B.Sc. Physical Sciences

(Physics, Chemistry, Mathematics)

Choice Based Credit System

Course Structure

B.Sc.

(2016-17)

School of Vocational Studies and Applied Sciences

Gautam Buddha University, Greater Noida, UP-201312

India

Bachelor of Science Physical Sciences
(Physics, Chemistry, Mathematics)

SEMESTER		COURSE OPTED	COURSE NAME	CREDITS
CC: Core Course, AECC: Ability Enhancement Compulsory Course, SEC: Skill Enhancement Course **DSE: Discipline Specific Elective**				
I	**EN-101**	**AECC-I**	English Proficiency	**2**
	PH-105	**CC-I**	Mechanics	**4**
	PH-107	**CC-I Practical**	Mechanics Lab	**2**
	CH-101	**CC-II**	Atomic structure, Bonding, General organic chemistry, Aliphatic Hydrocarbons	**4**
	CH-103	**CC-II Practical**	Laboratory (Atomic structure, Bonding, General organic chemistry, Aliphatic Hydrocarbon)-I	**2**
	MA-111	**CC-III**	Calculus-I	**3**
	MA-113	**CC-IV**	Matrices	**3**
		Contact Hours		**23**
II	**ES-101**	**AECC-II**	Environmental Science	**2**
	PH-106	**CC-V**	Electricity and Magnetism	**4**
	PH-108	**CC-V Practical**	Electricity and Magnetism Lab	**2**
	CH-102	**CC-VI**	Chemical Energetics, Phase equilibrium, Functional group organic Chemistry-I	**4**
	CH-104	**CC-VI Practical**	Laboratory (Chemical Energetics, Phase equilibrium, Functional group organic Chemistry Practicals)-II	**2**
	MA-112	**CC-VII**	Algebra	**3**

	MA-114	**CC-VIII**	Calculus-II	**3**
	BS-101	**AECC-III**	Human Values & Buddist Studies	**2**
III	**PH-201**	**CC-IX**	Thermal Physics and Statistical Mechanics	**4**
	PH-203	**CC-IX Practical**	Thermal Physics and Statistical Mechanics Lab	**2**
	CH-201	**CC-X**	Solution, Phase Equilibium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	**4**
	CH-203	**CC-X Practical**	Laboratory (Conductance, Electrochemistry & Functional Group Organic Chemistry–II)-III	**2**
	MA-213	**CC-XI**	Real Analysis	**3**
	MA-215	**CC-XII**	Introduction to Ordinary Differential Equation	**3**
	NSS-101	**AECC-IV**	NSS Paper 1	**2**
		Skill Enhancement Course -1	SEC-1	**2**
IV	**PH-202**	**CC-XIII**	Waves and Optics	**4**
	PH-204	**CC-XIII Practical**	Waves and Optics Lab	**2**
	CH-202	**CC-XIV**	Transition Metal & Coordination Chemistry, States of matter & Chemical kinetics	**4**
	CH-204	**CC-XIV Practical**	Laboratory (Transition Metal & Coordination Chemistry, States of matter &Chemical kinetics)-IV	**2**
	MA-212	**CC-XV**	Introduction to Partial Differential Equation	**3**
	MA-214	**CC-XVI**	Mathematical Methods	**3**
	NSS-102	**AECC-V**	NSS Paper-II	**2**
		Skill Enhancement Course -2	SEC-2	**2**
V		**Skill Enhancement**	SEC-3	**2**

		Course -3		
		Discipline Specific Elective -1	DSE-1	**6**
		Discipline Specific Elective -2	DSE-2	**6**
		Discipline Specific Elective -3	DSE-3	**6**
VI		**Skill Enhancement Course -4**	SEC-4	**2**
		Discipline Specific Elective -4	DSE-4	**6**
		Discipline Specific Elective -5	DSE-5	**6**
		Discipline Specific Elective -6	DSE-6	**6**
	Total Credits			**120**

	Code	**Discipline Specific Electives (DSE-1)**	**Credits**
1	PH-301	Solid State Physics	4
	PH-303	Solid State Physics Lab	2
2	PH-305	Physics of Semiconductor Devices	4
	PH-307	Physics of Semiconductor Devices Lab	2
3	PH-309	Introductory Atmospheric Physics	3
	PH-311	Basics of Nanoscience	3
	Code	**Discipline Specific Electives (DSE-2)**	Credits
1	CH-301	Industrial Chemicals & Environment	4
	CH-303	Laboratory (Industrial Chemicals & Environment)-V	2
2	CH-305	Quantum Chemistry, Spectroscopy & Photochemistry	4
	CH-307	Laboratory **(**Quantum Chemistry, Spectroscopy & Photochemistry**)**-V	2
	Code	**Discipline Specific Electives (DSE-3)**	Credits
1	MA-301	Programming in C	3
2	MA-303	Linear Algebra	3
3	MA-305	Tensor & Geometry	3
	Code	**Discipline Specific Electives (DSE-4)**	Credits
1	PH-302	Atomic, Molecular and Nuclear Physics	4
	PH-304	Atomic, Molecular and Nuclear Physics Lab	2
2	PH-306	Modern Physics and Quantum Mechanics	4
	PH-308	Modern Physics and Quantum Mechanics Lab	2
	Code	**Discipline Specific Electives (DSE-5)**	Credits
1	CH-302	Molecules of Life	4

	CH-304	Laboratory(Molecules of Life)-VI	2
2	CH-306	Chemistry of Main Group Elements, Theories of Acids and Bases	4
	CH-308	Laboratory (Chemistry of Main Group Elements, Theories of Acids and Bases)-VI	2
		Discipline Specific Electives (DSE-6)	
	Code		
1	MA-302	Numerical Methods	3
2	MA-304	Linear Programming	3
3	MA-306	Theory of Complex Variable	3

Skill Enhancement Course (SEC)								
Physics Based			**Math Based**			**Chemistry Based**		
SEC-I	**PH-205**	Renewable Energy and Energy harvesting,	**SEC-I**	**MA-215**	Theory of Equations	**SEC-I**	**CH -205**	Intellectual Property Rights
SEC-II	**PH-206**	Computational Physics	**SEC-II**	**MA-214**	Logic and sets	**SEC-II**	**CH-206**	**1.** Green Methods in Chemistry
SEC-III	**PH-313**	Photolithography and Device fabrication	**SEC-III**	**MA-317**	Mathematical Modelling	**SEC-III**	**CH-309**	Pharmaceutical Chemistry
SEC-IV	**PH-310**	Simulation Experiments in Physics	**SEC-IV**	**MA-318**	Experimental Statistics using R	**SEC-IV**	**CH-310**	Chemistry of Cosmetics & Perfumes

PHYSICS

PH105: MECHANICS

4-Credits (4-0-0)

Vectors: Vector algebra, scalar and vector products, derivatives of a vector with respect to a parameter.

Ordinary Differential Equations: First order homogeneous differential equations, second order homogeneous differential equations with constant coefficients.

Laws of Motion: Frames of reference, Newton's laws of motion, dynamics of a system of particles, centre of mass.

Momentum and Energy: Conservation of momentum, work and energy, conservation of energy, motion of rockets.

Rotational Motion: Angular velocity and angular momentum, torque, conservation of angular momentum.

Gravitation: Newton's law of gravitation, motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Kepler's laws (statement only), satellite in circular orbit and applications, geosynchronous orbits, weightlessness, basic idea of global positioning system (GPS).

Oscillations: Simple harmonic motion, differential equation of SHM and its solutions, kinetic and potential energy, total energy and their time averages, damped oscillations.

Elasticity: Hooke's law, stress-strain diagram, elastic moduli, relation between elastic constants, Poisson's ratio, expression for Poisson's ratio in terms of elastic constants, work done in stretching and work done in twisting a wire, twisting couple on a cylinder, determination of rigidity modulus by static torsion, torsional pendulum, determination of rigidity modulus and moment of inertia - q, η and by Searles method.

Special Theory of Relativity: Constancy of speed of light, postulates of special theory of relativity, length contraction, time dilation, relativistic addition of velocities.

Texts/References

1. An introduction to mechanics, Daniel Kleppner and Robert Kolenkov, 2/e, 2014, Cambridge University Press.
2. Concepts of Physics, H. C. Verma, 1/e, 1993 (second reprint 2011), Bharati Bhawan.
3. Mechanics Berkeley Physics course, Charles Kittel, et.al. 2007, Tata McGraw-Hill. University Physics. FW Sears, MW Zemansky & HD Young, 13/e, 1986, Addison Wesley.

PH107: MECHANICS LAB

2-Credits (0-0-3)

List of Experiments

1. Measurement of basic constant, length weight and time.
2. To determine the value of (g) with the help of a compound pendulum.

3. To determine the value of g by Katter's pendulum.
4. To study the coupled pendulum for in-phase, out-phase and beat oscillation.
5. To determine the Moment of Inertia of a Flywheel about its axis of rotation.
6. To determine the Moment of Inertia of an irregular body, about an axis passing through its gravity and perpendicular to its plane by dynamical method (Inertia Table).
7. To determine the modulus of rigidity of the material of wire with the help of a torsion pendulum
8. To determine the modulus of Rigidity of a wire by Maxwell's needle.
9. To determine the Young's modulus, modulus of Rigidity and Poisson ratio of the material of a wire by Searle's method.
10. To determine Young's Modulus of the given material in the form of a beam.
11. To determine the spring constant by Hooke's law.
12. To determine Poisson ratio of rubber.

Texts/References

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. B.Sc. Practical Physics, Geeta Sanon, R. Chand & Co. New Delhi, 2nd Ed. 2009.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengag Learning India Pvt. Ltd.
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

PH106: ELECTRICITY AND MAGNETISM

4-Credits (4-0-0)

Vector Analysis: Review of vector algebra (scalar and vector product), gradient, divergence, curl and their significance, vector integration, line, surface and volume integrals of vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

Electrostatics: Electrostatic field, electric flux, Gauss's theorem of electrostatics, applications of Gauss theorem, electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor, electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, calculation of electric field from potential, capacitance of an isolated spherical conductor, parallel plate, spherical and cylindrical condenser, energy per unit volume in electrostatic field, dielectric medium, polarisation, displacement vector.

Magnetism: Magnetostatics: Biot-Savart's law & its applications, straight conductor, circular coil, solenoid carrying current., divergence and curl of magnetic field, magnetic vector potential, Ampere's circuital law, **magnetic properties of materials:** magnetic intensity, magnetic induction, permeability, magnetic susceptibility, brief introduction of dia, para, and ferro-magnetic materials.

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, energy stored in magnetic field.

Maxwell`s Equations and Electromagnetic Wave Propagation: Equation of continuity of current, displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field,

electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Texts/References

1. Introduction to Electrodynamics, D. J. Griffith, Prentice Hall India (2009)
2. Electricity and Magnetism, E. M. Purcell, McGraw-Hill Education (1986)
3. Electricity and Magnetism, D. C. Tayal, Himalaya Publishing House, (1988)
4. University Physics, Ronald Lane Reese, Thomson Brooks/Cole, (2003)

PH108: ELECTRICITY & MAGNETISM LAB

2-Credits (0-0-3)

List of Experiments

1. To determine the capacitance of plate capacitor by charge measurement and dielectric constant of different dielectric materials. (Dielectric Constant)
2. To convert a Galvanometer into voltmeter/ammeter and to study resistance laws and a multi-meter.
3. To determine the specific resistance of a material of given wire using Carey foster's bridge.
4. To determine the specific resistance of a material of given wire using Wien's bridge.
5. Calibration of a voltmeter/ammeter with the help of a potentiometer.
6. To determine the magnetic field along the axis of current carrying coil and estimate the radius of the coil with the help of Tangent Galvanometer
7. To draw the Hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility and permeability of the given specimen.
8. Faraday's law and induced E.M.F.
9. To determine the electro chemical equivalent of Copper using copper voltmeter
10. Magnetic field measurement with search coil & ballistic galvanometer.
11. To study the characteristics of a series R-C circuit.
12. To determine the internal resistance of a Leclanche's cell using potentiometer.

Texts/References

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. B.Sc. Practical Physics, Geeta Sanon, R. Chand & Co., New Delhi, 2nd Ed. 2009.
3. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengag Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

PH201: THERMAL PHYSICS AND STATISTICAL MECHANICS

4-Credits (4-0-0)

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth law of thermodynamics and temperature, first law of thermodynamics and internal energy, conversion of heat into work, various thermo-dynamical processes, applications of first law, general relation between C_P & C_V, work done during isothermal and adiabatic processes, compressibility & expansion coefficient, reversible &

irreversible processes, second law & entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, entropy-temperature diagrams, third law of thermodynamics, unattainability of absolute zero.

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal energy functions, Maxwell's relations & applications, Joule-Thomson effect, Clausius-Clapeyron equation, expression for ($C_P - C_V$), C_P/C_V, T-dS equations.

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, mean free path (Zeroth order), law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Theory of Radiation: Blackbody radiation, spectral distribution, concept of energy density, derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan Boltzmann law, and Wien's displacement law from Planck's law.

Statistical Mechanics: Phase space, macrostate and microstate, entropy and thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity -Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Texts/References

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. Heat and Thermodynamics: Brij Lal and N. Subramanyam, S. Chand.
3. Fundamentals of Statistical and Thermal Physics: F. Rief, Waveland Press.
4. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
5. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
6. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G. L. Salinger. 1988, Narosa.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PH203: THERMAL PHYSICS AND STATISTICAL MECHANICS LAB

2-Credits (0-0-3)

List of Experiments

1. To determine the value of Stefan's constant.
2. To verify the Stefan's law by electric method.
3. To determine the coefficient of real expansion of a liquid (water) by up-thrust method.
4. To determine the coefficient of Linear Expansion of given Sample.
5. To determine the value of J, the mechanical equivalent of heat by Searle's friction cone apparatus.
6. To determine the mechanical equivalent of heat (J) with the help of Joule's calorimeter.
7. To determine the Coefficient of thermal conductivity of bad conductors by Lee's Disc method.
8. To determine the thermal conductivity of rubber in the form of tube.
9. To determine the critical temperature and critical pressure of a gas.
10. Determine of Temperature coefficient of resistance (α) for platinum wire by Callender and Griffith Bridge method.
11. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
12. To determine the value of Y (the ratio of two specific heats of gas) for air by Clement and Desorme's method.
13. To determine specific heat of a given liquid by method of cooling.

Texts/References

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

4. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.

PH202: WAVES AND OPTICS

4-Credits (4-0-0)

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1). Oscillations having equal frequencies and (2). Oscillations having different frequencies (Beats).

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and analytical methods, Lissajous figures with equal and unequal frequency and their uses.

Waves Motion: Transverse waves on a string, travelling and standing waves on a string, normal modes of a string, group velocity, phase velocity, plane waves, spherical waves, wave intensity.

Fluids: Viscosity: Viscosity, rate flow of liquid in a capillary tube, Poiseuille's formula, determination of coefficient of viscosity of a liquid.

Sound: Simple harmonic motion, forced vibrations and resonance, Fourier's Theorem, application to saw tooth wave and square wave, intensity and loudness of sound, Decibels, intensity levels, musical notes, musical scale.

Wave Optics: Electromagnetic nature of light, definition and properties of wave front, Huygens principle.

Interference: Division of amplitude and division of wavefront, Young's double slit experiment. Lloyd's mirror and Fresnel's bi-prism, phase change on reflection, Stokes' treatment, interference in thin films: parallel and wedge-shaped films, Newton's rings: measurement of wavelength and refractive index.

Michelson's Interferometer: Idea of form of fringes, determination of wavelength, wavelength difference, refractive index.

Diffraction: Fraunhofer diffraction: Single slit; double slit, multiple slits & diffraction grating. Fresnel diffraction: half-period zones, zone plate, Fresnel diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Polarization: Transverse nature of light waves, plane polarized light-production and analysis, circular and elliptical polarization.

Texts/References

1. N. K. Bajaj, Waves & Oscillations (Tata-McGraw-Hill)

2. A. K. Ghatak, Optics (Tata Mc Graw Hill)

3. D. P. Khandelwal, Optics & Atomic Physics, (Himalaya Publishing House)

4. Jenkins & White, Fundamentals of Optics (McGraw-Hill)

5. R. N. Chaudhary, Waves and Oscillations (New Age Publications)

PH204: WAVES & OPTICS LAB

2-Credits (0-0-3)

List of Experiments

1. To determine the wavelength of Sodium light by Newton ring method.
2. To determine the wavelength of Sodium light using Fresnel's Bi-prism.
3. To study interference and diffraction pattern with slits.
4. To determine the refractive index of the prism and its dispersive power with the help of spectrometer.
5. To determine the wavelength of different spectral light emitted by light sources with the Plane Transmission Grating.
6. To determine the specific rotation of cane sugar solution with the help of Polarimeter.
7. To verify the Malus's law.
8. To determine the plank's constant by photoelectric effect.
9. To verify Newton's formula for combination of two lenses.
10. Focal length of a combination of two lenses using Nodal slide assembly.
11. To determine frequency of AC mains using Sonometer.
12. To determine the surface tension by Searle's apparatus.
13. To determine the coefficient of viscosity by Poiseuillie's/Stoke's method.
14. To determine the frequency of an electrically maintained tuning fork by Melde's experiment and to verify λ^2-T law.
15. To study Lissajous' Figures.

Texts/References

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi

PH301: SOLID STATE PHYSICS

4-Credits (4-0-0)

Crystal Structure: Solids: Amorphous and crystalline materials, lattice translation vectors, lattice with a basis, unit Cell, Miller indices, reciprocal lattice, types of lattices, Brillouin zones, diffraction of X-rays by crystals, Bragg's law, atomic and geometrical factor.

Elementary Lattice Dynamics: Lattice vibrations and phonons: Linear monoatomic and diatomic chains, acoustical and optical phonons, qualitative description of the phonon spectrum in solids. Dulong and Petit's law, Einstein and Debye theories of specific heat of solids (qualitative only), T^3 law.

Magnetic Properties of Matter: Dia, Para, Ferri and Ferromagnetic materials, classical Langevin theory of dia and paramagnetic domains, quantum mechanical treatment of paramagnetism, Curie's law, Weiss's theory of Ferromagnetism and Ferromagnetic domains, discussion of B-H curve, hysteresis and energy loss.

Dielectric Properties of Materials: Polarization, local electric field at an atom, depolarization field, electric susceptibility, polarizability, Clausius-Mosotti equation, Classical theory of electric polarizability,

normal and anomalous dispersion, Cauchy and Sellmeir relations, Langevin-Debye equation, complex dielectric constant, optical phenomena, applications: plasma oscillations, plasma frequency, plasmons.
Elementary BandTheory: Kronig Penny model, band gaps, conductors, semiconductors and insulators, p and n type semiconductors, conductivity of semiconductors, mobility, Hall Effect, Hall coefficient.
Superconductivity: Experimental results, critical temperature, critical magnetic field, Meissner effect, type-I, and type-II superconductors.

Texts/References

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
3. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

PH303: SOLID STATE PHYSICS LAB
2-Credits (0-0-3)

List of Experiments

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique.
6. To determine the refractive index of a dielectric layer using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature (up to 150^{o}C) by four-probe method and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Texts/References

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

PH 305: PHYSICS OF SEMICONDUCTOR DEVICES
Credits: 4 (4-0-0)
Semiconductor Device Physics: Bonding in Solids, Energy Bands, Metals, Semiconductors, and Insulators, E-k diagram, Direct and Indirect bandgap Semiconductors, Density of states, Occupation probability, Fermi levels, Charge Carriers in Semiconductors, Effective Mass concept, Intrinsic and extrinsic Materials, Carrier concentration, Temperature dependence, Drift of Carriers in Electric and Magnetic Fields, Hall effect.

Semiconductor Diodes: p and n type semiconductors, Barrier Formation in PN Junction Diode, Current Flow Mechanism, junction characteristics, Static and Dynamic Resistance, Transition capacitance, Varactor diodes, junction breakdown, Zener diode and its characteristics, Tunnel Diode, Schottky Diodes, Principle and structure of Light Emitting Diodes (LED), Photodiode, Solar Cell.

Bipolar Junction transistors: n-p-n and p-n-p Transistors, Current flow mechanism, CB, CE and CC Configurations, Active, Cutoff, and Saturation Regions, Current gains α and β, Load Line and Q point, Biasing of Transistors, h-parameter model, Single-stage CE amplifier using Hybrid Model, Input and Output Impedance, Current, Voltage and Power Gains, Frequency response of transistors, pnpn diode, Silicon Controlled Rectifier (SCR).

Field Effect Transistors: Physical Description and Theory of JFET, Static characteristics, Small Signal Analysis, Equivalent circuit, Fundamental Concept of MOSFETs, Enhancement and Depletion Type.

Texts/References

1. Electronic Devices & Circuits, J. Millman and C.C. Halkias, Tata Mc-Graw Hill (1991).
2. Physics of Semiconductor Devices, S. M. Sze and K. K. Ng, Wiley Interscience (2007).
3. Solid State Electronic Devices: B. Streetman, S. Banerjee, PHI (2009)
4. Electronic Fundamentals and Applications, D. Chattopadhyay and P. C. Rakshit, New Age International (2008)

PH307 PHYSICS OF SEMICONDUCTOR DEVICES LAB

2-Credits (0-0-3)

List of Experiments

1. To measure of the band-gap of a semiconductor using four-probe method.
2. To study the Hall effect and determine the Hall Coefficient.
3. To study the **I-V** characteristics of pn junction diode and find the static and dynamic resistance.
4. To study the I-V characteristic of a Zener diode and use it as a voltage regulator.
5. To study the characteristics of (i) Light emitting diode and (ii) Photo-diode.
6. To study the characteristics of a Transistor in (i) CE, (ii) CB, (iii) CC configuration.
7. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
8. To study the characteristics of a FET.

Texts/References

1. B.Sc Practical Physics, Geeta Sanon, R. Chand & Co. (2010).
2. B.Sc Practical Physics, Harnam Singh, S. Chand & Co. (2002).

PH309: INTRODUCTORY ATMOSPHERIC PHYSICS

3-Credits (3-0-0)

General features of Earth's atmosphere: Thermal structure of the Earth's Atmosphere, Composition of atmosphere, Hydrostatic equation, Atmospheric Thermodynamics, Greenhouse effect, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze.

Atmospheric Waves: Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration

Atmospheric Radar and Lidar: Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications.

Atmospheric Aerosols: Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Optical phenomena in atmosphere, Aerosol studies using Lidars.

Texts/References

1. Fundamental of Atmospheric Physics-Murry L Salby; Academic Press, Vol 61, 1996.
2. The Physics of Atmosphere – John T. Houghton; Cambridge University press; 3rd edn. 2002.
3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004.
4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014

PH311: BASICS OF NANOSCIENCE
3-Credits (3-0-0)

Introduction to Nanoscience: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires), band structure and density of states of materials at nanoscale, size effects in nano systems, ***characteristic scale for quantum phenomena,*** quantum confinement, applications of Schrodinger equation, infinite potential well, quantum confinement of carriers in quantum confined nanostructures and its consequences.

Overview of Nano Fabrication Methods: Top-down and bottom-up approaches. Sol-Gel, Co-precipitation and Hydrothermal synthesis. Photolithography. Physical vapor deposition (PVD): Thermal evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). MBE

Characterization Tools: X-Ray Diffraction. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy.. Profilometry. PL, UV Spectroscopy

Optical Properties of nanostructural materials

Applications: Applications of nanostructures for photonic devices (LED's and solar cells). Introduction to CNT based devices. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots -magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS). Functionalized nanoparticles for biological application. Impact of nanotechnology on the environment.

Texts/References

1. Introduction to Nanotechnology by Charles P. Poole, Jr., Frank J. Owens, John Wiley & Sons, 2003.
2. Nanotechnology: Principles & Practices by S.K. Kulkarni, Springer, 3rd Edition, 2015.
3. Nanoscale science and technology, Robert Kelsall, Ian W. Hamley, Mark Geoghegan, John Wiley & Sons., 2005.

4. Nanomaterials: synthesis,properties and applications by A.S Edelstein, R.C Cammaratra, CRC Press, 1998
5. Electron Microscopy and Analysis, Peter J. Goodhew; John Humphreys; Richard Beanland, CRC Press, 3rd Edition, 2000.

PH302: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS
4-Credits (4-0-0)

Basics of Atomic Physics: Quantum states of an electron in an atom, electron spin spectra of H, He, and alkali metals.

Atoms in Electric and Magnetic Fields: Electron Angular Momentum, Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Raman Effect: Quantum Theory of Raman Effect. Characteristics of Raman Lines. Stoke's and Anti-Stoke's Lines. Complimentary Character of Raman and infrared Spectra.

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

Basics of Nuclear Physics: Structure of nuclei: Basic Properties of Nuclei, Radioactivity: Law of Radioactive Decay. Half-life, Radioactive Series, Binding Energy, Mass Formula, α-decay: Range of α-particles, Geiger-Nuttal law and α-particle Spectra. Gamow Theory of Alpha Decay, β-decay: Energy Spectra and Neutrino Hypothesis, γ-decay: Origin of γ-rays, Nuclear Isomerism and Internal Conversion, Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction. Compound Nucleus. Scattering Problem in One Dimension : Reflection and Transmission by a Finite Potential Step, Attractive and Repulsive Potential Barriers. Scattering Cross-section. Reaction Rate. Q-value of Reaction. Fission and Fusion. Nuclear Models: Liquid Drop Model. Mass formula. Shell Model. Meson Theory of Nuclear Forces and Discovery of Pion. Accelerators, Detectors of Nuclear Radiations (Qualitative Discussion Only).

Texts/References

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987)
2. Atomic physics by J.B.Rajam & foreword by Louis De Broglie.(S.Chand & Co., 2007).
3. Atomic Physics by J.H.Fewkes & John Yarwood. Vol. II (Oxford Univ. Press, 1991).
4. Nuclear physics by Irving Kaplan. (Oxford & IBH, 1962).
5. Introductory nuclear physics by Kenneth S. Krane.(John Wiley & Sons, 1988).
6. Concepts of nuclear physics by Bernard L.Cohen.(New Delhi: Tata Mcgraw Hill, (1998).

PH-304: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS LAB
2-Credits (0-0-3)

List of Experiments

1. To study the absorption spectra of He and Na source.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

4. To determine the absorption lines in the rotational spectrum of Iodine vapour.
5. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
6. To determine the wavelength of H-alpha emission line of Hydrogen atom.
7. To determine the ionization potential of mercury.
8. To setup the Millikan oil drop apparatus and determine the charge of an electron.
9. To determine the wavelength of laser source using diffraction of single slit.
10. To determine the wavelength of laser source using diffraction of double slits.
11. To determine angular spread of He-Ne laser using plane diffraction grating
12. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
13. Study of Zeeman effect: with external magnetic field; Hyperfine splitting

Texts/References

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11-th Ed., 2011,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

PH306: MODERN PHYSICS AND QUANTUM MECHANICS

4-Credits (4-0-0)

Dual nature of wave and particle: Origin of Planck's quantum theory, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering, de Broglie wavelength and matter waves; electron diffraction, Davisson-Germer experiment, Wave description of particles by wave packets, Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability amplitude and density, Wave amplitude and wave functions, Heisenberg uncertainty principle, Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Quantum mechanics: Matter waves and wave amplitude; time independent and dependent Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Applications of Schrodinger's equation: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization, Quantum mechanical tunneling in one dimension-across a step potential and rectangular potential barrier.

Basics of Atomic Physics: Quantum states of an electron in an atom, atomic spectra of H, He, and alkali metals, Bohr atom, Quatum theory of H atom, Quantum numbers, Spectral Notations for Atomic States, electron spin, Pauli's Exclusion Principle, Stern-Gerlach experiment (Brief discussion), Symmetric and antisymmetric wavefunctions, Hund's rule, Spin orbit coupling, Total Angular Momentum, L-S and J-J couplings.

Basics of Nuclear Physics: Size and structure of atomic nucleus and its relation with atomic weight; Binding energy, Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, Nature of nuclear force, Liquid Drop model: semi-empirical mass formula and binding energy.

energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion reactions (brief qualitative discussions).

Texts/References

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
5. A. Ghatak and S. Lokanathan, "Quantum Mechanics: Theory and Applications", Kluwer Academic Publishers (2004)
6. H. C. Verma, "Quantum Physics", Surya Publications (2006)

PH-308: MODERN PHYSICS AND QUANTUM MECHANICS LAB

2-Credits (0-0-3)

List of Experiments

1. Measurement of Planck's constant using black body radiation and photo-detector

2. Measurement of Planck's constant using Photoelectric effect.

3. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light

4. To determine work function of material of filament of directly heated vacuum diode.

5. To determine the Planck's constant using LEDs of at least 4 different colours.

6. To determine the wavelength of H-alpha emission line of Hydrogen atom.

7. To determine the ionization potential of mercury.

8. To determine the absorption lines in the rotational spectrum of Iodine vapour.

9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

11. To show the tunneling effect in tunnel diode using I-V characteristics.

12. To determine angular spread of He-Ne laser using plane diffraction grating.

Texts/References

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

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Physics: Skill Enhancement Courses (SEC)

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PH205: RENEWABLE ENERGY AND ENERGY HARVESTING

2-Credits (2-0-0)

Conventional Energy Sources: Review of conventional energy sources and their limitations.

Solar Energy: Solar energy and its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar energy, photovoltaic (PV) systems, PV models and equivalent circuits, sun tracking systems.

Wind Energy Harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Piezoelectric Energy harvesting: Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, piezoelectric parameters and modeling piezoelectric generators, applications.

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications.

Environmental issues and sustainability.

Texts/References

1. Non-conventional energy sources, B.H. Khan, Tata McGraw-Hill Education, 2006.
2. Solar Energy: Principles of Thermal Collection and Storage, K. Sukhatme, Suhas P. Sukhatme, Tata McGraw-Hill Education, 1996.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., Oxford University Press, 2012.
4. Solar Energy Resource Assessment Handbook, Jayakumar, Renewable Energy Corporation Network for the Asia Pacific, 2009.
5. J. Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

PH-206: COMPUTATIONAL PHYSICS

2-Credits (2-0-0)

Basic programming techniques, Introduction to MATLAB, variables and arrays; scalar and array operations; built-in MATLAB functions; file input/output. Data visualisation and plotting in MATLAB; Revision of error analysis; propagation of errors; MATLAB functions for error analysis; User-defined functions in MATLAB, Numerical methods for solving ordinary differential equations; Classical electrons in crossed electric and magnetic fields, Integral equations: Calculation of scattering cross section (a) quantum scattering with a spherically symmetric potential, Partial differential equations: Laplaces equation, wave equations , diffusion equation and Maxwells equations . Numerical solution of some specific computational problems in Physics.

Texts/References

1. J Hasbun, P. Devries, A first course in computational physics

2. Rudra Pratap, Getting started with Matlab 7: A quick introduction for Scientists and Engineers, Oxford University Press (2002).

PH313 : PHOTOLITHOGRAPHY AND DEVICE FABRICATION

2-Credits (2-0-0)

Fundamentals of Photolithography, Photo resists (PR), Positive and negative photo resists, Photo Resist Parameters, Developers, Key steps for doped Silicon photolithography, growth of oxide layer, surface preparation, coating of the Photo resist, Photo mask fabrication, Chromium etching, Optical exposure.

Transparent conducting oxides films in device applications, Optical and electronic properties (absorption, resistivity, work function) of indium tin oxide (ITO) thin film. Introduction to Solar Cells and Light emitting diodes (LED) structure.

Patterning of ITO, Surface treatment, evaporation or coating process, encapsulation, major challenges in device fabrication, optical out-coupling and approaches, Commercialization issues for solar cell and display devices: Efficiency, life time, size, weight & cost, Resolution, brightness, CIE, colour Gamut, aspect ratio, contrast ratio, power consumption.

Texts/References/Resources

1. S.M.Sze, VLSI Technology, Tata McGraw Hill Edition (2003).

2. Franky So,'Organic Electronics', CRC Press (2010).

3. Web: http://www.nptel.ac.in

PH-310: SIMULATION EXPERIMENTS IN PHYSICS

2-Credits (0-0-4)

1. Comparative study of gravitational, electromagnetic, and nuclear forces.

2. Planetary motion and satellite orbits.

3. Length contraction, time dilation, and mass energy equivalence.

4. Electric and magnetic field analysis for different charge and current distributions.

5. Electromagnetic wave propagation

6. Heat transfer

7. Blackbody radiation, ultraviolet catastrophe, and Planck's radiation law.

8. Calculating energy levels for hydrogen like atoms and analysis of their spectra.

9. Energy levels, wavefunctions and, probability densities for a particle in one dimensional infinitely rigid box.

10. Energy levels, wavefunctions and, probability densities for a harmonic oscillator.

11. Quantum mechanical scattering and tunneling.

12. I-V Characteristics of semiconductor devices.

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CHEMISTRY

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Core papers Chemistry (Credit: 06 each) :

Semester-I, CC-II

(i) CH 101- Atomic Structure, Bonding, General Organic Chemistry &Aliphatic Hydrocarbons
(ii) CH 103- Laboratory-I

Semester-II, CC-V

(i) CH 102- Chemical Energetic, Equilibrium & Functional Group Organic Chemistry-I
(ii) CH 104 Laboratory-II

Semester-III, CC-VIII

(i) CH 201- Conductance, Electrochemistry & Functional Group Organic Chemistry-II
(ii) CH 203 - Laboratory-III

Semester-IV, CC-XI

(i) CH 202-Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics
(ii) CH 204- Laboratory-IV

Discipline Specific Elective papers (Credit: 06 each):

Semester-V, DSE-2 (Choose one)

(i) CH 301-Industrial Chemicals & Environment
(ii) CH 303- Laboratory(DSE)-V
(iii) CH 305 Quantum Chemistry, Spectroscopy & Photochemistry
(iv) CH 307- Laboratory(DSE)-V

Semester-VI, DSE-5 (Choose one)

(i) CH 302-Molecules of Life
(ii) CH 304- Laboratory(DSE)-VI
(iii) CH 306- Chemistry of Main Group Elements, Theories of Acids and Bases
(iv) CH 308- Laboratory(DSE)-VI

Skill Enhancement Course (Credit: 02 each)

Semester-III, SEC-I

CH 205-Intellectual Property Rights.

Semester-IV, SEC-II

CH 206-Green Methods in Chemistry.

Semester-V, SEC-III

CH 309-Pharmaceutical Chemistry.

Semester-VI, SEC-IV

CH 310-Chemistry of Cosmetics & Perfumes.

SEMESTER-1

CHEMISTRY- CC-II:

CH 101-ATOMIC STRUCTURE, BONDING, GENERALORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Section A: Inorganic Chemistry-1 (30 Lectures)

Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normal and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams.Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number. **(7 Lectures)**

Periodicity of Elements:s, p, d, f block elements, the long form of periodic table. Detailed discussion of thefollowing properties of the elements, with reference to s & p- block,

Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

Electron gain enthalpy, trends of electron gain enthalpy.

Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio. **(7 Lectures)**

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations inionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding:VB Approach: Shapes of some inorganic molecules and ions onthe basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of

homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. **(16 Lectures)**

Section B: Organic Chemistry-1 (30 Lectures)

Fundamentals of Organic Chemistry: Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions. **(8 Lectures)**

Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds : Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

Carbon-Carbon pi bonds : Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes. **(12 Lectures)**

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models inInorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry:Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.

8. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
9. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010

CHEMISTRY LAB CC-I:

CH 103 – LABORATORY-I: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(60 Lectures)

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator & external indicator.
5. To determine calcium and magnesium hardness of given water sample separately.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, .

SEMESTER-II

CHEMISTRY- CC-V:

CH 102- CHEMICAL ENERGETICS, EQUILIBRIA , FUNCTIONAL ORGANIC CHEMISTRY

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Section A: Physical Chemistry-1 (30 Lectures)

Chemical Energetics: Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and Go, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases. **(8 Lectures)**

Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. **(12 Lectures)**

Section B: Organic Chemistry-2 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons: Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **(8 Lectures)**

Alkyl and Aryl Halides:

Alkyl Halides Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs elimination

Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li – Use in synthesis of organic compounds. **(8 Lectures)**

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Grignard Reagent: Preparation, Properties and Reaction mechanism.

Alcohols: preparation, properties and relative reactivity of 1^0 , 2^0 , 3^0 alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol- Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer – Tiemann and Kolbe's – Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. **(14 Lectures)**

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry,John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
4. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010
5. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
6. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
7. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009)

CHEMISTRY LAB CC-V:

CH 104- LABORATORY-I: CHEMICAL ENERGETICS, EQUILIBRIA& FUNCTIONAL ORGANIC CHEMISTRY (60 Lectures)

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of H.

Ionic equilibria

1. pH measurements
   a. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
   b. Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation ofquantitative yields to be done.
   a. Bromination of Phenol/Aniline
   b. Benzoylation of amines/phenols
   c. Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,
2. Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
3. Mann, F.G. & Saunders, B.C. Practical Organic ChemistryOrient-Longman, 1960.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

SEMESTER-III

CHEMISTRY- CC-VIII:

CH 201- SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Section A: Physical Chemistry-2 (30 Lectures)

Solutions: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **(8 Lectures)**

Phase Equilibrium: Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of

Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver,$FeCl_3$-H_2O and Na-K only).

(8 Lectures)

Conductance: Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **(6 Lectures)**

Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data.Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometrictitrations -qualitative treatment (acid-base and oxidation-reductiononly). **(8 Lectures)**

Section B: Organic Chemistry-3 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives: Carboxylic acids (aliphatic and aromatic), Preparation: Acidic and Alkaline hydrolysis of esters.Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. **(6 Lectures)Amines and Diazonium Salts:** Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation**:** from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts:

Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.**(6 Lectures)**

Amino Acids, Peptides and Proteins: Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids**:** ester of –COOH group, acetylation of –NH2 group, complexation with Cu2+ ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) byN-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. **(10 Lectures)**

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Reference Books:

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7thEd.,
7. Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002

CHEMISTRY CC-VIII- LABORATORY

CH 203- LABORATORY-II: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II (60 Lectures)

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:

i. $I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$

ii. $Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)x]^{2+}$

Phase equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations:
   - **i.** Strong acid vs. strong base
   - **ii.** Weak acid vs. strong base

Potentiometry

1. Perform the following potentiometric titrations:
   - **i.** Strong acid vs. strong base
   - **ii.** Weak acid vs. strong base
   - **iii.** Potassium dichromate vs. Mohr's salt
2. Determination of cell constant.
3. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
4. Perform the following conductometric titrations:
   - **i.** Strong acid vs. strong base
   - **ii.** Weak acid vs. strong base
   - **iii.** Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

2.

- **i.** Separation of amino acids by paper chromatography
- **ii.** Determination of the concentration of glycine solution by formulation method.
- **iii.** Titration curve of glycine

iv. Action of salivary amylase on starch
v. Effect of temperature on the action of salivary amylase on starch.
vi. Differentiation between a reducing and a non-reducing sugar.

Reference Books:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,
2. Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

SEMESTER-IV

CHEMISTRY- CC-XI:

CH 202-TRANSITION METAL &COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Transition Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).**(12 Lectures)**

Coordination Chemistry: Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.**(8 Lectures)**

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh*and *Td* complexes, Tetragonal distortion of octahedral geometry.Jahn-Teller distortion, Square planar coordination.**(10 Lectures)**

Section B: Physical Chemistry-3 (30 Lectures)

Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).**(8 Lectures)**

Liquids: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).**(6 Lectures)**

Solids: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Raydiffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **(8 Lectures)**

Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).**(8 Lectures)**

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009)
4. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
6. Wulfsberg, G. *Inorganic Chemistry,* Viva Books Pvt. Ltd.
7. Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd., 2008.

CHEMISTRY CC XI -LABORATORY

CH 204- LABORATORY-III: TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS (60 Lectures)

Section A: Inorganic Chemistry

Semi-micro qualitative analysis (using H2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb_2^+, Bi_3^+, Cu_2^+, Cd_2^+, Fe_3^+, Al_3^+, Co_2^+, Ni_2^+, Mn_2^+, Zn_2^+, Ba_2^+, Sr_2^+,Ca_2^+, K^+

Anions: CO_3^{2-} , S^{2-}, SO^2–, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_43^-, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

1.Estimate the amount of nickel present in a given solution as bis (dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.

2.Estimation of (i) Mg2+ or (ii) Zn2+ by complexometric titrations using EDTA.

3.Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Physical Chemistry

1. Surface tension measurement (use of organic solvents excluded).

i. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

ii. Study of the variation of surface tension of a detergent solution with concentration.

2. Viscosity measurement (use of organic solvents excluded).

i. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

ii. Study of the variation of viscosity of an aqueous solution with concentration of solute.

3. Chemical Kinetics: Study the kinetics of the following reactions.

i. Initial rate method: Iodide-persulphate reaction

ii. Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

c. Compare the strengths of HCl and $H2SO_4$ by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEMESTER-V

Discipline Specific Electives (DSE-2)

CHEMISTRY-DSE - 2

CH-301: INDUSTRIAL CHEMICALS AND ENVIRONMENT

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Industrial Gases and Inorganic Chemicals: Industrial Gases: Large scale production, uses, storage and hazards in handling of thefollowing gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling thefollowing chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate. **(10 Lectures)**

Industrial Metallurgy: Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. **(4 Lectures)**

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions

Atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO_2, CO_2 , CO, NO_x, H_2S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sourcesand nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile,

tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.
Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water. **(30 Lectures)**

Energy &Environment: Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its managemen. **(10 Lectures)**
Biocatalysis: Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.
(6 Lectures)
Reference Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, NewDelhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd.New Delhi.
5. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

CHEMISTRY DSE-2 LABORATORY:
CH 303- LABORATORY-V: INDUSTRIAL CHEMICALS & ENVIRONMENT
(60 Lectures)

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's*Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.

5. K. De, *Environmental Chemistry*: New Age International Pvt. Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi

CHEMISTRY DSE-2:
CH-305- QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus.

Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for
approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of $H2^{+}$. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules. **(24 Lectures)**

Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual

exclusion.

Electronic spectroscopy: Franck -Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

(24 Lectures)

Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. **(12 Lectures)**

Reference Books:

1. Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).

CHEMISTRY DSE-2 LABORATORY:

CH-307- LABORATORY-V: QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY (60 Lectures)

UV/Visible spectroscopy

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ max values. Calculate the energies of the two transitions in different units(J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

1. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
2. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
3. Study the kinetics of iodination of propanone in acidic medium.
4. Determine the amount of iron present in a sample using 1,10-phenathroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).
6. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
7. Analyse the given vibration-rotation spectrum of HCl(g)

Reference Books

1. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

2. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical PhysicalChemistry,* R. Chand & Co.: New Delhi (2011).
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in PhysicalChemistry 8th Ed.;* McGraw-Hill: New York (2003).
4. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

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SEMESTER-VI

Discipline Specific Electives (DSE-4)

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CHEMISTRY DSE-5:

CH-302- MOLECULES OF LIFE

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof).

Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. **(10 Lectures)**

Amino Acids, Peptides and Proteins

Classification of Amino Acids, Zwitterion structure and Isoelectric point.

Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis. **(12 Lectures)**

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring. **(12 Lectures)**

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson -Crickmodel) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **(10 Lectures)**

Lipids

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation,

Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(8 Lectures)**

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate-Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates. **(8 Lectures)**

Recommended Texts:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
5. Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

CHEMISTRY DSE-5 LABORATORY:

CH-304- LABORATORY-VI: MOLECULES OF LIFE (60 Lectures)

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

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CHEMISTRY–DSE-5

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CH-306- CHEMISTRY OF MAIN GROUP ELEMENTS, THEORIES OF ACIDS AND BASES
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

Acids and Bases: Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process. **(10 Lectures)**

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents.

Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process. **(8 Lectures)**

***s*- and *p*-Block Elements:**Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale).

General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature.

Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S.

Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals.

Solutions of alkali metals in liquid ammonia and their properties.

Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals. **(14 Lectures)**

Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable:

Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH_3), 14, 15, 16 and 17.

Oxides of N and P, Oxoacids of P, S and Cl.

Halides and oxohalides of P and S (PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2)

Interhalogen compounds. A brief idea of pseudohalides **(14 Lectures)**

Noble gases: Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF2, XeF4 and XeF_6 ,bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory. **(5 Lectures)**

Inorganic Polymers: Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in $(NPCl_2)_3$. **(9 Lectures)**

Recommended texts:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models inInorganic Chemistry, John Wiley & Sons.
4. Greenwood, N.N. &Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010.
7. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

CHEMISTRY DSE-5 LABORATORY:

CH-308 - LABORATORY-VI: CHEMISTRY OF MAIN GROUP ELEMENTS, THEORIES OF ACIDS AND BASES (60 Lectures)

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodimetric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches
4. Estimation of iodine in iodized salts.
5. Iodimetric estimation of ascorbic acid in fruit juices.
6. Estimation of dissolved oxygen in water samples.
7. Gravimetric estimation of sulphate as barium sulphate.
8. Gravimetric estimation of aluminium as oximato complex
9. Preparation of the following: potash alum, chrome alum, tetraamminecopper (II) sulphate monohydrate, potassium trioxalatoferrate (III)
   (any two, including one double salt and one complex).

Recommended Texts:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

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Skill Enhancement Course (any four) (Credit: 02 each)

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SEMESTER-III

SEC-1

CH-205- INTELLECTUAL PROPERTY RIGHTS (IPR)

(Credits: 02) Theory: 30 Lectures

In this era of liberalization and globalization, the perception about science and its practices has undergone dramatic change. The importance of protecting the scientific discoveries, with commercial potential or the intellectual property rights is being discussed at all levels – statutory, administrative, and judicial. With India ratifying the WTO agreement, it has become obligatory on its part to follow a minimum acceptable standard for protection and enforcement of intellectual property rights. The purpose of this course is to apprise the students about the multifaceted dimensions of this issue.

Introduction to Intellectual Property:

Historical Perspective, Different Types of IP, Importance of protecting IP.

Copyrights

Introduction, How to obtain, Differences from Patents.

Trade Marks

Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc.

Differences from Designs.

Patents

Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

Geographical Indications

Definition, rules for registration, prevention of illegal exploitation, importance to India.

Industrial Designs

Definition, How to obtain, features, International design registration.

Layout design of integrated circuits

Circuit Boards, Integrated Chips, Importance for electronic industry.

Trade Secrets

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

Different International agreements

(a) Word Trade Organization (WTO):

- **(i)** General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement
- **(ii)** General Agreement on Trade related Services (GATS)
- **(iii)** Madrid Protocol
- **(iv)** Berne Convention
- **(v)** Budapest Treaty

(b) Paris Convention

WIPO and **TRIPS, IPR** and Plant Breeders Rights, IPR and Biodiversity

IP Infringement issue and enforcement – Role of Judiciary, Role of lawenforcement agencies – Police, Customs etc. Economic Value of Intellectual Property

– Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Reference Books:

1. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge inDeveloping Countries, Sage Publications (2003).
3. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).

4. Arthur Raphael Miller, MichealH.Davis; Intellectual Property: Patents,Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. JayashreeWatal, Intellectual property rights in the WTO and developingcountries, Oxford University Press, Oxford.

SEMESTER-IV

SEC-2

CH-206- GREEN METHODS IN CHEMISTRY(Credits: 02) Theory: 30 Lectures

Theory and Hand-on Experiments: Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

The following Real world Cases in Green Chemistry should be discussed:

1. Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
2. Designing of environmentally safe marine antifoulant.
3. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
4. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Practicals

1. Preparation and characterization of biodiesel from vegetable oil.
2. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice.
3. Mechano chemical solvent free synthesis of azomethine.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

Reference Books:

1. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
2. Cann, M.C. &Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
3. Ryan, M.A. &Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
4. Sharma, R.K.; Sidhwani, I.T. &Chaudhari, M.K. Green ChemistryExperiments: A monograph I.K. International Publishing House PvtLtd.New Delhi, Bangalore.
5. Lancaster, M. Green Chemistry: An introductory text RSC publishing, 2nd Edition.
6. Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated
7. "A Social Awareness Project", Delhi University Journal of Undergraduate Research and Innovation, **1(1)**: 2015.

SEMESTER-V

SEC-3

CH- 309- PHARMACEUTICAL CHEMISTRY (Credits: 02) Theory: 30 Lectures

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents,
anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B_2, Vitamin B_{12} and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Reference Books:

1. G.L. Patrick: Introduction to *Medicinal Chemistry*, *Oxford University* Press, UK.
2. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*,VallabhPrakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: *Principles ofMedicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

SEMESTER-VI

SEC-4

CHEMISTRY OF COSMETICS & PERFUMES (Credits: 02) (30 Lectures)

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.

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Mathematics

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Course Name: Calculus-I
Course Code: MA-111 **Credits: 03**

Limit and Continuity (ε-δ definition), Indeterminate forms, Types of Discontinuities, Differentiability of Functions, Successive Differentiation, Leibnitz's Theorem, Partial Differentiation, Euler's Theorem on Homogeneous Functions, Tangents, Normals, Maxima & Minima, Curvature, Asymptotes, Singular Points, Tracing of Curves. Parametric Representation of Curves, Tracing of Parametric Curves, Polar coordinates, Tracing of Curves in Polar Coordinates. Rolle's Theorem, Mean Value theorems.

Sequences, Infinite Series, The Integral Test, The Comparison Tests, Ratio & Root Tests, Alternating Series, Absolute & Conditional Convergence, Power Series, Representations of Functions as Power Series. Taylor & Maclaurin series of $\sin x, \cos x, e^x, \ln(1+x), (1+x)^n$, Taylor's Theorem with Lagrange's and Cauchy's forms of remainder, Definite Integral, Introduction to improper integral.

Books Recommended:

1. G.B. Thomas, J Hass and Maurice D. Weir, *Thomas' Calculus,* Pearson Education, 2009.
2. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
3. S. R. Ghorpade and B. Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006.
4. J. Stewart, *Calculus: Early Transcendentals*, Cengage Learning, 2012

Course Name: Matrices
Course Code: MA-113 **Credits: 03**

Vector space over R and C, Concept of linear dependence and independence, basis, Subspaces, Translation, Dilation, Rotation, Reflection in a point, line and plane, Matrix form of basic geometric transformations, Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.Types of matrices, Rank of a matrix, Invariance of rank under elementary transformations, Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four, Matrices in diagonal form, Reduction to diagonal form upto matrices of order 3, Computation of matrix inverses using elementary row operations, Solutions of a system of linear equations using matrices and its applications.

Books Recommended

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, *Theory and Problems of Matrix Operations*, Tata McGraw Hill, 1989.

Course Name: Algebra

Course Code: MA-112 **Credits: 03**

Groups, Subgroups and their examples, the group Zn of integers under addition modulo n, The group U(n) of units under multiplication modulo n, cyclic groups, complex roots of unity, circle group, the general linear group GLn (n,R), Dihedral group. The commutator subgroup, Examples of subgroups including the center of a group, Cosets, Index of subgroup, Lagrange's theorem, order of an element. Normal subgroups: their definition, examples, and characterizations, Quotient groups, Class equat

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Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. I. Herrnstein, *Topics in Algebra*, 2nd ed., John Wiley, 1999

Course Name: Calculus-II
Course Code: MA-114 **Credits: 03**

Functions of two Variables: Limit, Continuity, Differentiability. Partial differentiation, Definite Integral, Evaluating Definite Integral, The Fundamental Theorems of Calculus. Indefinite Integrals & Substitution Rule, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals, Maxima and Minima, Lagrange's Multiplier Method, Areas between Curves, Improper Integrals, Jacobian, Double Integrals, Double Integrals in Polar Form, Triple Integrals in Rectangular Coordinates, Triple Integrals in Cylindrical & Spherical Coordinates, Substitutions in Multiple Integrals.

Books Recommended:

1. G.B. Thomas, J Hass and Maurice D. Weir, *Thomas' Calculus*, Pearson Education, 2009.
2. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
3. S. R. Ghorpade and B. Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006.
4. J. Stewart, *Calculus: Early Transcendentals*, Cengage Learning, 2012

Course Name: Real Analysis
Course Code: MA-213 **Credits: 03**

Set Theory: Relations, Equivalence Relation, Partial Order, Total Order, Zorn's Lemma, Finite & Infinite Sets, Examples of Countable and Uncountable Sets. Real Line, Bounded Sets, Cantor's Theorem, Continuum Hypothesis, Suprema & Infinima, Completeness Property of $\mathbb{R}$, Archimedean Property, Intervals, Bolzano-Weierstrass Theorem.

Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean Value theorems of integral calculus. Improper integrals and their convergence.

Point-wise Convergence, Uniform Convergence. Uniformly Bounded Sequence, Cauchy's Criterion for Uniform Convergence, Uniformly Cauchy Sequence, Weiertrass' M-test, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Power series and radius of convergence.

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. W. Rudin, *Principles of Mathematical Analysis*, McGraw Hill, 1976
3. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
4. K.A. Ross, *Elementary Analysis-The Theory of Calculus Series*-Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Course Name: Introduction to Ordinary Differential Equation
Course Code: MA-215 **Credits: 03**

Introduction to differential equation, Formulation of differential equation, Order and degree of differential equation, linear, nonlinear differential equation, First order exact differential equations. Integrating factors, First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations.

Books Recommended:

1. G. F Simmons, *Differential equations with Historical Notes*. Tata McGraw-Hill.
2. Shepley L. Ross, *Differential equation*, 3rd Ed., John Wiley & Sons.
3. William E. Boyce, Richard C. DiPrima, *Elementry Differential Equations and Boundary value*, Wiley, 2000.

Course Name: Introduction to Partial Differential Equation
Course Code: MA-212 **Credits: 03**

Introduction to partial differential equation, origins of first order partial differential equation, Order and degree of partial differential equation, Concept of linear and non-linear partial differential equations, Pfaffian differential forms and equations, Integral surfaces passing through a given curve, Linear partial differential equation of first order, Lagrange's method, Charpit's method, Non linear partial differential equations of the first order, Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended:

1. I. N Sneddon, *Elements of Partial Differential equations*, Tata McGraw-Hill. problems, John Wiley & Sons.
2. T. Amaranath, *An Elementary Course in Partial Differential Equations*, Narosa.

Course Name: Mathematical Methods
Course Code: MA-214 **Credits: 03**

Integral Transforms: Laplace Transformation, Laplace Transforms of derivatives and integrals, shifting theorems, differentiation and integration of transforms, convolution theorem. Application of Laplace transform in solution of ordinary differential equations, Fourier series expansion. Calculus of Variations: Functionals, Deduction of Euler's equations for functionals of first order and higher order for fixed boundaries. Shortest distance between two non-intersecting curves. Isoperimetric problems. Jacobi and Legendre conditions.

Recommended Books:

1. I.M. Gelfad and S.V. Fomin, *Calculus of Variation*, Prentice-Hall, Inc.
2. A.S. Gupta, *Text Book on Calculus of Variation*, Prentice-Hall of India.
3. Francis B. Hildebrand, *Methods of Applied Mathematics*, Dover, New York, 20124.
4.W. E. Boyce, R. C. DiPrima, *Elementry Differential Equations and Boundary value* , Wiley, 2000.

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Discipline Specific Electives (DSE-3)

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Course Name: Programming in C
Course Code: MA-301 **Credits: 03**

Introduction to C fundamentals, Constants, Variables, statements, iterative statements and Data types, Operators and expression, formatted input and output, Decision makings, Branching and Looping, Arrays, User defined functions, Passing arguments to procedure, procedures, Structures, Pointers, File handling, concept of recursion.

Recommended Books:

1. B.W. Kernighan and D.M. Ritchie, *The C Programming Language* 2nd Edition, (ANSI features) Prentice Hall, 1989.
2. V. Rajaraman, *Programming in C*, Prentice Hall of India, 1994.
3. Byron S. Gotfried, *Theory and Problems of Programming with C*, Tata McGraw-Hill, 1998.

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Course Name: Linear Algebra
Course Code: MA-303 **Credits: 03**

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.
Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.
Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended

1. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
2. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
3. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.

Course Name: Tensor &Geometry

Course Code: MA-305 **Credits: 03**

Contravariant and Covariant vectors, Transformation formulae, Symmetric and Skew symmetric properties, Contraction of tensors, Quetient law, Polar equation of a conic, Sphere, Cone, Cylinder, Illustrations of graphing standard quadric surfaces like cone, ellipsoid, Paraboloids, Central Conicoids.

Recommended Books:

1. Barry Spain, *Tensor Calculus*, Radha Publ. House Calcutta,1988.
2. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994
3. R.J.T. Bell, *Elementary Treatise on Co-ordinate geometry of three dimensions*, Macmillan India Ltd., 1994.
4. Shanti Narayan, *Analytical Solid Geometry*, S. Chand & Company, New Delhi.

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Discipline Specific Electives (DSE-6)

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Course Name: Numerical Methods

Course Code: MA-302 **Credits: 03**

Errors in computation, floating representation of number, binary number, significant digits, errors due to rounding/chopping Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and Central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.

Recommended Books

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.
3. R. S. Gupta, *Elements of Numerical Analysis*, Macmilan, 2009.

Course Name: Linear Programming
Course Code: MA-304 **Credits: 03**

Linear Programming Problems, Graphical Approach for Solving some Linear Programs, Convex Sets, Supporting and Separating Hyperplanes, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison, Duality, formulation of the dual problem, primal-dual relationships, economic Interpretation of the dual, sensitivity analysis.

Recommended Books

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.

2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGraw Hill, Singapore, 2004.

3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

Course Name: Theory of Complex Variable
Course Code: MA-306 **Credits: 03**

Limits, Limits involving the point at infinity, continuity, Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings, Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions, Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series.

Books Recommended

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.122

2. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

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Skill Enhancement Course (SEC)

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Course Name: Theory of Equations
Course Code: MA-215 **Credits: 02**

General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.
Symmetric functions, Applications symmetric function of the roots, Transformation of equations, Solutions of reciprocal and binomial equations, Algebraic solutions of the cubic and biquadratic, Properties of the derived functions.

Books Recommended

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

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Course Name: Logic and Sets
Course Code: MA-214 **Credits: 02**

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Book Recommended

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

Course Name: Mathematical Modeling
Course Code: MA-317 **Credits: 02**

Fundamental of Modelling, working with models, Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, Transport equation, Applications to Traffic Flow, Vibrating string, vibrating membrane, conduction of heat in solids, diffusion equation, gravitational potential, conservation laws, Mathematical modeling in Biological process.

Books Recommended:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

3. Y. Pinchover and J. Rubinstein, *An introduction to Partial Differential Equations*, Cambridge University Press.

Course Name: Experimental Statistics using R
Course Code: MA-318 **Credits: 02**

Experimental Design: Principles, experimental designs, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal.

Test of hypothesis: Chi-square test, t,F and Z tests and Turkey's Q test

Experimental Data Analysis: RBD, SPD, ANOVA, linear regression analysis using SPSS, Cluster nalysis.

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Books Recommended:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Model*, 9th Ed., Academic Press, Indian Reprint, 2007.
4. G.W.Snedecor and W.C.Cochran, *Statistical Method*, Oxford & IBH Pub.Pvt.Ltd. New-Delhi.

National Service Scheme - (NSS) Studies
Semester I & II
Credit Based Grading and Semester System
To be implemented from the Academic year 2015-2016

SEMESTER I
Title of the Course: NSS Paper I

Course code	Unit	Topic Headings	Lectures	Credits
NSS-101	I	Introduction to NSS	05	02
	II	Concept of Society & Social issues in India	O5	
	III	Indian Constitution & Social Justice	10	
	IV	Human Personality & National Integration	10	

SEMESTER II

Title of the Course: NSS Paper II

Course code	Unit	Topic Headings	Lectures	Credits
NSS-102	I	Socio Economic Survey & Special Camp	05	02
	II	Value System & Gender Sensitivity	O5	
	III	Environment & Energy Conservation	10	
	IV	Voluntary Organisation (VOs) and Government Organisation (GOs)	10	

To be implemented from the academic year 2015- 16
All UG Programs

SEMESTER – I

Subject Name: NSS Paper-I Course Code: NSS-101

Unit I: Introduction to NSS
Orientation and structure of NSS

The history of NSS- Objectives- Symbol and meaning- NSS hierarchy from national to college level

Regular activities
Distribution of working hours- association between issues and programs- community project- urban rural activities, association- modes of activity evaluation

Unit II: Concept of society- development of Indian society
Features- Division of labors and cast system in India
Features of Indian constitution: Provisions related to social integrity and development

Unit III
Social Justice
The concept- features Inclusive growth- the concept- feature
Basic social issues in India
Degeneration of value system, family system, Gender issues Regional imbalance
Unit-IV
Dimensions of human personality; National integration and communal harmony

SEMESTER – II

Subject Name: NSS Paper-II **Course Code: NSS-102**

UNIT1: socio economic survey meaning, need, design of questionnaire: data collection analysis and Report, Special campaigning activity
Concept of camp: Identification of community problems- importance of group living- team building- adaption of village- planning for camp- pre, during and post campaigning activities

UNIT II: Social Integration Meaning of value and types- human values and social responsibilities- Indian value system: Understanding of society, Physical: Physical exercise, Yoga, etc, Cultural: Basics of performing arts as tool for social awareness, street play, creative dance, patriotic song, folk song and folk dance- **National integration**
Gender sensitivity and woman empowerment, Concept of gender- causes behind gender related problems- majors, Meaning of empowerment- schemes for woman empowerment in India

UNIT III: Environment enrichment program; Sustainability in environment;- Features , issues, conservation of natural resources.
Energy conservation program; Concept of conservation- conventional and non-conventional energy

UNIT IV: Set up of VO/GO
Meaning of VO-Legal set up of formation-functioning of VO- Sources of functioning- VO and NSS Integration- Case study of any VO/GO/Welfare department; Government schemes for community development; Scheme from each department- detail provisions- examples, Communication skills and documentation.
Verbal and non verbal communication- activity report writing- basics of NSS accounting- annual report- press note preparation

Compulsory Course of Environmental Science for all Undergraduates as per the mandate of UGC from academic session 2015-2016

Course Name: Environmental Studies
Course code: ES 101
Credits :3
Syllabus

Unit I: Multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

Unit II: Natural Resources

Renewable and non-renewable resources:

i) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

ii) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

iii) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

iv) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

v) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

vi) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

vii) Natural resources and associated problems; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

Unit III: Ecosystems

i) Concept of an ecosystem.

ii) Structure and function of an ecosystem.

iii) Producers, consumers and decomposers.

iv) Energy flow in the ecosystem.

v) Ecological succession.

vi) Food chains, food webs and ecological pyramids.

vii) Introduction, types, characteristic features, structure and function of the ecosystem- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit IV: Biodiversity and its conservation

i) Introduction – Definition : genetic, species and ecosystem diversity.

ii) Biogeographical classification of India.

Course Offered at Undergraduate Programmes of Various Schools
Semester-I (July-December)
Course Contents

Paper Code: EN-101 **Paper Name: English Proficiency**

UNIT-1 : Functional Grammar

Form and Functions, Sentences: Simple, Complex, and Compound, Sub-Verb Agreement and Concord, Vocabulary Building: Affixations, Conversions, Idioms and Phrases, Words in Context

UNIT-2: Language Skills: LSRW

Listening Skills: Activity based, Speaking Skills: Activity based, Introduction to IPA, Use of Dictionary, Word stress, Reading Skills: Skimming and Scanning, Reading Comprehension, Writing Skills: Paragraph, Précis and Compositions, Note Making and Note Taking, Logical Ordering of Ideas and Contents, Figures of Speech

UNIT-3: Learning through thematic Texts

- ***My Visions for India*** Dr. Abdul Kalam
- From ***In an Antique Land*** Amitav Ghosh
- ***The Art of Living*** Samuel Smiles
- ***I Have Dream*** Martin Luther King Jr.
- ***The Overcoat*** Nikolai Gogol
- ***The Bet*** Anton Chekov
- ***Mending Wall*** Robert Frost
- ***If*** Rudyard Kipling

Suggested Books:

1. ***Word for Word***, Pointon & Clark, Oxford University Press
2. Carter, Ronald; McCarthy, Michael (2006). ***Cambridge Grammar of English: A Comprehensive Guide***. Cambridge University Press.
3. ***An English Pronouncing Dictionary***, London: Dent, rpt in facsimile in Jones (2002). 17th edn, P. Roach, J. Hartman and J. Setter (eds), Cambridge: CUP, 2006.
4. Redman, Stuart. 2011 English Vocabulary I Use: Pre-intermediate and intermediate. Cambridge: CUP ***Cambridge Phrasal Verbs Dictionary*** Second edition, Cambridge University Press