oscillations and waves (15 lecture)

Equilibrium and elasticity

Conditions for Equilibrium, Centre of Gravity, Solving Rigid-Body Equilibrium Problems, Stress, Strain, and Elastic Moduli Elasticity and Plasticity, Questions/Exercises/Problems **Periodic motion**

Describing Oscillation, Simple Harmonic Motion, Energy in Simple Harmonic Motion Applications of Simple Harmonic Motion, the Simple Pendulum, the Physical Pendulum, Damped Oscillations, Forced Oscillations and Resonance Questions/Exercises/Problems

Mechanical waves

Types of Mechanical Waves, Periodic Waves, Mathematical Description of a Wave, Speed of a Transverse Wave, Energy in Wave Motion, Wave Interference, Boundary Conditions, and Superposition, Standing Waves on a String, Normal Modes of a String. Questions/Exercises/Problems

Unit 2. Sound and Thermodynamics (15 lecture)

Sound and hearing

Sound Waves, Speed of Sound Waves, Sound Intensity, Standing Sound Waves and Normal Modes, Resonance and Sound Interference of Waves , Beats, The Doppler Effect , Shock Waves, Questions/Exercises/Problems

Temperature and heat

Temperature and Thermal Equilibrium, Thermometers and Temperature Scales, Gas Thermometers and the Kelvin Scale, Thermal Expansion, Quantity of Heat, Calorimetry and Phase Changes, Mechanisms of Heat Transfer. Questions/Exercises/Problems

Thermal properties of matter

Equations of State , Molecular Properties of Matter, Kinetic-Molecular Model of an Ideal Gas, Heat Capacities, Molecular Speeds ,Phases of Matter Summary Questions/Exercises/Problems

Unit 3. Laws of thermodynamics (15 lecture)

The first law of thermodynamics

Thermodynamic Systems ,Work Done During Volume Changes , Paths Between Thermodynamic States , Internal Energy and the First Law of Thermodynamics, Kinds of Thermodynamic Processes, Internal Energy of an Ideal Gas , Heat Capacities of an Ideal Gas, Adiabatic Processes for an Ideal Gas Questions/Exercises/Problems

The second law of thermodynamics

Directions of Thermodynamic Processes, Heat Engines, Internal-Combustion Engines, Refrigerators, The Second Law of Thermodynamics, The Carnot Cycle, Entropy, Microscopic Interpretation of Entropy, Questions/Exercises/Problems

References:

University Physics, Sears & Zemansky, Young and Freedman, Pearson
Fundamentals of Physics, Halliday and Resnick

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

Title: Optics

Learning Objectives: To acquire knowledge of fundamental optics.
Number of lectures: 45

UNIT 1: Nature of Light (15 Lectures)

ELECTROMAGNETIC WAVES

Maxwell's Equations and Electromagnetic Waves Plane Electromagnetic Waves, and the Speed of Light, Sinusoidal Electromagnetic Waves, Energy and Momentum in Electromagnetic Waves, Standing Electromagnetic Waves, Questions/Exercises/Problems

THE NATURE AND PROPAGATION OF LIGHT

The Nature of Light, Reflection and Refraction, Total Internal Reflection, Dispersion , Polarization, Scattering of Light, Huygens's Principle, Questions/Exercises/Problems

UNIT 2: Light Phenomenon (15 Lectures)

GEOMETRIC OPTICS

Reflection and Refraction at a Plane Surface, Reflection at a Spherical Surface , Refraction at a Spherical Surface , Thin Lenses , Cameras , The Eye , The Magnifier , Microscopes and Telescopes , Questions/Exercises/Problems

INTERFERENCE

Interference and Coherent Sources, Two-Source Interference of Light, Intensity in Interference Patterns, Interference in Thin, the Michelson Interferometer, Questions/Exercises/Problems

UNIT 3: Light Phenomenon (15 Lectures)

Diffraction

Fresnel and Fraunhofer Diffraction , Diffraction from a Single , Intensity in the Single-Slit Pattern, Multiple Slits , The Diffraction Grating , X-Ray Diffraction , Circular Apertures and Resolving Power , Holography , Questions/Exercises/Problems

Photons

Light Absorbed as Photons: The Photoelectric Effect, Light Emitted as Photons: X-Ray Production, Light Scattered as Photons: Compton Scattering and Pair Production, Wave–Particle Duality, Probability and Uncertainty, Questions/Exercises/Problems

List Of Recommended Reference Books

University Physics, Sears & Zemansky: Young and Freedman, Pearson
Fundamentals of Physics: Halliday and Resnick

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

The experiment will be from the following groups

Group I

1. Simple pendulum
2. Bar pendulum
3. Lee's method
4. Capillary rise
5. Surface tension – drop method
6. Use of manometer
7. CVAT
8. Determination of density of different liquids
9. Pascal's law
10. Beats
11. Different Thermometers
12. Measuring body temperature with various scales
13. Change of boiling point of water with pressure.

Group II

1. Mirrors.
2. Single lens: Real images and virtual images.
3. Combination of lens to design telescope and microscope.
4. Lens aberration: Spherical/ Chromatic.
5. Total internal reflection.
6. Study of prisms.
7. Wedge shaped film.
8. Newton's ring.
9. Study of spectra of different sources.
10. Transmission and reflection grating to find refractive index of liquid using Laser.
11. Brewster's law.

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

St. Xavier's College – Autonomous
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Syllabus
For 3rd Semester Courses in PHYSICS
(June 2017 onwards)

Contents:

Course: S. PHY.3.01

Title: Waves and Quantum Optics
Learning Objectives: To understand the interaction of light with matter.
Number of Lectures: 45

Unit 1 Interference and Diffraction **15 lectures**

Michelson Interferometer : circular fringes, localized fringes, white light fringes, Applications

Fresnel Diffraction : Shadows, Fresnel's half period zones,

Diffraction by a circular aperture and obstacle, zone plate, apertures and ostacles with straight edges, vibration curve for strip division: Cornu's Spiral, Rectilinear propagation of light, single slit

Unit 2 Polarization **15 lectures**

Double Refraction: Wave surfaces for uniaxial crystals, propagation of plane waves in uniaxial crystals, Plane wave in Oblique incidence, Indices of refraction for uniaxial crystal, Theory of double refraction

Intereferecne of polarized light: Elliptically and circularly polarized light, Quarter and half wave plates, Babinet compensator, Analysis of polarized light, Polarizing monichromatic filter

Optical activity: Rotation in plane of polarization, Rotary dispersion, Fresnel's explanation of rotation, double refraction in optically active crystal, Shape of wave surfaces in Quartz, Theory of optical activity, Rotations on liquids.

Unit 3 Quantum Optics **15 lectures**

Lasers: Metastable states, Optical pumping, Stimulated Emission, Resonator cavities, Coherence length, Frequency doubling, Laser safety, speckle effect, Ruby Laser, He-Ne Laser, Concave mirrors and Brewster's window, CO_2 Laser, semiconductor diode laser, dye laser, applications of LASERS.

Holography: Basic principles of Holography, viewing a Hologram, Thick or volume Hologram, Multiplex Holograms, Student Laboratory Holography

REFERENCE BOOKS:

1. Fundamentals of Optics –by Jenkins and White, 4th ed., McGraw Hill Education, 2001
2. Optics -by Ajoy Ghatak, McGraw-Hill Education, 2009
3. LASERS- by Ajoy Ghatak and Thyagarajan, Springer, 2010

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

Course: S.PHY.3.02

Title: Mathematical Physics
Learning Objectives: To understand the mathematical concepts related to physics
Number of lectures: 45

Unit 1 **15 lectures**

Conics 10+2 level (parabola, hyperbola, ellipse)
Vector analysis
Coordinate systems (orthogonal curvilinear)

Unit 2 **15 lectures**

Matrices and applications
Probability theory and applications.
Differential equations-1

Unit 3 **15 lectures**

Differential equations-2
Fourier series
Fourier and Laplace Transforms

References:-

1. Calculus -by Thomas and Finney, 9th edition, Addison Wesley, 1994
2. Mathematical physics -by H K Dass and Rama Verma, S. Chand, 2008
3. Mathematical physics -by B.D. Gupta, Vikas Publisher, 4th ed., 2009
4. Mathematical methods for physicists, G. Arfken and Weber, Academic press
5. Mathematical methods for physics and engineering, K.F.Riley, M.P.Hobson and S.J.Bence, 2nd or 3rd edition.

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

Course: S.PHY.3.03

Title: Electronics

Learning Objectives: Understanding working of basic electronic gadgets.

Number of Lectures: 45

UNIT I P-N junctions, BJT **15 Lectures**

Review of Semiconductor Diodes, Diode Applications (Revision), Passive filters (BN Chap 1, 2 and reference 3 or 4)

Bipolar Junction Transistor (BN Chp 3)

DC Biasing of BJTs (BN Chp 4, 4.8- 4.11, 4.15, 4.19 Self Study)

BJT Frequency Analysis (BN Chp 9: 9.1 to 9.8 , 9.10, 9.11 Only)

Unit II OPAMPs and Thyristors **15 Lectures**

Differential amplifiers, Operational amplifiers (BN Chap 10)

Op Amp applications (BN Chap 11)

SCR & UJT characteristics,

Applications of SCR & UJT (self study)(BN Chap 17)

Unit III Digital Electronics

Digital logic (Revision), (ML Chap 2)

Combinational logic circuits (ML chap 3 upto 3.9)

Number Systems and Codes (ML Chap 5)

Arithmetic circuits (ML Chap 6)

Flip flops (ML Chap 8)

Counters (ML Chap 9)

Main References :-

1. Electronic devices and circuit theory- Boylestad and Nashalsky, 11th edition(**units 1 and 2)**
2. Digital Principles and applications – Malvino, Leach and G. Saha, 7th edition, (**unit 3)**
3. Electronic priciples by A.P.Malvino -7th or 8th edition
4. Electronic devices and circuits- Allen Mottershead

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

COURSE : S.PHY.3.PR

REGULAR EXPERIEMENTS + PROJECT WORK (IN THEORY RELATED TOPICS)

Experimental Project work:	**30×3 marks**
Presentation:	**20 marks**
Exam on regular experiments	**25 marks**
Journal	**15 marks**

Minimum Three experiments from each paper

Mathematical Physics:

1. Numerical analysis of Mathematical methods(e.g. Differential equation, matrices, Fourier analysis, different random walks) using softwares like Octave, MS Excel.
2. Finding solutions of different physical systems (Coupled harmonic motion, LCR Circuits
   etc.) using numerical analysis (using above mentioned softwares)
3. Demonstration of Fourier series using OPAMP circuits.

Wave and Quantum Optics:

1. Schuster Method.
2. Cauchy's constant.
3. Cylindrical obstacle.
4. R. P. of telescope.
5. Fresnel diffraction of straight edge or circular aperture
6. Diffraction grating –wavelength of Hg lines

Electronics:

1. Bridge rectifier, Zener Diode.
2. Study of Clipper and clamper circuits
3. Transistor o/p characteristics, different biasing, load line and stability.
4. CE amplifier, frequency response, input and output impedance
5. Logic gates + half adder, Full adder
6. Sum of product and product of sum method.
7. Opamp- inverting, non inverting ammplifiers and voltage folloer

REFERENCES:

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

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Syllabus
For 4th Semester Courses in PHYSICS
(June 2017 onwards)

Contents:

Course: S.PHY.4.01

Title: Thermodynamics
Learning Objectives: To Understand the Laws of Thermodynamics and their applications
Number of lectures: **45**

Unit I **15 Lectures**

Temperature and the Zeroth Law of Thermodynamic (ZT Chap 1)
Simple Thermodynamics systems (ZT Chap 2)
Work (ZT Chap 3)
Heat and 1st law of thermodynamics (ZT Chap 4)

Unit II **15 Lectures**

Ideal Gas (ZT Chap 5)
2nd law of thermodynamics (ZT Chap 6)
Carnot Cycle and Thermodynamic temperature Scale (ZT Chap 7)
Entropy (ZT Chap 8)

Unit III **15 Lectures**

Pure substances (ZT Chap 9)
Mathematical Methods in thermodynamics (ZT Chap 10)
Open systems (ZT Chap 11)
Liquefaction of gases **(Ref.2)**

References:

1. Heat and Thermodynamics by Zemanky and Dittman, 7th or 8th edition
2. Treatise of heat , Saha and Srivastava

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

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**

Thermal Radiation and Planck's postulate
Photons—particle like properties of radiation
De broglie's postulate—wavelike properties of particles
Bohr's model of the atom
(Chapter 1-4 from ref.2)

UNIT II **15 Lectures**

Schroedinger's theory of quantum mechanics
Solutions of time-independent Schroedinger's equations
(Chapter 5 & Chapter 6 up to 6.8 from ref.2)

Unit III **15 Lectures**

Solutions of time-independent Schroedinger's equations
Particle in 3D box

(Article 6.9, Appendix G from ref.2 and Articles 41.1 and 41.2 from ref. 1)

References:

1.University Physics by young and freedman, Sears and Zemansky- 13th edition
2.Quantum Physics of atoms molecule and nuclei - Eisberg and Resnick, Wiley
3.Introduction to Quantum mechanics - Ajoy Ghatak
4. Introduction to quantum mechanics – D.J. Griffith

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

Course: S.PHY.4.03

Title: Acoustics

Learning Objective: Understanding Acoustics of Physical, Architectural and musical systems

Number of lectures:**45**

Unit I Physical Acoustics **15 Lectures**

Simple Harmonic Motion Applications.
Waves and Sound.
Standing Waves and the Overtone Series
Analysis and Synthesis of Complex Waves

Unit II Psycho-acoustics and architectural acoustics **15 Lectures**

The Human Ear and Voice
Musical temperament and pitch
Room and Auditorium Acoustics

Unit III Musical acoustics **15 Lectures**

Woodwind Instruments
Brass Instruments
Stringed Instruments
Percussion Instruments

Reference:

1. The Physics of Sound, Third Edition, Richard E. Berg, David G. Stork, Pearson, Addison Wesley.
2. The Science Of Sound, third edition by Rossing, Moore, and Wheeler, Addison Wesley.
3. Music and Engineering by Harry.F.Olson (for Practicals)
4. The Physics of Music by Alexander Wood

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

Course :S.PHY.4.PR.

REGULAR EXPERIEMENTS + PROJECT WORK (IN THEORY RELATED TOPICS)
Experimental Project work: 30×3 marks
Presentation: 20 marks
Exam on regular experiments 25 marks
Journal 15 marks

Minimum Three experiments from each paper

Acoustics:

1. Speed of sound by different methods
2. Concept of beats and resonance at audio frequency.
3. Open and closed end organ pipes.
4. Frequency response of speakers

Thermodynamics:

1. J by Electrical Method.
2. Heat conductivity by Lee's method.
3. Constant Volume Air Thermometer.
4. Experiments on laws of thermodynamics

Quantum Mechanics:

1. Planck's Constant using LED.
2. Simulation experiments/ plotting of wave and probability functions using using softwares like Octave, MS Excel.. **(two experiments)**

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

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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