To

The Asst. Registrar (Admin.)
CSJM University
Kanpur-208024

Date: 30/04/2011

Through: proper channel

As per the letter with reference no. C.S.J.M.U./Acad./100414/2011 dated 27/04/2011 regarding the syllabus of running courses in the Department of Physics, UIET, is given below and detailed syllabus is also attached with this letter.

I[st] Semester:

(i). B. Tech.: PHY-101 (Theory and Lab.)
(ii). M. Phil.:
1. MPPH-101 (Research Methodology)
2. MPPH-102 (Computational Physics)
3. MPPH-103 (A) (Physics of Novel Materials)
OR
MPPH-103 (B) (High Energy Physics)
OR
MPPH-103(C) (Advanced Laser and Non-Linear Optics

II[nd] Semester:

(i). B. Tech.: PHY-102 (Theory and Lab.)
(ii). M. Phil.:
(1) MPPH-201(A) (Fiber Optics and Photonics)
OR
(2) MPPH-201(B) (Nanophysics)
OR
(3) MPPH-201(C) (Ferroelectrics and Ferromagnetism
(4) MPPH-202 (Dissertation)

I/C Khem Raj
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Dept. Physics, UIET

B. Tech.

Physics Syllabus (PHY-101 & PHY-102)

PHY-101

1. Scalars, vectors, vector differentiation, gradient, divergence and curl, vector integration, Gauss divergence and Stoke's theorem, coordinate systems (spherical polar & cylindrical), reference frames
2. Motion in non-inertial frames, fractious forces
3. Special theory of relativity
4. Newton's laws and their applications; Friction, conservative forces and potentials
5. Work energy theorem, conservation of energy and linear momentum, variable mass system (rocket), system of particles and collision
6. Conservation of angular momentum, central forces, Gravitation and Kepler's Laws
7. Elementary rigid body kinematics and dynamics
8. Simple harmonic motion (SHM), small oscillations and resonance

Reference Books

1. Mechanics: D S Mathur
2. A textbook of Mechanics: J C Upadhyay
3. Physics I & II: H C Verma
4. Introduction to Mechanics: Keplanar
5. Physics: Resenik and Halliday

PHY-102

1. Physical optics: Vibrations and waves (origin the refractive index), Interferences: division of wave-front and division of amplitute
2. Diffractions: Fraunhoffer, Grating, Resolving power (grating, prism, telescope and microscope), Polarizations: Production of polarized light, double refraction, optical activity, specific rotation
3. Revision of Divergence and curl, vector integration, Gauss divergence and Stoke's theorem, coordinate systems (Cartesian, spherical polar & cylindrical)
4. Electrostatics, electric dipoles, electric polarization, dielectrics and electric potential
5. Magnetostatics, magnetic potential, magnetic polarization, Magnetic properties of materials (para, dia and ferro)
6. Electromagnetic induction (including displacement current), Maxwell's equations for free space and matter; Electromagnetic waves propagation (vacuum and conductor)
7. Elements of quantum mechanics: wave equation, wave function and particle in box

Reference Books

1. Optics: Ajoy Ghatak
2. A textbook of OPTICS: Subrahmanyam, Brijlal and Avadhanulu
3. Electrodynamics: David J. Griffith
4. Classical electrodynamics: J. D. Jackson
5. Modern Physics: Author Beiser

MPPH-102

Computational Physics

Unit 1: Basics of Computational Physics-

Types of computers and languages, Introduction to C/C^{++} and FORTRAN, Accuracy consideration, Representation of integer numbers and numerical precision, Interpolations, differentiation and integration.

Unit 2: Numerical Methods for Vectors and Matrices-

Vector algebra, Dot and cross product Matrix operations, Determinant of a matrix, Unit matrix and Inverse matrix. Numerical Methods for Matrices, Linear Algebra, Data fitting, Least Square fitting, Goodness of fitting.

Unit 3: Derivative and Integrations-

First and second derivatives of a function, Rectangles Method, Trapezoidal method, Simpson's methods, Numerical differentiation, Numerical integration, Multiple Integrals, Solutions of Linear Equations.

Unit 4: Differential Equations-

Ordinary Differential Equations, Euler's method, second order Runge-Kutta method, Fourth order Runge-Kutta method, Adaptive meshes, Partial Differential Equations, Elliptical PDEs, Parabolic PDEs, Hyperbolic PDEs.

Unit 4: Quantum Mechanics-

Normalization, Expectation values, Solution of Schrodinger Equation Particle in a well. Monte-Carlo Simulations, Monte-Carlo integration, Monte-Carlo methods for Quantum mechanical systems (The one-dimensional harmonic oscillator, the hydrogen atom and Helium).

Reference Books:

1. Introduction to Numerical Analysis - S. S. Sastry.
2. Mathematical Physics -- H. K. Das.
3. Computational Physics --M. Hjorth-Jensen
4. Computational Physics -- N. J. Giordano (Prentice-Hall, 1997).
5. Computational Physics -- RC Verma, PK Ahluwalia and KC Sharma (New-Age Publication).
6. Computational Physics (Problem solving with computers) – R. H. Landau and M. J. P. Mejia, (John Wiley&sons,1997) .
7. Numerical Methods for Physics -- A. L. Garcia (Prentice-Hall, 1994)
8. Introductory Computational Physics—A. Kelin and A. Godunov(Cambridge University press)
9. Numerical Analysis --G. Shanker Rao, New Age Publication

MPPH - 103(B)

High Energy Physics

Unit-1 Symmetries and Unitary Symmetry

Conservation laws, Parity, Charge conjugation and time reversal CPT theorem, Isospin, G-Parity, Strange particles, Gell-Mann Nishijima scheme, Application of Isospin symmetry to EM Weak Ineractions, Unitary symmetry in 2-dimensions,Lie Algebra of SU(2),Fundamental representation, Unitary symmetry in 3-dimensions, representation of SU(3).

Unit-2 Quark Model of Hadrons

Historical development strange, charm bottom & top quark, particle classification SU(3) of flavour, SU(2) of spin and the SU(6),Quark statistics and colour octet and decuplet of baryons, mesons, application of Quark model to Hadron masses, Magnetic Moments and radioactive decays, Quark cluster model.

Unit-3 Hadron currents , Non lepotonic weak interaction:

Structure of Hadrons, the quark partons model, the weak interactions, Strangeness non-changing decays, V -A law, Strangeness changing decays, cabibbo theory of currents . Non leptonic decays , Non leptonic weak decay of strange particles, CP Violation in K decays.

Unit-4 Gauge Invariance, the standard model

Abelian transformations, Electro Dynamics of a Dirac field, spontaneous symmetry breaking, Non Abelian transformations Electro weak intraction, weak quark mixing, quantum chromo dynamics.

Unit-5 Recent developments

Introduction to Grand theories (GUT), SU(5) model of Georgi and Glashow, Beyond the GUT model, Basics of super symmetry, super string theories, heavy flavour-spin symmetry cosmology and particle physics, Rishon model.

Reference Books:

1. Introduction to particle Physics -- MP Khanna
2. Introduction to High Energy Physics -- DH Perkins
3. Unitary Symmetry and dementary particles -- DB Lichtenberg
4. Quark and Partons -- Fe Close
5. Quark --Cluster model

MPPH-103 (A)

Physics of Novel materials

Unit 1. Semiconductor Heterostructures:

General aspects of crystal structures, electron in periodic structures, Semiconductor band structures, band structures of binary and ternary alloys, quantum wells and super lattices, hydrogenic impurities in quantum wells, phonons in hetrostructures, Transport in semiconductors, parallel transport in quantum well and MODFETS, High temperature and high field transport in quantum wires, Applications of heterostructures.

Unit 2. Amorphous Semiconductors:

Electrons in non-crystalline materials, Chemical bond, localized and extended status in unperturbed lattice. The Hubbard Model, Metal-insulator transitions, Hopping conductivity, Kubo-Green wood formula, idea of Anderson localization, localized states in disordered lattices, impurity bands and amorphous semiconductors. Porous silicon, Quasi-crystals.

Unit 3. High-Tc Superconductors & Liquid Crystals:

Crystal structure and electronic structure of superconductors, Electric and Magnetic behaviour, Theories of superconductivity, Limits of BCS theory, Vortex state, Abnikorov lattice, Flux pinning, Important applications of high Tc superconductors, Basics and applications of liquid crystals.

Unit 4. Carbon related Materials:

Introduction to the bonding between carbon atoms, Single and multi walled carbon nanotubes, electronic structure, crystal structure, junctions and defects in nanotubes, transport, optical, thermal and mechanical properties of nanotubes. Fullerene structures and bonding, Mechanism of formation and fragmentation, potential applications and future directions. Conducting polymers.

Units 5. Characterization of Novel Materials:

Common concepts in materials characterization, Vacuum techniques, Thermal analysis, thermo gravimetric analysis, electrical and electronic measurements, conductivity, capacitance-voltage (C-V) and Hall effects in semiconductors, structural analysis using X-ray diffraction techniques, Scanning and tunneling microscopices, UV-VIS absorption spectroscopy, Raman and Photoluminescence spectroscopy, Ellipsometry.

Reference Books :

1. *Physics of Semiconductors and Heterostructures*, by Jasprit Singh (McGraw Hill)
2. *Physics of Amorphous Materials* by SE Elliott
3. *Electrons in Non-Crystalline materials* by Mott and Davis
4. *Superconductivity* by AV Narlikar
5. *Carbon nano-tubes, Synthesis, structure properties and applications* by MS Dresselhans
6. *Quantum dot heterostructures*, by D Bimberg et al.

MPPH – 103(c)

Advanced Laser and Non Linear Optics

Unit I: Laser Analysis (I)

Modes of a Rectangular Cavity, Open Planar Resonator, Quality Factor – Q of a cavity, Origin of Line Shape Function, Shape and width of Spectral Lines, Threshold Condition for Laser Oscillation, Spiking Behavior of Laser Production of Giant Pulse: Q- Switching – Kerr Effect,

Unit II: Laser Analysis (II)

Peak Power Emitted during the pusle, Giant Pulse Dynamics, Laser Amplifiers, Mode Locking Distributed feed back Lasers The Ultimate Line width of the Laser, Laser rate equations and Population Inversion in Three and four Energy Level schemes, comparison of three and four level Systems.

Unit III Types of Lasers:

He – Ne Laser, Argon ion Laser, N2 Laser, CO2 laser, Excimer Laser, Ruby Laser, Nd: YAG Laser, Dye Laser, Semiconductor Laser, Holography and its Applications.

Unit IV: Non Linear Optics

Harmonic Generation, second Harmonic generation, Phase Matching, Third Harmonic generation, optical mixing, Parametric generation of light, self focusing of light, Multiquantum Photoelectric effect, two Photon Processes, Multi photon Process, Parametric generation of Light, parametric light oscillator, Frequency Upconversion, Phase Conjugate Optics.

Unit V: Scattering

Rayleigh and Raman Scattering, Stimulated Raman Effect, Hyper Raman Effect, Coherent Anti _ Stokes Raman scattering, Spin flip Raman Laser, free electron laser, Photo Acoustic Raman Spectroscopy, Brillouin scattering.

Reference Books:

1. Laser and Non linear optics – B.B. Loud
2. Laser: Theory and Applications – K. Thyagrajan & A.K. Ghatak
3. Laser Fundamentals – William Silfvast
4. Essential of Laser and Non Linear Optics – G.D. Baruah

MPPH-201 (A)

Fiber Optics and Photonics

Unit 1. Modal propagation in Optical Fiber:

Modal propagation characteristics of step index and graded index fibers, weakly guided step index fibers, losses in fibers, material dispersion. Numerical techniques of the analysis of simple optical waveguides in weak guidance approximation.

Unit 2. Fiber Optics Technology:

Waveguide dispersion and design consideration, optical materials, fabrication, cabling and installation of optical fibers, optical joints and couplers. Integrated optical waveguide types, modes in asymmetric planar waveguide, channel and strip waveguides

Unit 3. Periodic Optical fibers:

Guided and defect modes in periodic optical waveguides, optical filters and monochromator, Bragg's reflection waveguides and Bragg's filters. Helically cladded optical fibers and their applications. Modes selection in different fibers.

Unit 4. Optical Solitons and Application of Fiber Optics:

Analysis of optical solitons and their applications, leaky modes, Optical Amplification and Si - doped waveguides, Application of fiber optics in non-communication and sensors.

Unit 5. Photonic Band Gap Materials:

Photonic crystals, Photonic crystal fibers, Photonic band gap structures, Analytical and numerical study of photonic band gap fibers and their dispersion characteristics, reflectance, transmittance in PBG fibers, negative refractive index materials. Optical filters from Photonic band gap and its application in loss bends and high Q cavities.

References Books:

1. Mynbav & Scheiner : "Fiber optic communication technology", Prentice hall
2. Ajoy Ghatak & K. Tyagrajan : Introduction to Fiber optics
3. Peter L. Bocho, James A Savage, et al: Optical Materials
4. E.D. Palik, et al: Hand book of Optical Constants of Solids Academic Press
5. Frederic Zolla Et. Al.: Foundation of Photonic Crystal Fibers
6. C. M. Soukolis: Photonic Band Gap Materials
7. Ralf Menzel: Photonics
8. P.N. Rampal: Nanophotonics

MPPH-101 (B)

Nanophysics

Unit 1. General aspects of Nanomaterials:

Free electron theory and band theory of solids, Introduction to two-dimensional, one-dimensional, and zero-dimensional nanomaterials e.g. quantum well, quantum wire, quantum dots, thin films and nanotubes. Quantum size effect, quantum confinement in two-dimensional and one-dimensional wells Variation of density of state and band-gap with dimensionality. Idea of carbon nano-structures, fullerenes (C_{60}, C_{70}), nanofibers and nanotubes (single walled, double-walled, multiple-walled and bamboo like structures).

Unit 2. Preparation of Nanomaterials:

Top down approach (lithography, Chemical etching, Ball-milling etc.) and Bottom-up approach (Arch evaporation, thermal evaporation, Molecular beam epitaxy, Chemical vapor deposition CVD, Plasma CVD, Spray pyrolysis, Thermal decomposition of organomettalic compounds, ion beam deposition, chemical reaction method, pulsed laser ablation etc.)

Unit 3. Characterization of Nanomaterials:

Determination of particle size from X-ray diffraction patterns. Use of XPS, EELS at nanoscale. General aspects of scanning probe microscopy, SEM, TEM, HRTEM, STM, AFM and their applications in nano characterization, Raman spectroscopic, Near field Raman microscopic and photoluminescence characterization of Nanomaterials.

Unit 4. Properties of Nanomaterials:

Surface to volume ratio in nanomaterials. High aspect ratio in nanowires and nanotubes. Transport in Quantum dots and carbon nanotubes. Field-emission properties, reactivity, optical magnetic and electronic properties of nanomaterials. Quantum optics and nano-magnetism. Spintronics.

Unit 5. Applications of Nanomaterials:

Nanomaterials as chemical and biological sensors. Nano-applications in display devices, solar cells, infra-red detectors, batteries, RAM, FeRAM, coatings, NEMS, MEMS, Optical switches. Medical applications of nanomaterials, nanomedicine, drug delivery and targeted nanotherapy, nanotechnology for genomics and Proteomics.

Reference Books :

1. *Hand book of Nanoscience and Nanotechnology*, H.S.Nalva (American Scientific)
2. *Encyclopedia of Nanoscience and Nanotechnology*. H.S.Nalva
3. *Introduction to Nanotechnology*, S.P.Toole and F.J.Owens (John Willey)
4. *Nanotechnology*, M Ratner and D Ratner (Pearson Education)
5. *Electron microscopy in the Nanomaterials*, T.J.Grundy and GA Jones
6. *Handbook of Semiconductor Nanostructures and Nanodevices*, Edited by AA Balandian and KL Wang (American Scientific).

MPPH-201(C)

Ferroelectricity and Ferromagnetism

Unit 1: General aspects of ferroelectrics
Mean field theory and Soft mode concept, First and second order phase transition, Landau Theory, Classification of ferroelectric materials, Ferroelectric hysteresis, Polarization mechanisms and breakdown, Oxygen octahedral, Order Disorder Ferroelectrics, Films ceramics and metastable polarization

Unit 2: Electro-optics and non-linear optic coefficients
The non-linear susceptibility, The anharmonic oscillator, Bond anharmonic polarizability model, The polarization potential, study of soft modes using Infrared and optic techniques

Unit 3: Ferroelectric devices and applications
Dynamic random access memories, Non-Volatile random access memories, Varactor diodes, Pyroelectric detection, Memories and display, Electro-optic Modulators

Unit 4: Ferromagnetism
Pauli paramagnetism, Properties of magnetically ordered solids; interpretation of exchange interaction in solids, ferromagnetic domains; Technical magnetization, intrinsic magnetization of alloys; Theory of antiferromagnetic and ferrimagnetic ordering; Ferromagnetic oxides and compounds

Unit 5: Ferromagnetic materials and devices
Magnetic properties of metals, Paramagnetism of metals, soft and hard ferromagnetic Magnetoelectronics materials, magnetic nanostructures, and ultrahigh density magnetic recording

Suggested Books:

1. **Ferroelectric Crystals by Jona & Shirane**
2. **Principle and application of ferroelectrics and related materials by Lines & Glass**
3. **Physics of Ferromagnetism by Chikazumi, Soshin**
4. **Electronic Structure and Magneto-Optical Properties of Solids by Bruce, Harmon, Alexander.**

SEMESTER I 1001

Course-I (CMP-1): Research Methodology (01)
(M.Phil)

Unit-I Basic Concepts of Research

Research Definition-Importance and Meaning of research, Characteristics of research, Types of research, Steps in research - Identification, Selection and formulation of, research problem, Design Formulation of Hypothesis, Review of Literature, Survey of literature through Internet.

Unit-II Sampling and Data Collection

Sampling theory and techniques, types of sampling, steps in sampling, Sample size-Problems in determining the sample size, Advantage and limitations of sampling. Data collection through experimental techniques and theoretical calculations, types of data - Primary Data-Meaning-Data collection methods. Scrutinising primary data Secondary Data-Meaning, Method of collection of secondary data, limitations and cautions.

Unit- III Statistics in Research

Analysis and interpretation of data obtained: coding, editing and tabulation of data, various kinds of charts and diagrams used in data analysis. Application of statistical techniques for analyzing the data. Use of data analysis tool like SPSS and Excel.

Unit-IV Parametric Tests

Testing of significance – Mean, Proportion, Variance and Correlation – testing for difference between means, proportions, Variance and correlation co-efficient. Chi-square tests: ANOVA-one- way and two-way

Unit V- Errors Precision and Accuracy in Instrumental Methods

Introduction, Types of error, significant figures, Precision and Accuracy, Methods of expressing precision, Confidence limits, Photometric errors.

Unit-VI Computers in Research and Research Report

Fundamentals of computers, planning the Interpretive programme, Conducting Data processing, Interfacing computer Personnel, Types of reports, Precautions in preparing

the research Dissertation, contents, styles of reporting, steps in drafting reports, editing of draft, evaluating the final draft.

Recommended Texts:

1. *Statistical Methods-S.P.Gupta*
2. *Research Methodology Methods and Techniques-C.P.Kothari*
3. *Statistics (Theory and Practice) – B.N. Gupta*
4. *Research Methodology Methods and statistical Techniques-Santhosh Gupta*
5. *Research Methodology and statistical Measures- Reddy and Rao*
6. *Research Methodology- Sharma and Jain.*

1002

Course – II (MCH-2): Instrumentation and Application (02)

Unit I

Electroanalytical methods:- Polarography (DC, AC and pulse), cyclic voltammetry, coulometry and anode stripping voltammetry.

Unit II

Optical methods.- UV/Visible, X-ray photoelectron spectroscopy (XPS), Auger Electron Spectroscopy (AES), ESCA, Atomic absorption and emission spectroscopy.

Unit III

Diffraction Methods: Electron diffraction, X-ray diffraction

Unit IV

Imaging Techniques: Electron microscopy (SEM, TEM)

Unit V

Infrared Spectroscopy, Dispersive and Fourier Transformed Raman, Resonance Raman and Surface Enhanced Raman Spectroscopy- Dispersive and Fourier Transformed, Nuclear magnetic resonance spectroscopy, Mass spectroscopy.

Unit VI

Hifanated Techniques: GC-IR, TG-IR Spectroscopy, GC-Mass Spectroscopy and any other.

Unit VII

Separation Methods: Theory and applications of separation methods in analytical chemistry solvent extraction, ion exchangers including liquid ion exchangers and chromatographic methods for identification and estimation of multicomponent systems (such as TLC, GC, HPLC, etc).

Unit VIII

Thermal Methods: TG, DTA, DSC and thermometric titrations.

Recommended Texts:

1. Hollas, J. M. *Modern Spectroscopy* 4th Ed., John Wiley & Sons (2004).
2. Kemp, W. *Organic Spectroscopy* 3rd Ed., W. H. Freeman & Co. (1991)
3. Silverstein, R. M., Bassler, G. C. & Morrill, T. C. *Spectroscopic Identification of Organic Compounds* John Wiley & Sons (1981).
4. Ebsworth, E. A. O. *Structural Methods in Inorganic Chemistry*. Blackwell Scientific Publications (1991).
5. Drago, R. S. *Physical Methods in Chemistry* W. B. Saunders Co., U.K. (1977)

1005

Course-III (MCH-IV): Advanced Quantum Chemistry (05)

Unit I

Operators, eigenfunctions, variation principle. Many electron systems, Determinantal wavefunctions. Spin orbitals and spatial orbitals Pauli matrices. Term symbols and term energies. Matrix elements for one and two electron operators. Introduction to second quantization in chemistry. Roothaan equations. Koopmans and Brillouin theorem. Basis sets (Slater, Gaussian and integral transform). Basis Set Superposition Error (BSSE). Electron correlation and CI theories, pair and coupled, pair theories, coupled cluster approximation

Unit II

A review of HMO, EHT and PPP methods ZDO approximation and CNDO, INDO and other semiempirical theories

Unit III

Hohenberg-Kohn theorem. Nature of electron density distribution and Density Functional theories, hybrid functionals Density functional interpretation of some concepts (electronegativity, electronegativity equalization, softness and hardness, etc.)

Unit IV

Computational Techniques and simulation studies, Motivation and applications, Intermolecular potentials, Molecular Dynamics and Monte Carlo Methods, free energy calculations, application of Hartree Fock molecular orbital and DFT calculations

Recommended Texts:

1. Atkins, P. W. & Friedman, R. S. Molecular Quantum Mechanics 3rd Ed. Oxford University Press (1997).
2. Levine, I. N. Quantum Chemistry 5th Ed., Prentice-Hall Inc.: New Jersey (2000).
3. Lowe, J. P. & Peterson, K. Quantum Chemistry Academic Press (2005).
4. Szabo, A and Ostlund, N.S., Modern Quantum Chemistry, Mc Graw Hill (1989).

1006

Course-III (MCH-V): Advanced Electrochemistry (06)

Unit I

Electric Double Layer at Metal / Semiconductor – Electrolyte interface Thern of the double layer, Electrocapillary phenomena; Experimental evaluation excesses and electrical parameters, Adsorption, Langmuir, Frumkin, Temkin, isotherms,Structure of electrified interfaces - Gouy-Chapman, Stern, Devanathan-Mottwatts, Tobin, Bockris, Devanathan models, Effect of semiconductor-solution interface.

Unit II

Electrode kinetics: Derivation of Butler-Volmer equation and its implications, Overpotential, Exchange current density, Multistep reactions, Determination c multistep reactions

Unit III

Quantum aspects: Charge transfer at electrode-solution interfaces, Quantization transfer, Tunnelling

Unit IV

Electrochemical methods: Controlled potential and current te Electrocrystallization, Electrogrowth of metals on electrode- Nucleation, Growth Diffusion, Underpotential deposition, Electrochemical instrumentations,

Unit V

Bioelectrochemistry, Membrane potentials, Nernst-Planck equation, Hodgkin-Hu equations, Core Conductor model.

Unit VI

Applied Electrochemistry: Corrosion, forms of corrosion, Corrosion measu Corrosion monitoring and prevention methods, Conversion and stor electrochemical energy: PEC Cells, Fuel cells and batteries, Electrocatalysis. Infl various parameters

Unit VII

Electroanalytical Techniques – Cyclic Voltammetry - Cell Design, instrume interpretation of voltammograms. Impedance Technique – Application for s electrode kinetics and corrosion Polarography – Instrumentation & appli Amperometry, Coulometry and Electrography - Instrumentation & applications

1003

Course-III (MCH-III): Macromolecules (03)

Unit I

Recapitulation: Polymers and their classification and nomenclature. Types of polymerization. Molecular weight and size, degree of polymerization, polydispersity. Practical significance of polymer molecular weight.

Unit II

Kinetics of polymerization, Kinetics and statistics of step growth polymerization, size distribution in linear polymers, nonlinear polymerization and prediction of gel point. Kinetics of free radical chain polymerization, cationic polymerization, anionic polymerization and polycondensation.

Unit III

Structure of macromolecules: Polymer crystals, crystallization in polymers, factors determining crystal structure. Morphology of solution grown single crystal and bulk grown crystal. Semi-crystalline polymers: spherulites, degree of crystallinity, crystallization and melting. Kinetics of crystallization. Molecular mechanism of crystallization, factors affecting melting.

Amorphous polymers, Structure in amorphous polymers. Meaning of glass transition temperature (Tg), factors influencing the glass transition temperature, importance of glass transition temperature Tg and molecular weight, Tg and melting point. Polymer microstructure, Microstructure based on chemical structure and geometrical structure.

Unit IV

Polymer solutions: Process of polymer dissolution, Thermodynamics of polymer dissolution. The Flory-Higgins Theory of polymer solutions, nature of polymer molecules in solution. Viscosity of polymer solutions. Colligative properties. Conformations and configurations of polymers in solutions.

Unit V

Electrically conducting polymers: Discovery of electrically conducting polymers, Factors affecting the conductivity of conducting polymers. Electrochemical polymerization. Doping of conducting polymers. Important structural features. Nature of charge carriers in conducting polymers: solitons, polarons and bipolarons. Mechanism of conduction in polymers. Electronic structure of polymers: Band theory of polymers. Methods for determining band structure of polymers: An introduction.

Unit VI

Stimuli-sensitive (smart) polymers, Temperature- and pH-sensitive smart polymers and their applications in biotechnology and medicine.

Unit VII

Types of degradable polymers, Chemical and biodegradation. Applications of degradable polymers.

Recommended Texts:

1. DeGennes, P. G. Scaling Concepts in Polymer Physics Cornell University Press (1979).
2. Young, R. J. & Lovell, P. A. Introduction to Polymers 2nd Ed. Chapman & Hall (1991).
3. Billmeyer, F. W. *Textbook of Polymer Science* 3rd Ed. Wiley-Interscience: New York (1984).
4. Fried JR, *Polymer Science and Technology*, Prentice-Hall of India, (2000)

1004

Course-III (CMP-6): Chemistry of Materials (04)

Unit I

Electrical, optical, magnetic and thermal properties of inorganic materials. Thin Films and Langmuir-Blodgett film

Unit II

Magnetic Materials: Magnetism, Types of magnetic behaviour (Ferromagnetism, antiferromagnetism, ferrimagnetism, Hysteresis, Remnance and coercivity), magnetic susceptibilities, Pascal's constants, paramagnetism in experimental simple systems where $S = ½$, Magnetism of a transition metal complexes and rare-earth –containing compounds: some examples, Orbital Models for magnetic interactions: Mechanism of anisotropic and antisymmetric interactions, Magnetic Chain Compounds, Design of Molecular –based magnets: three dimensional magnetic ordering, Orbital degeneracy and ferromagnetic interaction, Magnetic interactions in Charge transfer complexes, Magnetic ordering and Spin canting.

Unit III

Composites and nanomaterials Microscopic and macroscopic composites, dispersion strengthened and particle-reinforced, fibre-reinforced composites. Nanocrystalline phase, preparation procedures, special properties, applications. Preparation of nanomaterials and their characteristic differences over bulk materials. Principles of Electron Microscopy, Dynamic Light Scattering, Atomic Force Microscopy and characterization of nanomaterials.

Unit IV

Liquid crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases, smectic-nematic transition and clearing temperature- homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular rearrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

Unit V

Ionic conductors: Types of ionic conductors, mechanism of ionic conduction, interstitial types (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of

ionic conductors. Organic solids, fullerenes, Conducting organics, organic superconductors.

Recommended Texts

1. Oliver Kahn. *Molecular Magnetism*, VCH Publishers, (UK).
2. W. D. Callisters. *Materials Science and Engineering: An Introduction*, Wiley.
3. N. W. Aschcroft and N. D. Mermin. *Solid State Physics*,
4. J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rowlings *Materials Science*,, *ELBS*
5. Kelker and Hatz. *Hand Book of Liquid Crystals*,

Course-I (MCH-X): Medicinal Chemistry

Unit I

Introduction to the history of medicinal chemistry, Properties required in a drug, concept of pharmacophare, Drug targets, pharmacokinetic aspects, ADME properties, biological testings.

Unit II

Lead compounds (synthesis and stereochemistry considerations, Combinatorial synthesis, Target oriented drug design, optimizing reactions, some applications and case studies.

Unit III

General introduction to antibiotics, Mechanism of action of lactam antibiotics, non-lactam antibiotics and quinolines, antiviral and anti-AIDS

Unit IV

Neurotransmitters, classes of neurotransmitters, Drugs affecting collingeric and adrenergic mechanisms

Unit V

Anti-histamines, anti-inflammatory, anti-analgesics, anticancer and anti-hypertensive drugs

Unit VI

New developments, e.g., gene therapy and drug resistance.

Unit VII

Bioactive Compounds

Pyrethroids: Introduction; structure elucidation and synthesis of pyrethroids, namely pyrethrins, cinerins and Jasmoline; Synthetic pyrethroids. Structure activity relationships; synthesis of various synthetic pyrethroids.

Insect pheromones: Semiochemicals, pheromones, primers and releasers, different classes of pheromones, synthesis of different pheromones; advantages of pheromones over conventional pesticides.

Hormones: General study of hormones including classification, mechanism of action of water soluble and fat soluble hormones, secondary messengers, negative feedback mechanism; Antifertility agents.

Recommended Texts:

1. Gringauz, A. *Introduction to Medicinal Chemistry: How Drugs Act and Why?* John Wiley & Sons (1997).

2. Patrick, G. L. *Introduction to Medicinal Chemistry* Oxford University Press (2001).