Department of Physics

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16UPH1MC01 PROPERTIES OF MATTER AND ACOUSTICS

Category: MC **Credits: 7**

Semester: I **No of Hours/Week: 7**

Objective:

The aim of this paper is to expose the students to the fundamentals of properties of matter and sound.

Unit 1: ELASTICITY (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Hooke's Law – stress–strain diagram – Moduli of Elasticity – Poisson's ratio – Relation between elastic constants and Poisson's ratio – Work done in stretching a wire – Twisting couple on a cylinder – Torsional pendulum(with and without weights) – Bending of beams – Bending moment – Cantilever loading – Expression for depression at the loaded end – Oscillations of a cantilever – Young's Modulus – Non-Uniform and uniform bending – Koenig's method.

Unit 2: VISCOSITY (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Streamline and turbulent motion – Newton's law – Poiseuille's flow – terminal velocity and Stoke's formula – Ostwald viscometer – Meyer's modification of Poiseuille's formula – Rankine's method – Effect of temperature and pressure on viscosity – Equation of continuity – Bernoulli's theorem – Venturimeter –Toricelli's theorem.

Unit 3: SURFACE TENSION(Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Definition – molecular forces –Jaegar's method – Excess pressure inside a curved liquid surface – Variation of surface tension with temperature – Angle of contact – Quincke's method – Drop weight method of determining the surface tension of liquid – interfacial surface tension – experiment to

determine the interfacial surface tension between water and liquid.

Unit 4: WAVES AND OSCILLATIONS (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

SHM – Differential equation of SHM – Graphical representation of SHM – illustration of SHM: Oscillations of a gas in a cylinder – Wave motion – transverse and longitudinal waves – general equation of simple harmonic motion – wave velocity and particle velocity – differential equation of wave motion – Stationary waves – properties of stationary waves – Doppler effect.

Unit 5: ACOUSTICS (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Intensity of sound – Decibel and Bel – Loudness of sound – Reverberation – Sabine's reverberation formula – Acoustic intensity – Factors affecting the acoustics of Buildings – Ultrasonic waves – production of ultrasonic waves – piezo electric crystal method –Magnetostriction effect – application of ultrasonic waves.

TEXT BOOKS:

1. D.S Mathur, Elements of Properties of Matter, S .Chand And Co (2010)
2. BrijLal and N. Subrahmanyam, Properties of Matter, S.Chand and Co(2003)
3. D.R.Khanna and R.S. Bedi, Textbook of Sound, Atma ram and sons (1969)
4. N.Subrahmanyam And BrijLal, A Text Book of Sound,Vikas Publishing House - Second revised edition (1995)

BOOKS FOR REFERENCE:

1. H.R Gulati, Fundamental of General Properties of Matter, R Chand and Co, Fifth edition (1977)

2. N.K Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill (1988)
3. A.P French, Vibration and Waves, MIT Introductory Physics, Arnold–Heinmann India (1973)
4. SatyaPrakash and AkashSaluja, Oscillations and Waves, PragatiPrakashan (2002)

16UPH1MC02 PHYSICS PRACTICALS I

Category: MC **Credits: 2**

Semester: I **No of Hours/Week: 2**

Objectives:

The course aims at exposing the under graduate students to thetechnique of handling simple measuring instruments.

List of experiments.

1. Young's modulus– Cantilever– Pin and microscope
2. Rigidity modulus –Torsional pendulum–without weights
3. Viscosity– graduated burette
4. Verification of laws of transverse vibration –Sonometer.
5. Pressure coefficient of air – Jolly's bulb.
6. Determination of A,D and μ– spectrometer– solid prism
7. Calibration of an ammeter– Potentiometer
8. Moment of a bar magnet – Deflection magnetometer– Tan C

16UMT1AL01 MATHEMATICS FOR PHYSICS – I

Semester:I	**Credits**	**:3**
Category: MC	**Hours/Week**	**:6**

Objectives:

1. To get a good exposure to the basic concepts of Mathematics.
2. To familiarize the learner with applications of mathematics to Physics.

Unit1: The nth derivative-Leibnitz theorem (no proof) and applications - subtangentand subnormalin cartesianand polar coordinates-slopeof a curve and angle of intersectionofcurvesin polarcoordinates-maximaandminima of functions of one variable. (2+14+2 Hrs)

Unit2: Series – Convergence and divergence of series – Test for convergence – Comparison test – Ratio Test – Binomial,exponentialand logarithmicseries (no proof) and applicationtosummation.
(2+14+2 Hrs)

Unit3: Laplace transform ofelementaryfunctions andperiodic functions - inverse transform-applicationtodifferentialequations.
(2+14+2 Hrs)

Unit4: Matrices – Types of Matrices – Inverse of a Matrix – Characteristic equation of Matrix – Cayley Hamilton Theorem (no proof) - solving problems using Cayley Hamilton Theorem – Eigen values and Eigen vectors – Solving system of equations using matrix inverse method, Cramer's rule and Gauss Elimination Method. (2+14+2 Hrs)

Unit 5: Probability- Basic Terminology – mean - standard deviation- Correlation – Rank Correlation - Regression - Binomial, Poisson andNormal distributions. (2+14+2 Hrs)

Books for Study

1. Narayanan, S., and ManickavachagamPillai, T.K., Calculus, Vol.I, S.ViswanathanPrinters&Publishers,1996.
   Unit 1: Chapter 3: 1.1 – 1.4, 2.1; Chapter 5: 1.1 – 1.5; Chapter 9: 1.2, 1.4, 2, 4.1 – 4.5
2. Narayanan, S., and ManickavachagamPillai, T.K., Calculus,Vol. III, S.ViswanathanPrinters&Publishers,1996.
   Unit 3: Chapter 5: 1 – 9
3. P.K. Mittal, Matrices, Vrinda Publications (P) Ltd., 2007.
   Unit 4- Chapter 1: 1.1, 1.2; Chapter 2: 2.1, 2.3 – 2.8; Chapter 4: 4.1, 4.3; Chapter 7: 7.1 – 7.3, 7.5; Chapter 9: 9.1,9.3,9.4.
4. ManickavachagamPillai,T.K,Natarajan,T.andGanapathy,K.S. Algebra,Vol.I, S.ViswanathanPrinters&Publishers,1994.
   Unit 2: Chapter 2: 8 – 14, 16; Chapter 3: 10; Chapter 4: 3, 5 – 7, 9.
5. S.P.Gupta., V.K. Kapoor, Fundamentals of Mathematical Statistics,SultanChandandsonsPublishers, 2002.
   Unit 5: Chapter 2: 2.5, 2.13.4; Chapter 3: 3.1 – 3.5, Chapter 8: 8.4, 8.4.1, 8.4.6, 8.5, 8.5.2, 8.5.5, 8.5.9; Chapter 9: 9.2, 9.2.1, 9.2.5, 9.2.14; Chapter 10: 10.4, 10.4.2, 10.7.1; Chapter 11: 11.2, 11.2.1, 11.2.2

Books for References

1. Allan Gut, Probability: A Graduate Course, Second Edition, Springer, New York, e-Book, 2012.
2. Duraipandian,P.,VectorAnalysis,EmeraldPublishers,1984.
3. P. Kandasamy, K. Thilagavathy, Allied Mathematics Vol I, S Chand, e-Book, 2014.
4. ShanthiNarayanan,DifferentialCalculus,S.Chand&Co.,1964.
5. Singaravelu, A.,Allied Mathematics,A.R.S. Publications,2014.
6. Vittal,P.R.Allied Mathematics,MarghamPublications,2015.

16UPH2MC01 MECHANICS

Category: MC **Credits: 7**

Sem: II **No of Hours/Week: 7**

Objective:

To make the students understand the basic principles of mechanics and enable them to analyze and solve problems.

Unit 1: NEWTON'S LAWS OF MOTION (Introduction – 1 hr, content – 15 hrs, revision – 5 hrs)

Newton's Laws of motion– forces and equations of motion– motion of a particle in a uniform gravitational field– Newtonian law of universal gravitation–Examples–electric and magnetic forces on a charged particle–The magnetic field and Lorentz force–Examples– motion of charged particle in a uniform constant electric field. Conservation of momentum–contact forces: friction– Problems

Unit 2: CONSERVATION LAWS(Introduction – 1 hr, content – 15 hrs, revision – 5 hrs)

Definition of concepts–conservation of energy–Work–kinetic and potential energy– Examples–Conservative Forces–Potential energy and conservation of energy in gravitational and electric field– Examples.

Conservation of Linear and angular momentum: Internal forces and momentum conservation–center of mass– Examples– General elastic collision of particles of different masses– System with variable mass–Examples– Conservation of angular momentum–Torque due to internal forces–Torque due to gravity– Angular momentum about center of mass– Proton scattering by heavy nucleus.

Unit 3: ELEMENTARY RIGID BODY DYNAMICS (Introduction – 1 hr, content – 16 hrs, revision – 4 hrs)

The equation of motion–angular momentum and kinetic energy–Moment of inertia–parallel axis theorem– Perpendicular

axis theorem– examples–Rotation about fixed axis: time dependence of motion– Examples– Rolling without slipping– Torque about center of mass–Example– Rotation about fixed axes: Behavior of angular momentum vector.

Unit 4: HARMONIC OSCILLATOR AND INVERSE SQUARE LAW OF FORCE (Introduction – 1 hr, content – 15 hrs, revision – 5 hrs)

Mass on spring–simple pendulum–Compound pendulum–LC circuit– motion of systems displaced from position of stable equilibrium–Average kinetic energy and potential energy– Friction–Damped Harmonic oscillator.

Inverse square law of forces and static equilibrium– Orbits: Equation and eccentricity–Circular orbit–Kepler's laws– Examples

Unit 5: SPECIAL RELATIVITY (Introduction – 1 hr, content – 15 hrs, revision – 5 hrs)

Constancy of speed of light–Michelson–Morley experiment – invariance of c – Basic assumptions– Lorentz transformation– Length contraction– Measurement of length perpendicular to relative velocity– Time dilation of moving clocks–Examples– velocity transformation– velocity addition–aberration of light– longitudinal Doppler effect.

Text book for study:

1. Charles Kittel, Walter D knight, Mechanics (in SI units), (Berkeley Physics course–volume 1), Tata McGraw Hill publication, second edition (1973)

Text books for reference:

1. A.P.French, Newtonian mechanics, Viva Books Private, 2011 edition
2. Kleppner and Kolenkow, Introduction to mechanics, McGraw Hill Publishers(Special Indian edition), first edition (2010)

16UPH2MC02 PHYSICS PRACTICALS II

Category: MC **Credits: 2**

Semester : II **No of Hours/Week: 2**

List of experiments.

1. Determination of g and k – Compound bar pendulum
2. Surface tension– capillary rise
3. Young's modulus– non-uniform bending – pin and microscope
4. Refractive index of a liquid- hollow prism-spectrometer
5. Specific resistance of a wire – Carey- Foster's bridge
6. Transverse and longitudinal mode– Melde's string
7. Figure of merit– Table Galvanometer
8. Determination of m and B_H-deflection and vibration magnetometer

16UMT2AL01 MATHEMATICS FOR PHYSICS – II

Category: AL **Credits: 3**

Semester:II **Hrs/Wk: 6**

Objectives:

1. To familiarize the students with applications of Mathematics in Physics

2. To develop analytical skills

Unit 1: Integration -Methods of integration - integration of rational and irrational functions - integration by parts-Bernoulli's formula-Reduction Formula. (2+14+2 Hrs)

Unit 2: Definite integrals - properties of definite integrals - Beta and Gamma integrals and their properties. (2+14+2 Hrs)

Unit 3: Ordinary differential equations-solutions of first order and first degree equations-exact equations Mdx+Ndy= 0 second order differential equations with constant coefficients.

Unit 4: Multiple integrals-Double and Triple integrals (simple problems)- change of order of integration-change of variables-Jacobian. (2+14+2 Hrs)

Unit 5: Differentiation of vectors-gradient-divergence and curl-line integrals-verification of Gauss theorem, Green's theorem and Stokes theorem. (2+14+2 Hrs)

Books for Study:

1. Narayanan, S. and ManickavachagamPillai, T.K., Calculus Vol. II, S. Viswanathan Printers & Publishers, 1996.
   Unit 1: Chapter 1: 2, 3, 6.2 – 6.6, 7.3, 7.4, 8 (case i& ii), 12, 13.1 – 13.6; 15.1
   Unit 2: Chapter 1: 4, 11; Chapter 7: 2 – 5.
   Unit 3: Chapter 5: 1 – 4, Chapter 6: 1.1, 1.2, 2.1.
2. Narayanan, S. and ManickavachagamPillai, T.K., Calculus Vol. III, S. Viswanathan Printers & Publishers, 1996.
   Unit 4: Chapter 1: 2.1 – 2.4, 3.1; Chapter 2: 1 – 4.
3. Narayanan, S. and ManickavachagamPillai, T.K., Ancillary Mathematics Vol II, S. Viswanathan Printers & Publishers, 1996.
   Unit 5: Chapter 8.

Books for References:

1. Duraipandian, P., Vector Analysis, Emerald Publishers, 1984.
2. John B.Fraleigh, A First Course in Abstract Algebra, Addison Wesley Publishing Co.,1975.
3. P. Kandasamy, K. Thilagavathy, Allied Mathematics Vol II, S Chand, e-Book, 2014.
4. Louis Brand, Vector Analysis, Dover Publications, e-Book, 2012.
5. Shanthi Narayanan, Integral Calculus, S.Chand& Co., 1964.
6. Viswanathan,K. and Selvaraj,S., Vector Analysis, Emerald Publishers, 1988.

16UPH3MC01MATHEMATICAL PHYSICS

Category: MC **Credits: 6**

Sem: III **No of Hours/Week: 6**

Objective:

To make the student understand the application of mathematics to various branches of physics

Unit 1: COMPLEX ANALYSIS (Introduction – 1 hr, content – 20 hrs, revision – 4 hrs)

Complex Numbers– Complex plane–polar form– arithmetic operations– Powers and roots of complex numbers – complex functions– Derivatives – Analytic function–Cauchy–Riemann equation– Laplace equation and harmonic functions–Exponential, trigonometric and hyperbolic functions and their properties–Logarithm and general power. Line integral in the complex plane– Parametric representation– Cauchy integral theorem– Independence of path–Cauchy integral formula.

Unit 2: VECTOR CALCULUS (Introduction – 1 hr, content – 9 hrs, revision – 1 hr)

Basics of Vector algebra– Vector and scalar functions and fields– Gradient of a scalar field– Directional derivatives– Divergence and curl of a vector field: rotation of a rigid body– Line integrals and independent of path– Double integrals– Green's theorem in the plane.

Unit 3: FOURIER ANALYSIS(Introduction – 1 hr, content – 16 hrs, revision – 3 hrs)

Periodic functions– Trigonometric series– Fourier series: Rectangular wave– Orthogonailty of trigonometric system– Functions of any period: Periodic square wave and Half–wave rectifier–Even and odd functions: Rectangular pulse and saw tooth wave–Half range expansions– complex Fourier

series–Forced oscillations–Fourier integrals– Square wave– Fourier cosine and sine integrals: Laplace integrals

Fourier Transform: complex form of Fourier integral– Fourier transform and its inverse– Physical interpretation: Spectrum– Linearity and Fourier Transform of Derivatives.

Unit 4: PARTIAL DIFFERENTIAL EQUATIONS (Introduction – 1 hr, content – 22 hrs, revision – 3 hrs)

Basic Concepts– Modelling: Vibrating string, Wave equation– Separation of variables– Use of Fourier series– Examples– D'Alembert's Solution of the wave equation– Heat Equation: Solution by Fourier series– Examples–Representation of Laplacian in polar coordinates, cylindrical and spherical coordinates(No derivation)–Boundary value problem in spherical Coordinates.

Unit 5: NUMERICAL METHODS (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Interpolation–Lagrange interpolation formula for unequally spaced data– Newton forward interpolation formula for equally spaced data –Numerical integration: Trapezoidal rule, Simpson 1/3 rule, Newton Raphson method–Curve fitting by the method of least squares–First order differential equation by Euler's method and the improved Euler method

Text book for study:

1. Erwin Kreyszig, Advanced engineering mathematics, Wiley student edition, 8th edition,2005.
2. H.K. Dass, Mathematical Physics, S. Chand & Co. Ltd. 2010 (for unit V)

Text book for reference:

1. TulsiDass and SatishK.Sharma, Mathematical Methods in Classical and Quantum Physics, Universities Press, 1998.

2. Louis Albert Pipes & Lawrence R. Harville, Applied mathematics for Engineers and Physicists (3rdEd.), International Student Edition, 1970.
3. George Arfken, Hans Jurgen Weber, Mathematical methods for Physicists, 6th Ed.– Academic Press, 2003
4. Mary L. Boas, Mathematical methods in Physical Sciences, 3rd Ed. Wiley, 2006.
5. Riley & Hobson, Foundation Mathematics for Physical Sciences, Cambridge University Press, 2011
6. S SSastry, Introductory methods of Numerical Analysis, PHI, 3rd Ed,2004.

16UPH3MC02 ELECTRONICS – I

Category: MC **Credits: 4**

Semester: III **No of Hours/Week: 4**

Objectives:

To expose the under graduate students to the fundamentals of analog and digital electronics. The various topics augment the electronics experiments that will be done in the Laboratory.

Unit 1 : Circuit Analysis(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

DC circuits – Voltage and current sources – transformations – maximum power transfer theorem –Superposition, Thevenin and Norton's theorems.

Unit 2: Amplifiers and Oscillators(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Single stage amplifier – DC load line – operating point stability – Introduction to biasing – Voltage divider biasing –multi stage amplifier, RC and direct coupled amplifiers – Feedback requirements for oscillators – Colpit's oscillator and Wien

Bridge oscillators –Multivibrators – Astable, Monostable, Bistable.

Unit 3: Operational amplifier and special devices(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Ideal operational amplifier parameters – CMRR– virtual ground– inverting and non inverting – summing and difference amplifiers – Solving simultaneous equations – FET, MOSFET – Structure, working and I–V characteristics.

Unit 4 : Digital Electronics(Introduction – 1 hr, content – 15 hrs, revision – 1 hr)

Boolean algebra – K–maps – Half adder, full adder Parallel binary adder. Flip–flop – RS flip–flop – D flip–flop – T flip–flop – JK flip–flop and Master Slave flip–flop – Truth tables.

Counters – Binary ripple counter(4–bit up counter, 4–bit down counter, 4–bit up/down counter) – modulus counter (mod–2,4,8) – decade counter – Registers –Shift registers (4–bit right, left).

Unit 5: Integrated Circuit technology(Introduction – 1hr, content – 5 hrs, revision – 1hr)

Scale of integration – VLSI – monolithic, thick, thin film and hybrid integrated circuits – bipolar and MOS technology comparison – ULSI – Overview of Lithographic techniques – fabrication of monolithic I.C. – fabrication of integrated components like resistors, capacitors, transistors and diodes – linear and nonlinear I.C's.

BOOKS FOR STUDY:

1. B. L. Theraja, Basic Electronics (Solid State), S. Chand & Co.
2. MehthaVK., Principles of Electronics, S.Chand& Co., 11th Ed. 2010.
3. Millman J. and Halkias C.C., Integrated Electronics, Analog & Digital Circuits and systems, McGraw–Hill 2nd edition 2009.

4. Chattopadhay D. and Rakshit, Electronics Fundamental and applications, New age publishers, 11 Ed.,2010.
5. A.P Malvino, D.P. Leach, GautamSaha Digital Principles and Applications 7th Edition Tata McGraw–Hill Education, 2011

BOOKS FOR REFERENCE:

1. John D. Ryder, Electronic, fundamentals and applications, Prentice Hall, 5th ED., 2009.
2. Ben G. Streetman, Sanjay Banerjee Solid State Electronic Devices 6th Edition PHI Learning, 2009
3. M. Morris Mano, Michael D. Ciletti, Digital Design, 4th Edition Pearson, 2008
4. Malvino, Electronic principles, Tata McGraw Hill, Ed., 1995.

16UPH3MC03 PHYSICS PRACTICALS III

Category: MC **Credits: 2**

Semester : III **No of Hours/Week: 2**

List of experiments.

1. Young's modulus –uniform bending – pin and microscope
2. Rigidity modulus– Torsional pendulum – with weights
3. Determination of B_H- Field along the axis coil of a circular coil.
4. Thickness of a wire/insulation – Air wedge
5. Determination of wavelength of mercury spectrum– Grating – normal incidence
6. Temperature coefficient of resistance– Carey – Foster's bridge
7. Specific heat of a liquid–Newton's law of cooling
8. Refractive index of the material of a convex lens– Newton's rings

16UCH3AL01 GENERAL CHEMISTRY FOR PHYSICS-I

Category: AL **Credits: 2**

Semester: III **Hrs/Wk: 4**

Objectives

1. To get a good exposure to the basic concepts of chemistry

2. To enable them to apply concepts related to chemistry in their careers.

Unit 1: Coordination Compounds (1+9+1 h)

1.1 Double salts and coordination compounds. Basic concepts of coordination compounds.

1.2 Types of ligands. IUPAC nomenclature of mononuclear complexes.

1.3 Theories: Werner, valence bond and Sidgwick-Powell theories. Crystal field theory: Splitting of d-orbital degeneracy in tetrahedral and octahedral complexes. Relationship between magnetism and geometry.Spectral behavior (Colour).

1.4 Mention of biologically important coordination compounds: Haemoglobin and Chlorophyll.

Unit 2: Basic concepts in Organic Chemistry (1+10+1 h)

2.1 Electronic displacement effects: Inductive, resonance and steric effects.

2.2 Organic reactions and their basic mechanisms: Addition – ionic, free radical, electrophilic, nucleophilic.Substitution - S_N1 and S_N2 reaction of alkyl halides. Elimination - E1 and E2 reactions.

2.3 Isomerism-geometrical isomerism: methods of differentiating cis and trans isomers on the basis of boiling

point, melting point, dipole moment and chemical reaction. Optical isomerism with special reference to lactic and tartaric acids.Conformational isomerism of ethane, n-butane.

Unit 3: Ionic Equilibria and Electrochemistry (1+11+1 h)

3.1 Ionic Equilibria: Acids and bases-Arrhenius and Lewis concept. Strong and weak electrolytes.Ionic product of water, pH, pK_a, pK_b, buffer solutions, solubility, solubility product of sparingly soluble salts.

3.2 Electrochemistry: Electrode potential, standard hydrogen electrode and calomel electrode, cell potential -Standard Westoncell,electrochemical cell – galvanic and electrolytic cell. Derivation of Nernst equation, calculation of EMF of the cell. Corrosion – causes and prevention.

Unit 4: Kinetics and Photochemistry (1+11+1 h)

4.1 Kinetics and catalysis: Rate, rate law, rate constant, order and molecularity.Derivation of rate expression for first and second order reaction-equal and unequal concentrations of reactants. Methods of determining order of a reaction.Catalysis - homogeneous and heterogeneous.Energy of activation and Arrhenius equation.

4.2 Photochemistry: Comparison between thermal and photochemical reactions, Grotthus-Drapper law, Stark-Einstein law, Beer-Lambert law, Chemiluminescence, fluorescence, phosphorescence, quantum yield, photosensitization and photosynthesis.

Unit 5: Industrial chemistry (1+9+1 h)

5.1 Water treatment: hardness of water- temporary and permanent hardness, disadvantages of hard water. Estimation of hardness by EDTA method.Purification process – ion exchange, reverse osmosis, activated charcoal

treatment.Desalination, Disinfection – ozone, UV, chlorination, BIS- specification of drinking water.

5.2 Polymers: monomers, oligomers and polymers. Addition and condensation polymerization with suitable examples.Thermo and thermosetting plastics with examples.Vulcanization of rubber.

Books for study

1. R. Gopalan, S. Sundaram, *Allied Chemistry*, 4th edn., Sultan Chand and Sons, 2006.
2. P.C. Jain, M. Jain, *Engineering Chemistry*, 16th edn.,Dhanpatrai and sons: Delhi, 2004.
3. V.R. Gowariker, *Polymer Science*, Wiley Eastern, 1995.
4. C.N.R. Rao, *University General Chemistry*, Macmillan Co., India Ltd, 1973.
5. M.J. Sienko, R.A. Plane, *Chemistry-Principles and Properties*, international Student ed., 1995.

Books for reference

1. G.C. Hill, J.S. Holman, *Chemistry in Context*, ELBS, 1998.
2. W.R. Kneen, M.J.W. Rogers, P. Simpson, *Chemistry – Facts, patterns and principles*, ELBS, 1999.
3. Bruce H. Mahan, *University Chemistry*, 3rd edn., Addition-Wesley Publishing Company, 1977.
4. B.R. Puri, L.R. Sharma, M.S. Pathania, *Principles of Physical Chemistry*, 46th edn., Vishal Publishing Co. Jalandhar, 2013.

16UCH3AL02 CHEMISTRY PRACTICAL FOR PHYSICS-I

Category: AL **Credits: 1**

Semester: III **Hrs/Wk: 2**

Objective

To understand the principle and carry out the qualitative organic analysis systematically.

Organic Analysis

a) Detection of nitrogen, sulphur and halogens

b) Tests for aromaticity

c) Tests for saturation

d) Identification of chemical nature (acidic/basic/neutral) and the following functional groups

i) Carboxylic acid
ii) Phenols
iii) Aldehydes
iv) Ketones
v) Carbohydrates
vi) Primary amines
vii) Amides

Books for study

1. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd edn.,S.Chand Publications, New Delhi, 2004.
2. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.
3. Raj K.Bansal, *Laboratory Manual of Organic Chemistry*, 4th edn., New AgePublishers, 2001.
4. J.N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.

16UPH4MC01 ELECTRICITY AND MAGNETISM

Category: MC **Credit: 4**

Semester: IV **No of Hours/Week: 4**

Objectives:

To give the students a firm understanding of the basics of Electricity and Magnetism. To expose the students to the applications of Electricity and Magnetism

Unit 1: Electrostatics I (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Coulumb's law - Gauss law and its applications – Gauss divergence theorem – differential form of Gauss law. Laplace and Poisson`s equations from Gauss law – Curl of an electric field. Field due to a charged conductor – electro static pressure on the surface of a charged conductor.

Unit 2: Electrostatics II (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Potential as a line integral of electric field – potential and field due to a dipole and quadrupole.Potential at a point on the axis of a uniformly charge disc.Potential energy of a dipole in an electric field.Electrostatic energy – energy of a uniformly charged sphere.

Unit 3 : Magnetic effects of an electric current (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Biot – Savart's law and its application to circular loop – Helmholtz galvanometer.Ampere's circuital law both in integral and differential form and its application to current carrying loop, solenoid and toroid. Properties of B : Curl and divergence.

Force on a current element in a magnetic field – moving coil galvanometer– ballistic galvanometer – damping correction – figure of merit. Determination of absolute capacitance of a capacitor.

Unit 4: Electromagnetic Induction (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Faraday's laws of Electromagnetic Induction (differential and integral form) – Lenz law – self and mutual inducation – Coefficient of coupling.Self inductance of a long solenoid – mutual inductance of two solenoids – measurement of L and M using d.c source and ballistic galvanometer.Transformer – construction and working – efficiency and energy loss.

Unit 5: Electromagnetic waves (Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

A review of electricity and magnetism – concept of displacement current – Maxwell's equations – concept of displacement current - Electromagnetic wave equations – velocity of EM wave – Transverse nature of EM wave.Poynting vector and its significance.Reflection and transmission of electromagnetic wave at an interface of non–conducting medium. Snell`s law.

Books for Study:

1. R. Murugeshan, Electricity and Magnetism (2008) S Chand & Co, New Delhi
2. BrijLal&Subramanyam, Electricity and Magnetism (2005) RatanPrakashanMandir Publishers, Agra

Books for Reference:

1. David J. Griffith, Introduction to Electrodynamics (2012) PHI, New Delhi
2. NavinaWadhwani, Electricity and Magnetism (2007) PHI, New Delhi
3. K.K Tewari, Electricity and Magnetism (2007), S Chand & Co, New Delhi
4. Halliday – Resnick and Walker, Fundamentals of Physics – Electicity and Magnetism (2011), Wiley India Pvt Ltd

16UPH4MC02 PHYSICS PRACTICALS IV

Category: MC **Credits: 2**

Semester : IV **No of Hours/Week: 2**

List of experiments.

1. Focal length of a concave lens and convex mirror
2. Viscosity– Searle's viscometer
3. Refractive index– liquid lens
4. Thermal conductivity– Lee's disc
5. Figure of merit– BG
6. Determination of B_H -Field along the axis of a circular coil and vibration magnetometer
7. Determination of g and moment of Inertia – Bifilar pendulum
8. Calibration of a low range voltmeter–Potentiometer

16UPH4ES01 ASTRONOMY AND ASTROPHYSICS

Category: ES **Credit: 4**

Semester: IV **No of Hours/Week: 6**

Objectives:

To familiarize the studentswith the basic concepts of Astronomy and Astrophysics.

Unit 1:Astronomical Techniques(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Celestial Sphere, Coordinate systems(Basics), Diurnal motion of the sun and stars – sidereal day – sidereal time, Zones and seasons of Earth –equinoxes and solstices– Variations in the durations of day and night during the year– Time (GMT, JD)

Unit 2: Observations and Instruments (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Observing Through the Atmosphere – Different wavelength regions– Optical Telescopes(Refracted and Reflected) – Mounting systems(alt–azimuth–equatorial) Angular resolution– Magnification– Detectors and Instruments– CCD camera– Working principle – Radio Telescopes – Interferometry techniques.

Unit 3: Photometric Concepts and Magnitudes(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Stellar distances, Trigonometric parallax, Intensity, Flux Density and Luminosity, Apparent Magnitudes, Magnitude Systems, Absolute Magnitudes, Extinction and Optical Thickness.

Unit 4: Classification of Stars (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Life–cycle of the Stars, The Black Body Model of a Star, Spectral Classification of Stars, Stellar Colours, Colour index, Hertzsprung–Russell Diagram -Visual Binaries, Astrometric Binary Stars, Spectroscopic Binaries, Photometric Binary Stars

Unit 5: Galaxies and Cosmology(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Observable Universe,Classification of Galaxies Based on Hubble Sequence, Properties of each Galaxies, Our Milky way Galaxy, Star formation in galaxies, Explanations of spiral structure, Dark matter in galaxies, Red–Shifts and Blue–Shifts – Hubble's Law in Relation to the Expanding Universe.

Books for Study:

1. Karttunen, Fundamental Astronomy, Springer, 5th Edition, 2006
2. Marc. L Kutner, Astronomy: A physical perspective, Cambridge University Press, 2003.
3. A.B. Bhattcharya, S.Joradar and R. Bhattacharya, Astronomy and Astrophysics, Infinity Science Press

LLC, 2008.

Books for Reference:

1. S. Kumaravelu and SusheelaKumaravelu,Astronomy, 2013.
2. Dinah L. Moché , Astronomy – A Self Teaching Guide,—7th ed, John Wiley & Sons, Inc., 2009
3. Steve B. Howell, Handbook of CCD Astronomy, Cambridge University Press, 2006.
4. Mark H. Jones, Robert J. A. Lambourne, Stephen Serjeant, An Introduction to Galaxies and Cosmology, Cambridge University Press, 2015

Web Source references:

http://hyperphysics.phy–astr.gsu.edu/hbase/HFrame.html

http://www.astr.ua.edu/keel/galaxies/

16UPH4ES02 ENERGY PHYSICS

Category: ES **Credit: 4**

Semester: IV **No of Hours/Week: 6**

Objective:

To introduce to students the perspectives of energy sources, their availability, demands, basic principles of energy conversions, conservation and alternate energy resources.

Unit 1: Introduction to Energy Sources (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

World Energy Reserves and Future —Various forms of energy – Conventional energy Sources – Fossil fuels – Coal, Oil and

Natural Gas – impact of conventional energy sources on environment – global warming – climate change – non–conventional energy sources – Prospects in the energy sector.

Unit 2: Solar Energy (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Solar Radiation at the Earth's surface —Physical Principles of the Solar Energy Conversion - Solar pond – Applications: Solar Water Heating, Space Cooling, Distillation, Green Houses – Solar Photovoltaics – Solar Cells – Principles, types and power generation – Merits and Demerits.

Unit 3: Wind Energy and Biomass Energy(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

The Nature of the Wind –Wind Data and Energy Estimation – Basic Components of a Wind Energy Conversion System (WECS) – Classification of WECS – Applications – Merits and Demerits.Biomass Conversion Technologies – Photosynthesis – Photosynthetic Efficiency – Biogas Generation – Applications – Advantages and Disadvantages.

Unit 4: Emerging Sources of Renewable Energy(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Geothermal energy – Ocean Thermal Energy Conversion (OTEC) – Tidal Energy – Micro Hydel Systems – Chemical Energy Sources – Fuel Cells, Hydrogen Energy – Magneto Hydro Dynamic Power Generation – (*Basic Principles, Applications, Advantages and Disadvantages*).

Unit 5: Energy Consumption, Conservation and Options (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Patterns of energy consumption in domestic, industrial, transportation and agricultural sectors – Principles of Energy Conservation and Energy Audit – energy crisis and possible solutions – energy options for the developing countries – International Policies on Climate Change – UNFCCC; COP; Kyoto Protocol; CANCUN Agreement and Paris Agreement.

Books for Study:

1. G.D. Rai, Non Conventional Energy Sources, 4th Ed., Khanna Publishers, 2007.
2. D.S. Chauhan and S. K. Srivastava, Non–conventional Energy Resources, New Age Int. Pvt. Ltd., 2004
3. Solar Photovoltaics: Fundamental, technologies and applications, CS Solanki, PHI (2011)

Books for Reference:

1. B.H. Khan,Non–conventional Energy Resources, 2nd Ed., Tata McGraw Hill, 2009
2. G.D. Rai, Solar Energy Utilization, Khanna Publishers, Ed. V, 1995.
3. S.P. Sukhatme, Solar energy, Tata McGraw–Hill Publishing Company, 2nd Ed., 1997.
4. S. Rao and Dr. B.B. Parulekar, Energy Technology, 2nd Edition, 1997.
5. Godfrey Boyle, Renewable Energy: Power for a sustainable Future, Oxford Univ. Press, 2nd Ed., 2004.
6. Jyoti K. Parikh, Energy models for 2000 and Beyond, Tata McGraw Hill, 1997.
7. A.K. Wahil, Power Plant technology, Tata McGraw Hill, 1st Ed., 2nd Reprint, 2010

16UPH4ES03 INTRODUCTORY NANO SCIENCE & NANO TECHNOLOGY

Category: ES **Credit: 4**

Semester: IV **No of Hours/Week: 6**

Objectives:

- To introduce the students the basic ideas of nanoscience and nanotechnology.

- To familiarize them with the varied applications of nanotechnology.

Unit 1: Nanoscience and Nanotechnology (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Introduction–Nanoscience and Nanotechnology– Length, energy, and time scale of Nanoscale systems– Classification– Nanoparticles–Nanoclusters – 0D Nanostructures (quantum dots), 1 D, 2D and 3D nanostructures.

Unit 2: Basic properties of Nanoparticles (Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Introduction– Size and shape effect– Mechanical properties– Elastic behaviour; Hardness and Strength – Electrical properties– Surface Scattering; Change of Electronic Structure; Quantum Transport – Magnetic properties –Superparamagnetism– Dielectric properties – Optical properties of nanoparticles– Surface Plasmon Resonance (SPR); Quantum Size Effects.

Unit 3: Synthesis of Nanomaterials(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Introduction– Top down– Ball Milling– Nanolithography– Bottom up approach– Physical Vapor Deposition– Laser Ablation– Chemical Vapor Deposition– Sol Gel Process– Inert Gas Condensation–Molecular Beam Epitaxy.

Unit 4: Tools for Characterization of Nanomaterials(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

X–Ray Diffraction (XRD)– crystallite size – UV spectroscopy – Field Emission Scanning Electron Microscopy (FESEM) – Transmission electron microscopy (TEM) – Scanning Tunnelling Microscopy (STM) – Atomic Force Microscopy (AFM).

Unit 5: Applications of Nanotechnology(Introduction – 1 hr, content – 15 hrs, revision – 2 hrs)

Introduction– Nanomaterials in Medicine–Drug Delivery System; Cellular Imaging; Nanorobots for diagnostics and therapy – Nanomaterials in Energy Sector – High energy density batteries; Hydrogen Storage; Solar Photovoltaic Cells; Nanomaterials in Communication technology– Long lasting Satellites; Nano Lasers; Quantum Computers.

Books for Study:

1. G. Timp, Nanotechnology, AIP press, Springer–Verlag. Editor, New York, 1999
2. Charles Poole, Introduction to nanotechnology, A Wiley Interscience Publication, 2003
3. M.A.Shah, Tooker Ahmad, Principles of Nanoscience and Nanotechnology, Narosa Publishing House, 2010
4. B S Murthy, P Shankar, Baldev Raj, B BRath and James Murday, Textbook of Nanoscience and Nanotechnology, University Press, 2012.
5. Thomas Varghese, K.M. Balakrishna, Nanotechnology, Atlantic Publishers and Distributors, New Delhi, 2012.

Books for Reference:

1. A.S Edelstein, Nanomaterials Synthesis properties and applications, Editor:– A.S Edelstein, IOP Publishing, UK (1996).
2. Hari Singh Nalwa, Nanostructured materials and nanotechnology, Concise Edition, Editor:–; Academic Press, USA (2002).
3. Hari Singh Nalwa, Hand book of Nanostructured Materials and Technology, Vol.1–5, Editor, Academic Press, USA (2000).

16UCH4AL01 GENERAL CHEMISTRY FOR PHYSICS-II

Category: AL **Credits: 2**

Semester: IV **Hrs/Wk: 4**

Objectives

To understand the basic concepts of chemistry

Unit 1: Analytical Chemistry (1+8+1 h)

1.1 Methods of expressing concentration: normality, molarity, molality,mole fraction, ppm, ppb

1.2 Primary and secondary standards: preparation of standard solutions

1.3 Principle of volumetric analysis: end point and equivalence point.

1.4 Accuracy-Precision-Types of error.

Unit 2: Solid State Chemistry (1+13+1 h)

2.1 Classification, amorphous and crystalline solids; types of crystals- ionic, vander Waals and covalent.

2.2 Determination of lattice energy by Born-Haber cycle, properties of ionic compounds.

2.3 Structure of ionic solids: radius ratio, coordination number in ionic crystals, crystal structures-sodium chloride, zinc blende, cesium chloride and wurtzite.

Unit 3: Biomolecules and Dyes (1+13+1 h)

3.1 Carbohydrates: Classification and functions of carbohydrates. Structure of glucose and fructose, (no elucidation required) interconversions, mutarotation. Differences between reducing and non-reducing sugars.

3.2 Structure of sucrose (no elucidation required), inversion of cane sugar.

3.3 Components of nucleic acids: structure of purine and pyrimidine bases, structure of DNA and RNA. Hydrogen bonding in nitrogeneous bases in DNA, differences between DNA and RNA. Replication, translation and transcription of DNA, mutation, genetic engineering.

3.4 Dyes: Colour and constitution: chromophores and auxochromes. Classification based on structure and mode of dyeing, uses of mordants.

Unit 4: Thermodynamics and Electrochemistry (1+8+1 h)

4.1 Energetics: First law of thermodynamics: Concepts of internal energy and enthalpy. Hess's law, heat of formation, combustion, neutralization, bond energy, Kirchoff's equation

4.2 Electrochemistry: Faraday's law, electrolysis of aqueous NaCl and $CuSO_4$ solutions using corresponding metal or inert electrodes. Electrolytic conductance: Determination, variation of conductance with concentration. Equivalent conductance at infinite dilution: Determination, Kohlrausch's law, determination of K_a and K_{sp}. Conductometric titrations.

Unit 5: Industrial Chemistry (1+8+1 h)

5.1 Nuclear energy: principle of fission and fusion reaction, uses of radio isotopes in medicine, agriculture and industry.

5.2 Solar energy conversion-photovoltaic and photogalvanic cell. Batteries- Lead acid storage, dry cell.Fuel cells-principle, hydrogen –oxygen fuel cells.

5.3 Glass-physical and chemical properties, manufacture of glass, types and uses, borosilicate -photochromic and safety glass.

5.4 Ceramics-general properties- permeable and impermeable wares.

Books for study

1. R.Goplalan, S.Sundaram, *Allied Chemistry*, Sultan Chand and sons, 2006.
2. C.N.R. Rao, *University General Chemistry*, Macmillan Co. India, Ltd, 1973.
3. M.J.Sienko and R.A.Plane, *Chemistry: Principles and properties*, International Student Edition, 1995.

Books for references

1. B. R. Puri, L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNagin Chand and Co., Delhi, 1996.
2. B.R. Puri, L.R. Sharma, M. S. Pathania, *Principles of physical Chemistry*, ShobanLalNagin Chand and Co., Delhi, 2013.
3. B.K.Sharma, *Industrial Chemistry*,Goel Publishing House,Merrut,13thedn., 2002.
4. W.R. Kneen, M.J.W.Rogers and P.Simpson, *Chemistry: Facts, patterns and Principles*, ELBS, 1999.
5. Bruce H.Mahan, *University Chemistry*, 3rdedn., Addition-Wesley Publishing company, 1977.
6. Darrell D. Ebbing, Steven D. Gammo, *Fundamentals of Chemistry*, Houghton Mifflin College, 2010.

16UCH4AL02 CHEMISTRY PRACTICAL FOR PHYSICS-II

Category: AL **Credits: 1**

Semester: IV **Hrs/Wk: 2**

Objectives

To understand the concepts of volumetric analysis

Experiments:

I. Acidimetry and Alkalimetry

1. Estimation of NaOH
2. Estimation of Na_2CO_3
3. Estimation of HCl
4. Estimation of mixture of $Na_2CO_3$and $NaHCO_3$

II. Permanganometry

1. Estimation of Oxalic acid.
2. Estimation of ferrous ammonium sulphate.

III. Iodometry

1. Estimation of $K_2Cr_2O_7$
2. Estimation of $KMnO_4$
3. Estimation of copper.
4. Estimation of ascorbic acid.

IV. Complexometric Titrations

1. Estimation of zinc.

Applications of Volumetric Analysis

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
3. Estimation of hardness of water by EDTA.

Books for references

1. J.N. Gurtu and R. Kapoor, *Experimental Chemistry*,S.Chand and Co, 1987.

2. N.S. Gnanapragasam and G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.

16UPH5MC01 QUANTUM MECHANICS

Category: MC **Credits: 7**

Semester V **No of Hours/Week: 7**

Objective:

This paper aims to introduce to the undergraduate students the development and formulation of Quantum Mechanics, its underlying Mathematical and Physical principles through exactly solvable problems.

Unit 1: Emergence of Quantum Mechanics(Introduction – 2hrs, content – 18hrs, revision – 3hrs)

Failure of classical mechanics, black – body radiation, photoelectric effect, Compton effect, de – Broglie hypothesis, experimental confirmation (Davisson – Germer experiment and GP Thompson experiment), wave – particle duality, Heisenberg's uncertainty principle, wave packets and motion of wave packets, group velocity and wave velocity, application of uncertainty relation

Unit 2: Foundation of Quantum Mechanics(Introduction – 2hrs, content – 18hrs, revision – 3hrs)

Schrodinger wave equation, interpretation of the wave function, probability interpretation, probability current density and equation of continuity, Ehrenfest's theorem, time independent Schrodinger wave equation, stationary states, admissibility conditions, linear vector space, linear operator, eigenfunctions and eigenvalues, Hermitian operator, postulates of Quantum Mechanics, Dirac's notation.

Unit 3: Application of Schrodinger wave equation to 1D(Introduction – 2hrs, content – 18hrs, revision – 2hrs)

Free particle, particle in a 1D box, particle in a potential well, non-classical behavior, potential barrier, barrier penetration and α –decay, linear harmonic oscillator, energy eigenvalues and eigen-functions, operator method of LHO, matrix representation of operators.

Unit 4: Angular momentum(Introduction – 2hrs, content – 16hrs, revision – 2hrs)

Orbital angular momentum, general formalism, commutation relations, matrix representation, spin angular momentum, experimental evidence - Stern &Gerlach experiment, spin $\frac{1}{2}$ particles, Pauli matrices, eigenfunctions of oL_z&L^2, properties of spherical harmonics.

Unit 5: Three dimensional Problems(Introduction – 2hrs, content – 14hrs, revision – 1 hr)

1. In Cartesian coordinates: Free particle, 3D box, degeneracy, harmonic oscillator
2. In spherical polar coordinates: rigid rotator – reducing two body problem to single body problem, central potential – general treatment, Hydrogen atom – energy eigenvalues and eigenfunctions.

Books for study:

1. NouredineZettili, Quantum Mechanics – concepts and applications, , 2009, 2nded, Wiley
2. G Aruldhas, Quantum Mechanics, 2013, 2nded (for Chapter – 2), PHI
3. David Griffiths, Introduction to Quantum Mechanics, 2015, 2nded, Pearson
4. Arthur Beiser et all, Concepts of Modern Physics, 2009, 6thed, Tata- McGraw Hill

Books for reference:

1. PM Mathews & K Venkatesan, A text book of Quantum Mechanics, 2011, 2nded, Tata McGraw Hill

2. Walter Greiner, Quantum Mechanics – an introduction,1997, 4th ed, Springer
3. Sie, EyvindWichman, Quantum Physics – Berkeley series,1971, 1st ed, Tata McGraw Hill
4. Feynman, Leighton, Sands, The Feynman Lecturers on Physics, Volume 3, 2015, the new millennium edition, Pearson

16UPH5MC02 THERMAL PHYSICS

Category: MC **Credit: 7**
Sem: V **No of Hours/Week: 7**

Objective:

To make the students understand the foundational Principles of Thermodynamics and to solve problems.

Unit 1: Kinetic theory of gases (Introduction – 1hr, content – 17hrs, revision – 2hrs)

Introduction–Basic assumptions of kinetic theory– Pressure Exerted by gas–kinetic interpretation of Temperature–classical theory of heat capacities– Distribution of molecular velocities in a perfect gas–Distribution of molecular speeds–Average speed, RMS speed, most probable speed, Energy distribution function–Examples

Unit 2: Transport Phenomena & Basic concepts ofThermodynamics (Introduction – 1hr, content – 17hrs, revision – 2hrs)

Mean free path (Zeroth and First order)– Van der Waal's equation of state (Derivation)– Thermodynamic system, surroundings, boundaries–state of system and thermodynamic variables – Thermodynamic equilibrium– Processes– The Zeroth law and concept of temperature– Some deductions from the equation of state.

Unit 3: First and second law of thermodynamics (Introduction – 1hr, content – 17hrs, revision – 2hrs)

Introduction–origin of the first law– internal energy–Various interactions–the first law–applications of first law (heat

capacities of gas, adiabatic equation of state & lapse rate)– Enthalpy–the second law – Kelvin and Planck statement–Heat engines –the Carnot cycle– Carnot theorem–Thermodynamic Temperature–irreversibility and unavailable energy.

Unit 4: Entropy and thermodynamics relations (Introduction – 1hr, content – 17hrs, revision – 2hrs)

Introduction– Entropy– Entropy change in reversible processes – Reversible heat transfer– the inequality of Clausius–Entropy change in irreversible process–the principle of increase of entropy– Joule's expansion–the entropy form of first law– Unavailable energy: Thermal death of universe – Physical concept of entropy– Maxwell's relations– thermodynamic relations involving heat capacities–The TdS equations– The energy equations.

Unit 5: Free energies and thermodynamic equilibrium (Introduction – 1hr, content – 17hrs, revision – 2hrs)

Introduction–General condition for natural change– Adiabatic process, isothermal Processes–Free energies and Maxwell's relations– Thermodynamic mnemonic diagrams–General conditions for thermodynamic equilibrium– Equilibrium between phases–First order Phase transition.

Books for study

1. S.C.Garg, R M Bansal&CK Ghosh, Thermal physics, Tata McGraw Hill Publications, 1st edition.

Books for reference:

1. M W Zemansky,R.H.Dittman, Heat and thermodynamics, (McGraw Hill International publication), 7th edition.
2. Sears Salinger, Thermodynamics, kinetic theory and statistical thermodynamics, (Narosa Publishing House), 3rd Edition.

3. Daniel V.Schroeder, An Introduction to thermal Physics,(Pearson Publications), 1st Edition.
4. K.Huang, Statistical mechanics, Wiley Student edition (2008).

16UPH5MC03 PHYSICS PRACTICALS V

Category: MC **Credits: 2**

Semester : V **No of Hours/Week: 2**

List of experiments.

1. Determination of wavelength of mercury spectrum– Spectrometer – grating – minimum deviation
2. i–d curve– spectrometer
3. Comparison of mutual inductance – BG
4. Calibration of a high range voltmeter – potentiometer-Method1
5. Emissivity and emissive power
6. Moment of a bar magnet -Field along the axis of a circular coil.
7. EMF of a thermo couple-potentiometer
8. Resolving power and Cauchy's constant – prism-spectrometer

16UPH5MC04 PHYSICS PRACTICALS VI

Category: MC **Credits: 2**

Semester : V **No of Hours/Week: 2**

List of experiments.

1. Inverting and non–inverting amplifier– OP AMP
2. Summing and difference – OP AMP
3. Colpitts oscillator
4. AND,OR and NOT using transistor
5. Transistor- RC coupled amplifier

6. AstableMultivibrator using 555 Timer
7. NAND and NOR as universal building blocks
8. High pass filter- OP AMP

16UPH5ES01 PROBLEMS SOLVING SKILLS IN PHYSICS

Category: ES **Credits: 4**

Sem: V **No of Hours/Week: 6**

Objectives:

To develop the skills to solve problems in physics which will enable them to prepare for physics competitive exams like JAM,JEST& TIFR etc. Every unit must contain minimum 20 problems based on various principles of Physics.

Unit 1: Problems in Mechanics (20 hours)

Newton laws of motion for various systems (1, 2 and 3 dimension), Conservation laws and collisions, Rotational mechanics, central force, Harmonic oscillator, special relativity

Unit 2: Problems in Thermal Physics (20 hours)

Kinetic theory– MB distribution–Laws of thermodynamics – Ideal Gas law–Various Thermodynamic process– Entropy calculation for various process– Heat engine–TS and PV diagram–Free energies and various relations

Unit 3: Problems in Electricity & Magnetism (15 hours)

Electrostatics– calculation of Electrostatic quantities for various configurations– Conductors, Magneto statics– Calculation of Magnetic quantities for various configuration, Electromagnetic induction, Poynting vector, Electromagnetic waves.

Unit 4: Problems in Quantum mechanics (20 hours)

Origin of Quantum mechanics– Fundamental Principles of Quantum mechanics– potential wells and harmonic oscillator– Hydrogen atom.

Unit 5: Problems in General Physics & Mathematics (15 hours)

Plotting the graphs for various elementary and composite functions–Elasticity–Viscosity and surface tension– fluids– Buoyancy–pressure–Bernoulli's theorem–applications–waves and oscillations, Errors and propagation of errors.

Books for study:

Study material for this syllabus will be prepared and provided by the Department.

Books for reference:

1. Charles Kittel, Walter D knight, Mechanics (in SI units) (Berkeley Physics course–volume 1), Tata McGraw Hill publication ,second edition.
2. S.C.Garg, RM Bansal&CK Ghosh, Thermal physics, (Tata McGraw Hill Publications), 1st edition.
3. E.M.Purcell, Electricity &magnetism(in SI units), Tata Mcgraw hill Publication, 2nd Edition.
4. N.Zettili, Quantum mechanics, Wiley Publishers, second edition.
5. David. J.Griffith, Introduction to quantum mechanics, Pearson Publications, second edition
6. Halliday&Resnick, Fundamentals of Physics, Wiley Publications, 8th Edition
7. Nelkon and Parker, Advanced level physics, CBS publishers, 7th edition
8. AmithAgarwal, Play with graphs, Arihant Publications
9. D.S.Mathur, Properties of matter, S.Chand Publications, 11th Edition

16UPH5ES02 BIOMEDICAL INSTRUMENTATION

Category: ES **Credits: 4**

Sem: V **No of Hours/Week: 6**

Objective:

With widespread use and requirements of Medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.

Unit 1: BIOMEDICAL ELECTRODES AND TRANSDUCERS (Introduction – 1hr, content – 15hrs, revision – 2hrs)

Introduction – Design of medical instruments – components of the biomedical instrument system – Electrodes – Transducers

Unit 2: BIOSIGNALS (Introduction – 1hr, content – 15hrs, revision – 2hrs)

Introduction - Physiological signal amplifiers – Isolation amplifiers – Medical preamplifier design – Bridge amplifiers – Line driving amplifier – Biosignal analysis.

Unit 3: BIOPOTENTIAL RECORDERS (Introduction – 1hr, content – 15hrs, revision – 2hrs)

Introduction – Characteristics of the recording system – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG)

Unit 4: PHYSIOLOGICAL ASSIST DEVICES (Introduction – 1hr, content – 15hrs, revision – 2hrs)

Introduction – Pacemakers – Pacemaker batteries – Artificial heart valves – Nerve and Muscle stimulators.

Unit 5: OPERATION THEATRE EQUIPMENT (Introduction – 1hr, content – 15hrs, revision – 2hrs)

Introduction – Surgical diathermy – Shortwave diathermy – Microwave diathermy – Therapeutic effect of heat.

Books for Study

1. M.Arumugam, Bio–Medical Instrumentation, Anuradha Agencies, 2003
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 2004.
4. J.B.Gupta , A course in electronic and electrical measurements and instrumentation, 12th Edition, S.K Kataria& sons
5. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Delmar, Cengage Learning, 2010.

Books for Reference

1. Leslie Cromwell, Biomedical Instrumentation and measurement, Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw–Hill, New Delhi, 2003.
3. Myer Kutz, Standard Handbook of Biomedical Engineering & Design, McGraw–Hill Publisher, 2003.

16UPH5ES03 GEOPHYSICS

Category:ES **Credits: 4**

Semester: V **No of Hours/Week: 6**

Objectives:

To make the students understand the basic principles of geophysics, geomagnetism and concepts of earthquakes.

Unit 1: Physics of the Earth (Introduction – 2 hrs, content – 14 hrs, revision – 2 hrs)

Introduction to Geophysics- Earth as a member of the solar system-Atmosphere-Ionosphere-Asthenosphere-Lithosphere-Hydrosphere and Biosphere-Meteorology-Oceanography and Hydrology.

Unit 2: Geophysical and Geochemical methods(Introduction – 2 hrs, content – 14 hrs, revision – 2 hrs)

Geophysical methods: Geo referencing using Arc GIS software. Elctrical methods-Quatitative interpretation of Vertical Electrical Sounding curves –Preparing pseudo cross section for electrical resistivity data and interpretation.

Geochemical methods: Introduction-Principles of groundwater chemistry-Sources of contamination- Ground water quality analysis using geochemical methods.

Unit 3: Introduction to Seismology(Introduction – 2 hrs, content – 14 hrs, revision – 2 hrs)

The earth's interior and crust as revealed by earthquakes-Rayleigh waves and Love waves-Elastic rebound theory-Continental drift-Earthquake magnitude and intensity-Horizontal seismograph and seismograph equation-Tsunami-Causes andImpacts-Tsunami warning systems.

Unit 4: Geomagnetism and Gravity (Introduction – 2 hrs, content – 14 hrs, revision – 2 hrs)

Historical introduction –The physical origin of magnetism-Causes of the main field-Dynamo theory of earth's magnetism.

Gravitational potential-Laplace's equation and Poisson's equation-Absolute and relative measurements of gravity-Worden gravimeter.

Unit 5: Geochrology and Geothermal physics(Introduction – 2 hrs, content – 14 hrs, revision – 2 hrs)

Radioactivity of the earth-Radioactive dating of rocks and minerals-Geological time scale-The age of the earth.

Flow of heat to the surface of the earth –Sources of heat within the earth-Process and heat transport and internal temperature of earth.

Books for study:

1. Arthur W.Hounslow, Water quality data -Analysis and Interpretation, 1995,Lewis publishers ,Washington D.C.
2. Cook,A.H , Physics of the Earth and Planets, McMillanPress,London 1973.
3. John Milsom, Field geophysics-The geophysical field guide III edition, Wiley publications ,England.
4. Krauskopf.K.B, Introduction to Geochemistry, McGraw Hill,1967.
5. RamachandraRao, Outline of geophysical prospecting-a manual for geologists, University of Mysore,1975.

Books for reference:

1. Garland, Introduction to Geophysics 11 edition, WB Saunder Company, London, 1979.
2. William Lowrie, Fundamentals of Geophysics, 11 Edition, Cambridge press,UK.
3. Nils-Axel Morne, Geochronology-Methods and case studies, INTECH publications .
4. John Raferty, Geochronology –Dating and Precambrian time –The beginning of the world as we know it, Britannica Educational publishers, New York-2011.
5. Don L.Anderson, Theory of the Earth, Blackwell scientific Publications-1989,UK.

16UPH5SK01 ELECTRONICS – II

Category :SK **Credits : 3**
Semester :V **No of Hours/Week: 4**

Objectives:

1. *To expose the students to the principles and design of non–linear circuits and A/D & D/A convertors.*
2. *To provide the students with a thorough understanding of the functioning of the microprocessor 8085.*

Unit 1: Operational amplifiers (non–linear circuits)(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Integrator – Differentiator – solving differential equations – logarithmic amplifiers– II order high pass and low pass filters – astable and monostablemultivibrators – instrumentation amplifiers.

Unit 2: Digital to analog and analog to digital conversion(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Weighted resistor D/A converter – R–2R ladder D/A converter – parallel A/D converter – A/D conversion by counter method – A/D conversion by successive approximation method.

Unit 3: Architecture of µP 8085(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Pin functions of 8085 – Architecture of 8085 –Instruction set – data transfer, arithmetic, logic, branching and machine control group of instructions – addressing modes of data.

Unit 4: Assembly language programming – µP 8085(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Assembly language programs: addition – subtraction – multiplication – division (by all modes of programming)–

square – square root – sorting in ascending and descending order – picking largest/smallest in an array – code conversion– subroutines.

Unit 5: Interfacing I/O devices(Introduction – 1 hr, content – 10 hrs, revision – 1 hr)

Types of interfacing devices – address decoding for I/O – input/output ports – Programmable peripheral interface 8255 – Features of 8255 – programming 8255

BOOKS FOR STUDY:

1. Gaykwad. A, Operational Amplifier and Linear Integrated Circuits, Prentice Hall, 11 Ed. 1991.
2. S. L. Gupta, V. Kumar, A Handbook of Electronics, PragatiPrakashan 2008
3. R.P.Jain,Modern Digital Electronics, Tata McGraw-Hill Education, 2003
4. Ramesh S. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International, IV Ed., 2000.
5. Adithya P Mathur, Introduction to Microprocessors, Tata McGraw-Hill, III Ed.,2001.

BOOKS FOR REFERENCE:

1. B. L. Theraja, A. K. Theraja, A Text book of Electrical Technology, S Chand 2004
2. K. A. Krishnamurthy, Ten days with 8085 microprocessor, PHI Learning Pvt. Ltd-New Delhi 2010
3. V. Vijayendran,Fundamentals of Microprocessor 8085, Viswanathan S. Printers & Publishers Pvt.Ltd.,2009.
4. Lance A. Levanthal, Introduction to Microprocessors, Prentice Hall, 1978.

16UPH5SK02 ELECTRONICS – II – Practical

Category : SK **Credits : 1**
Semester : V **No of Hours/Week: 2**

Objectives:

1. *This paper aims at providing an in- depth knowledge of the operational amplifier and the eight bit microprocessor 8085.*
2. *The students will also get the opportunity to practically work out the assembly language programs during the lab sessions.*

1. OPAMP – Solving simultaneous equations
2. OPAMP – R–2R ladder D/A converter
3. ASM programs – Add, subtraction, multiplication & division (all modes of addressing) – microprocessor 8085
4. ASM programs – factorial & square root (all modes of addressing) – microprocessor 8085
5. ASM programs – sorting & determining largest and smallest in an array – microprocessor 8085
6. Microprocessor 8085 – Interface I (LEDs)
7. Microprocessor 8085 – Interface II (LEDs & Switches)
8. Microprocessor 8085 – Interface IV (waveform generation)

16UPH6MC01 ATOMIC AND NUCLEAR PHYSICS

Category: MC **Credits: 7**

Semester VI **No of Hours/Week: 7**

Objectives:

This paper aims to familiarize under graduate students to the fundamental nature of matter, its constituents and interactions. The paper throws light on how an understanding of these fundamentals explain the experimental observations like emission spectrum, nuclear energy etc.

Unit 1: Charged Particles and atom models(Introduction – 2hrs, content – 18hrs, revision – 3hrs)

Detection of charged particles in electric and magnetic fields- specific charge of electron –Dunnigton's method –charge of electron – Millikan's method –mass of electron - positive ray analysis: Thomson's parabola method –mass spectrometers – Dempster's and Bainbridge mass spectrograph

Bohr's atom model – Sommerfeld's relativistic atom model- hydrogen spectrum – orbital magnetic moment of H atom – Larmor precession – electron spin - Stern and Gerlach experiment- the Vector atom model and the quantum numbers- spin – orbit interaction and fine structure – Pauli's exclusion principle and electronic structure - Many electron systems - Coupling schemes: L-S coupling and j-j coupling – Hund's rule

Unit 2: Atomic and molecular spectra(Introduction – 2hrs, content – 16hrs, revision – 2hrs)

Fine structure and sodium doublet –normal Zeeman effect: experiment – Quantum mechanical explanation–anomalous Zeeman effect – Paschen Back effect

Molecular energies – pure rotational spectra –intensities of spectral lines – vibration – rotation spectra – rotation – vibration – electronic spectra -Frank – Condon principle – Raman effect –

characteristics of Raman lines – Quantum theory of Raman effect.

Unit 3: Properties of nuclei and Radioactivity(Introduction – 2hrs, content – 16hrs, revision – 2hrs)

Constituents of nuclei – isotopes, isobars, isotones and mirror nuclei, nuclear mass and binding energy – unit of atomic mass – BE and stability of the nucleus- mass defect and packing fraction – binding fraction vs mass number curve – nuclear size – nuclear spin - nuclear energy levels - nuclear magneton – parity of the nuclei – electric multipole moments –Rutherford's scattering formula

Radioactivity: Decay law – activity of a radioactive sample – radioactive radiations – general properties of $\alpha, \beta, \gamma -$ rays- radioactive series: Displacement law – successive transformation – radioactive dating – radioactivity of light elements.

Unit 4: Nuclear models, Fission and Fusion(Introduction – 2hrs, content – 18hrs, revision – 2hrs)

Discovery of neutron, Mass, half life, charge, Magnetic Moment, production and detection– Liquid drop model of nucleus – semi-empirical mass formula –application - Shell model– assumptions of shell model – predictions – quadrupole moment

Nuclear fission – energy released – liquid drop theory of fission - fission of light nuclei – Chain Reaction – critical mass – reproduction factor – nuclear reactor – types of reactors – breeder reactor – nuclear power plant – atom bomb - Nuclear Fusion – thermonuclear reaction – source of stellar energy – uncontrolled fusion - Hydrogen bomb – controlled fusion – stellarator, levitron and tokamak – radiation hazards

Unit 5: Elementary particle physics(Introduction – 2hrs, content – 16hrs, revision – 2hrs)

Four fundamental interactions in nature, elementary particle classification, conservation laws (exact and approximate), CPT theorem, anti-particles, anti-nucleon, quarks model, unification of interactions, the standard model and GUT.

Books for study:

1. AB Gupta, Modern Atomic and Nuclear Physics, 2014 - Books and Allied
2. R.Murugeshan and KiruthigaSivaprasath - Modern Physics - 14th Ed, 2009, S.Chand and Company Ltd

Books For Reference:

1. H.S.Mani and Mehta (G.K) ,Introduction to Modern Physics, , Affiliated East-West Press, 1989.
2. Arthur Beiser et all, Concepts of Modern Physics, 2009, 6thed, Tata- McGraw Hill

16UPH6MC02 OPTICS

Category: MC **Credits: 7**

Semester: VI **No of Hours/Week: 7**

Objectives:

To expose the students to the fundamental of optics and to provide the students with knowledge of the applications of optics.

Unit 1: Geometrical Optics (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Matrix method in ray optics–Effect of translation and refraction – Thick and thin lens formulae –Unit planes–Nodal planes– System of two thin lenses.

Dispersive power of a prism– Cauchy's formula–combination of prisms to produce –dispersion without deviation – deviation without dispersion –Direct vision spectroscope.

Lens aberrations –monochromatic aberrations – spherical aberration –Coma–astigmatism–curvature of the field– distortion– Chromatic aberrations methods of minimizing aberrations–Huygen's eyepiece–Ramsden's eyepiece.

Unit 2: Interference (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Fresnel's biprism –determination of wavelength of light and thickness of thin sheet of transparent materials– Fresnel's mirrors and Lloyd's single mirror experiments– Achromatic fringes–Interference in thin films due to reflected and transmitted light–Fringes in wedge shaped films –Reflected and antireflected coating –Michelson's interferometer– determination of wavelength of light and thickness of thin transparent sheet.

Unit 3: Diffraction (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Rectilinear propagation of light–Zone plate – Fresnel diffraction – Diffraction at circular aperture, circular disc and a straight edge – Fraunhoffer diffraction – Diffraction at a single and double slit– Missing orders in double silt– Theory of diffraction grating – Determination of wavelength – Dispersive power – Rayleigh's criterion for resolution power of a telescope, microscope, prism and grating.

Unit 4: Polarization (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Plane of polarization– Polarization of refraction – Brewster's law– pile of plates – Polarization by reflection – Malu's law – Double refraction – Nicol prism – Huygen's explanation of double refraction in uniaxial crystals– Elliptically and circularly polarized light– Quarter and half wave plates – Production and determination of plane , elliptically and circularly polarized light– Optical activity – Fresnel's theory –Specific rotation – Laurent's half shade polarimeter.

Unit 5: Applied Optics (Introduction – 2 hrs, content – 17 hrs, revision – 2 hrs)

Lasers – spontaneous and stimulated emission – Einstein's coefficients – He– Ne Laser – properties of laser beam –Carbon dioxide and Nd–YAG lasers. semiconductor Laser –Homo junction and Hetro junction laser–Industrial and medical applications of Laser.

Non linear optics – Harmonic Generation, sum and difference frequency generation , wave mixing, Pockwl and Kerr effect.

Optical Fibers – Principle – configuration– Characteristics of optical fiber, Electromagnetic wave propagation through optical fiber, Losses and dispersion in optical fiber – wave propagation in multimode and single mode optical fibers.

BOOKS FOR STUDY :

1. AjoyGhatak, Optics, Tata McGraw Hill Co.3rdedtion – 2005 (For Matrix methods)
2. Jenkins & White, Fundamental of optics, McGraw Hill 4th edition –1981
3. Brijlal and M. N. Avadhanulu , A Text Book Of Optics ,Subrahmanyam, 25th edition , S. Chand and Co.2012
4. Khanna D.R &Gulati H.R., Optics, Chand& Co., pvt.Lid., New Delhi. 4 th edition 2000
5. R.Menzel, photonics, springer, 2001.

BOOKS FOR REFERENCE:

1. H.Lipson and D.S Tannhauser, S.G. Lipson, Optical Physics, (3rd edition) Cambridge University press–1995
2. Miles V. klein and Thomas E.Furtak, Optics, (2nd edition) JohnWiley& sons–1987
3. R.Murugeshan and kiruthikasivaprasath, Optics and spectroscopy , S. Chand Co, New Delhi.–2007
4. T.P.Pearsall, Photonics Essentials : An introduction with experiments, McGraw –Hill, 2002.

5. Gerd Keiser, Optical Fiber Communication, McGraw – Hill International, Singapore, 3rd Ed., 2000.
6. Pedrotti and Pedrotti , Introduction to Optics, 3rd Ed, Addison Wesley –2006
7. Eugine Hecht, Optics,4thEd, pearson publication –2008.
8. S.Mohan, V.Arjunan, M.Selvarani, M.Kanchana mala, Laser physics, MJP Publishers, 2012.
9. C.K.Sarkar,D.C.Sarkao, Optical Electronics and Fiber optics communications, New Age International (P) Limited, 2010
10. AjoyGhatak&K.Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (UK) 1998.

16UPH6MC03 SOLID STATE PHYSICS

Category: MC **Credits: 6**
Semester: VI **No of Hours/Week: 6**

Objectives:

To expose the students to relate the various properties of matter from a microscopic to the macroscopic point of view.

Unit 1: Crystal Structure (Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Solids :– Amorphous and Crystalline Materials. Lattice Translation Vectors.Lattice with aBasis – Central and Non–Central Elements.Unit Cell.Reciprocal Lattice.Types of Lattices.Laue equations– Bragg's Law–Diffraction of X–rays by Crystals –Powder and rotating crystal method – BrillouinZones .

Unit 2: Elementary Lattice Dynamics (Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Lattice Vibrations and Phonons :– Linear Monoatomic and Diatomic Chains. Acoustical andOptical Phonons.Qualitative Description of the Phonon Spectrum in Solids. Einstein andDebye Theories of Specific Heat of Solids.T^3Law– phonon–photon interaction

Unit 3: Electrical Properties of Materials (Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Elementary Band Theory of Solids.Effective Mass of Electron.Concept of Holes.Band Gaps.Energy Band Diagram and Classification of Solids.Law of Mass Action.Insulators, and Semiconductors. Direct and Indirect Band Gap.Intrinsic and Extrinsic Semiconductors. p– and n– Type Semiconductors. Conductivity in Semiconductors. Hall Effect in Semiconductors (Qualitative Discussion Only)

Unit 4: Magnetic Properties of Matter(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Dia,Para, Ferro and Ferri magnetic Materials. Classical Langevin Theory of dia andParamagnetism – magnetic domains – Quantum Mechanical Treatment of Paramagnetism. Curie's law,Weiss's Theory of Ferromagnetism . Discussion of B–H Curve.Hysteresis and Energy Loss.

Unit 5: Superconductivity: (Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Experimental Results.Critical Temperature.Critical magnetic field.Meissner effect. Type Iand type II Superconductors - HTS - London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation): Cooper Pair and Coherence length. Variation of Superconducting Energy Gap with Temperature.Experimental Evidence of Phonons. AC/DC Josephson Effect(No derivation)

Books For Study

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.

2. A J Dekkar, Solid State Physics, Macmillan India Limited, 2000.
3. J. S. Blackmore, Solid State Physics, Cambridge University Press, Cambridge.
4. Wahab, solid state physics, Narosa Publication house, 2nd edition.

Books for Reference

1. N. W. Ascroft and N. D. Mermin, Solid State Physics, (Harcourt Asia, Singapore, 2003).
2. M. Ali Omar, Elementary solid state physics: principles and applications, (Pearson Education, 1999)

16UPH6MC04 PHYSICS PRACTICALS VII

Category: MC **Credits: 2**

Semester : VI **No of Hours/Week: 2**

List of experiments.

1. To determine the value of Planck's Constant by using LEDs of at least 4 Different Wavelengths.
2. Refractive index– small angled prism
3. i–i' – spectrometer
4. High resistance by leakage– BG
5. Determination of absolute capacitance – B.G
6. Thermo EMF of a thermo couple– spot galvanometer
7. Moment of a bar magnet-Seale's vibration magnetometer
8. Calibration of a high range voltmeter – potentiometer-Method 2

16UPH6MC05 PHYSICS PRACTICALS VIII

Category: MC **Credits: 2**

Semester : VI **No of Hours/Week: 2**

List of experiments.

1. Light to frequecy converter- Astablemultivibrator– OP AMP
2. Wien's bridge oscillator – OP AMP
3. Zener regulated power supply
4. Half adder and full adder
5. Low pass filter – OP AMP
6. Mod n counter– (2-9) - IC 7493
7. Temperature to voltage converter-OP AMP
8. Phase locked loop- lock-in-range- relay

16UPH6MS01 MATERIALS SCIENCE

Category : MS **Credits : 4**

Semester : VI **No of Hours/Week: 6**

Objectives:

1. To introduce the concepts of materials science and motivate the students to a research career in it.

2. To focus on the relationship of structure of materials with its properties and to throw light into the latest developments in the field.

Unit 1: Engineering materials and chemical bonding(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Classification of engineering materials – levels of structure – structure-property relationship in materials –stability and metastability – bond energy – bond type and bond length – ionic and covalent bonding – Metallic bonding-secondary

bonding-lattice energy – Born Haber cycle – cohesive energy – variation in bonding character and properties.

Unit 2: Mechanical and thermal behaviour of materials(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Elastic behaviour – atomic model of elastic behaviour – Young's modulus – Poisson's ratio – shear modulus – bulk modulus –composite materials - the modulus as a parameter of design – rubber like elasticity – plastic deformation – tensile – yield strength – toughness –elongation – hardness – impact strength – stress - strain curve -Heat capacity, thermal conductivity, thermal expansion of materials.

Unit 3: Magnetic materials and dielectric materials(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Terminology and classification – magnetic moment due to electron spin – ferromagnetism, Antiferromagnetism and Ferrimagnetism – Influence of temperature on magnetic behaviour – Domains and Hysteresis – soft and hard magnetic materials.

Polarization – electronic, ionic, orientation and space charge polarization – temperature and frequency effects – Determination of dielectric constant – dielectric loss – uses of dielectric materials – dielectric breakdown – ferroelectric materials and applications.

Unit 4: Smart materials(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Definition of smart materials – Types – Piezoelectric materials- Materials for MEMS and NEMS- Ferro fluid- Magnetic shape-memory alloys (MSMAs)- Shape memory alloy (SMA)- One way and Two way memory effect- Dielectric elastomers (DEs)- Light sensitive materials- Smart catalysts–solar cell materials (single crystalline, amorphous and thin films) - surface acoustic wave and sonar transducer materials and applications - Introduction to Nano phase materials and their properties.

Unit 5: Non-destructive testing and materials characterisation(Introduction – 1 hr, content – 16hrs, revision – 2 hrs)

Radiographic methods – photo-elastic methods – magnetic methods – electrical method – ultrasonic method – Equipment used for NDT – metallurgical microscope - electron microscope – scanning electron microscope (SEM) – Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy. Characterisation of materials with electrometer- Mechanical hardness using Vickers's micro hardness tester – thermal properties using TG/DTA, functional group analysis by FTIR-characterisation of materials by UV-Visible Spectroscopy – Photoconductivity – Computer simulation of crystal structure.

BOOKS FOR STUDY:

1. Raghavan V – Materials science and engineering – A first course, 5th Ed, Prentice Hall India 2012

2. Arumugam - Materials Science - Anuradha agencies & publishers, 1990

3. Gandhi M V and Thompson B S Smart Materials and Structures. Chapman & Hall 1992.

4. Baldev Raj, T. Jayakumar, M. Thavasimuthu - Practical Non-destructive Testing – first published Narosa publishing house New Delhi - second edition 2002.

BOOKS FOR REFERENCE:

1. Kittel C – Introduction to Solid State Physics – VII Ed – Wiley Eastern

2. Manchandra V K – A text book of Materials Science – New India Publishing House – 1992

3. Myer Kutz - Mechanical Engineers' Handbook: Materials and Mechanical Design, Volume 1, Third

Edition. John Wiley & Sons, Inc - 2006

4. Culshaw B Smart Structures & Materials. Artech House, 1996.

PHYSICS ALLIED OFFERED TO OTHER DEPARTMENTS

16UPH1AL01 PHYSICS FOR MATHEMATICS – I

Category: AL **Credits: 2**
Semester: I **No of Hours/Week: 4**

Objectives:
This paper is offered to the students of mathematics as allied required.Togive a broader persepective of basic physics.

Unit 1: Mechanics
(Introduction: 1 hr, Content: 6 hr, Revision: 1 hr)
a) Particle dynamics: Displacement, velocity and acceleration– distance –time graph–velocity – time graph –projectile motion – uniform circular motion – tangential acceleration in circular motion – relative velocity and acceleration
b) Simple Harmonic Motion: Formula for acceleration, velocity and displacement – oscillation in spring mass system – potential and kinetic energy exchanges – springs in series and parallel – simple pendulum – energy method for period – oscillations of liquid in U – tube.

Unit 2: Gravitation (Introduction: 2 hr, Content: 8 hr, Revision: 2hr)
a) Classical theory of gravitation : Kepler's laws, Newton's investigation on planetary motion, Motion of moon round the earth – Newton's law of gravitation – G and measurement – Boy's method – Relation between g and G – Gravitational field strength.
b) Earth satellites – parking orbit – earth density – mass of the Sun –gravitational potential – velocity of escape – satellite potential and kinetic energy.

Unit 3: Properties of matter (Introduction: 2 hr, Content: 8 hr, Revision: 2 hr)

a) Elastic properties : Elastic limit – Hooke's law – moduli of elasticity – Poisson's ratio –relation between q,n,k – force in a bar due to contraction or expansion – energy stored in a wire – rigidity modulus – torsion in a wire –torsional oscillations method.

b) Viscosity and surface tension : Newton's formula – Stoke's formula – Poiseuille's flow – molecular theory of surface tension – excess pressure over curved surface – spherical and cylindrical drops – surface energy – capillary rise – Quincke's method for mercury.

Unit 4: Electronics (Introduction: 2 hr, Content: 8 hr, Revision: 2 hr)

a) Operational amplifier: ideal operational amplifier – CMRR – inverting and non– inverting amplifiers – summing amplifier – differential amplifier —– solving simultaneous equations.

b) Digital circuits: J–K–Flip–Flop –Karnaugh map– 2, 3 and 4 variables – Full and half binary adders –Asynchronous counters.

Unit 5: Special theory of relativity (Introduction: 2 hr, Content: 8 hr, Revision: 2 hr)

Frames of reference – inertial frames and non– inertial frames – Galilean transformations – Michelson Morley experiment – interpretation of results – postulates of special theory of relativity – Lorentz transformation equations – length contraction – time dilation – transformation of velocities– variation mass with velocity – Mass –energy equation

Books For Study:

1. R.Murugeshan, Allied Physics–Paper–I&II For B.Sc., Allied students of Madras University, ,S.Chand and Co., New Delhi, Revised and enlarged edition, 2010.
2. Nelkon and Parker, Advanced level physics, Arnold Publishers – 7th edition.

3. M.Narayanamurthy and N.Nagarathnam, Dynamics, The national publishers.
4. D.S.Mathur, Properties of matter, S.Chand and Co., New Delhi.
5. R.S.Sedha, A text book of applied electronics, S.Chand and Co., New Delhi, I edition, 1998.
6. Robert Resnick, Introduction to special relativity, Wiley Eastern.

Books For Reference:

1. D.Halliday and R.Resnick, Physics, Part 1,Wiley eastern.
2. Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman lectures on physics series, vol. 1, 2 & 3, narosa publishing, New Delhi reprint 2006.

16UPH1AL02 PHYSICS FOR MATHEMATICS PRACTICAL– I

Category: AL1 **Credits: 1**

Semester: I **No of Hours/Week: 2**

LIST OF EXPERIMENTS

1. Young's modulus by stretching –vernier microscope

2. Rigidity modulus –torsional pendulum

3. Surface tension and interfacial tension – method of drops

4. Viscosity – capillary flow

5. Sonometer –Verification of laws

6. Compound bar pendulum – determination of 'g' and radius of gyration

7. Basic Gates – AND, OR, NOT, NAND, NOR

8. NAND, NOR as Universal Building Blocks

16UPH3AL01 PHYSICS FOR CHEMISTRY - I

Category: AL3 **Credits: 2**

Semester: III **No of Hours/Week: 4**

Objective: This paper is offered to the students of chemistry as allied. While the chemical properties are learnt in the major, the study of physical properties will complement their studies.

Unit 1: Mechanics(Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) Particle dynamics: Displacement, velocity and acceleration – distance-time graph – velocity- time graph – projectile motion – uniform circular motion – acceleration in circular motion – angular momentum – conservation of momentum – relative velocity.

b) Simple Harmonic Motion: Formula for acceleration, velocity and displacement – oscillation in spring mass system – potential and kinetic energy exchanges – springs in series and parallel – simple pendulum – energy method for period – oscillations of liquid in U – tube.

Unit 2:Properties of matter (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) Elastic properties: Elastic limit – Hooke's law – moduli of elasticity – Poisson's ratio –relation between q, n , and k – force in a bar due to contraction or expansion – energy stored in a wire – rigidity modulus – torsion in a wire – torsional oscillations method (without mass).

b)Viscosity and surface tension: Newton's formula – Stoke's formula – Poiseuille's flow – molecular theory of surface tension – excess pressure over curved surface – spherical and cylindrical drops – surface energy – capillary rise – Quincke's method for mercury.

Unit 3: Thermodynamics (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) Gas laws: Boyle's law – Charles's law – Expansivity of gas – Absolute temperature – Ideal gas equation, the gas constant – Avogadro's Hypothesis: Molar gas constant – General gas equation- Application – Mixture of gases: Dalton's law – Unsaturated and saturated vapors – Gas laws for vapors.

b) Basic Thermodynamics: Work done by gas – Internal energy of gas – First law of thermodynamics – Internal energy changes, Ideal gas – Work done from p-v graphs – Isothermal changes – Kinetic theory in isothermal change – External work done in expansion – Adiabatic change – Heat and mechanical work in engines –Refrigerators and the second law – Real gases, critical temperature.

Unit 4: Crystal Physics (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) Crystal structures: Introduction – periodic array of atoms – crystal lattice – unit cell – basis – symmetry considerations – classification of crystals – Bravais lattices in three dimensions – crystal planes and Miller indices – simple crystal structures.

b) Crystal diffraction: Bragg's law – experimental X-ray diffraction methods: rotating crystal method – powder method.

Unit 5: Special theory of relativity(Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

Frames of reference – inertial frames and non-inertial frames – Galilean transformations – Michelson-Morley experiment – interpretation of results – postulates of special theory of relativity – Lorentz transformation equations – length contraction – time dilation – transformation of velocities – variation of mass with velocity – Mass-energy equation.

Books for study:-

1. M.Narayanamurthy and N.Nagarathnam, Dynamics – The national publisher – 8thedition (1976).

2. D.S.Mathur, properties of matter – S.Chand and Co., New Delhi (Reprint 2007).

3. Nelkon and Parker, Advanced level physics — Arnold Publishers – 7th edition (2006).

4. C.Kittel, Introduction to solid state physics – Wiley eastern – 8th edition (2012).

5. Robert Resnick, Introduction to special relativity – Wiley Eastern – 7th edition (Reprint 2007).

Books for Reference:-

1. D.Halliday and R.Resnick, Physics, Part 1 (Wiley eastern) - 5th edition (2005).
2. Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman lectures on physics series, vol. 1 & 2, Narosa publishing House, New Delhi, 8th reprint (1995).
3. M.A.Wahab, Solid State Physics – Narosha Publishing House, 2nd edition (2009).

16UPH3AL02 PHYSICS FOR CHEMISTRY - PRACTICAL - I

Category: AL3 **Credits: 1**

Semester: III **No of Hours/Week: 2**

LIST OF EXPERIMENTS

1. Young's modulus by stretching - vernier microscope

2. Rigidity modulus -torsional pendulum

3. Surface tension and interfacial tension - method of drops

4. Surface tension - capillary rise

5. Viscosity - capillary flow

6. Specific heat of liquid - electrical heating

7. Sonometer -verification of laws

8. Compound bar pendulum - determination of 'g'and radius of gyration

16UPH4AL01 PHYSICS FOR CHEMISTRY – II

Category: AL4 **Credits: 2**

Semester: IV **No of Hours/Week: 4**

Objectives:

This paper is offered to the students of chemistry as allied. This paper aims to give some fundamental physics required for their higher studies.

Unit 1: Electronics(Introduction: 1hr, Content: 9hr, Revision: 2 hr)

a) Semiconductor devices: Semiconductors – intrinsic and extrinsic semiconductor – PN junction diode – LED – solar cell. Transistor: Construction – Mechanism of amplification – current components – modes of operation.

b) Operational amplifier: Ideal op-amp – inverting and non-inverting amplifiers – summing amplifier – differential amplifier – integrator – differentiator.

Unit 2: Atomic physics (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) Atomic physics: Bohr's atom model – hydrogen spectrum – fine structure splitting: sodium doublet – quantum numbers- Pauli's exclusion principle- periodic table.

b) X- rays and photo electric effect: Production of X-rays- continuous and characteristic X- ray spectra – industrial and medical applications of X- rays. Laws of photo electric emission – Einstein's photoelectric equation- Millikan's experiment – Photo electric cells (emissive, electric and voltaic) – photo multiplier tubes.

Unit 3: Nuclear physics (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

a) General properties of nuclei: Nuclear mass and binding energy- B.E/A versus A curve - nuclear spin and magnetic

moment- mass, half-life and spin of neutron - semi empirical mass formula.

b) Nuclear models and elementary particles: nuclear reactions: cross section – nuclear fission – liquid drop model – nuclear forces- elementary particles: classification- Quarks and leptons.

Unit 4: Molecular forces and solid materials (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

(**a) Molecular forces:** Particle nature of matter, molecules – size and separation of molecules – intermolecular forces and potential energy – properties of solids from molecular theory – elasticity, thermal expansion, latent heat of vaporization – bonds between atoms and molecules.

b) Solid materials: Classification of solids – crystalline, amorphous, glassy, polymeric solids – imperfections in crystals – mechanical behavior of solids – structure of polymers – branching and cross linking of polymer molecules – thermosetting and thermoplastic polymers.

Unit 5: Quantum mechanics (Introduction: 1 hr, Content: 9hr, Revision: 2 hr)

Black body radiation spectra – Planck's theory – matter waves – De Broglie wavelength- Davisson and Germer experiment- Heisenberg's uncertainty principle – applications: binding energy of the hydrogen atom and radius of the Bohr's orbit – proving the non- existence of electron in the nucleus- Schrodinger equation – wave function and its interpretation.

Books for Study:-

1. V.K.Mehta, Principles of electronics, S.Chand Publishers – 11th edition (2010).

2. A.B.Gupta and DipakGhosh, Atomic and nuclear physics – Books and allied (sp) Ltd, Calcutta (1997).

3. H.S.Mani and Mehta. G.K., Introduction to modern physics – East West Press Pvt Ltd, New Delhi – (Reprint 2000).

4. Nelkon and Parker Advanced level physics — Arnold Publishers – 7th edition (2006).

5. Powell and Crasemen, Quantum mechanics – Narosa Publishing House (1988).

Books for Reference:-

1. Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman lectures on physics series, vol. 3 , Narosa publishing House, New Delhi, 8th (Reprint 1995).

2. R. Murugesan, Modern Physics – S. Chand & Company, 15th edition (2011).

16UPH4AL02 PHYSICS FOR CHEMISTRY - PRACTICAL II

Category: AL4 **Credits: 1**

Semester: IV **No of Hours/Week: 2**

1. Determination of Young's Modulus (Non-uniform bending) - Pin and Microscope

2. Determination of Rigidity Modulus (Pointer method) - Static Torsion

3. Determination of focal length - concave and convex lenses

4. Determination of thickness of wire - Air wedge

5. Determination of wavelengths (Grating) - mercury spectrum

6. Universal building block - NAND gates

7. Inverting and non-inverting amplifier op-amp

8. PN- Junction Diode characteristics (2+14+2 Hrs)