# CAREER POINT UNIVERSITY
## KOTA (RAJASTHAN)

## School of Basic and Applied Science

# Syllabus and Course Scheme
## (Annual Scheme)

# Bachelor of Science
## (Mathematics)
## Session – 2021-22
### Duration of the Course- Three Years

**University Campus:** Alaniya, Kota 325 003, Rajasthan Ph: +91-80941-62999

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# Course Scheme of B.Sc. Part-III

| Annual Course Scheme of B.Sc. Part-III | | | | |
|---|---|---|---|---|
| Branch-Mathematics | | | | |
| S.No. | Paper Code | Paper Name | Marks | |
| | | | Min. Marks | Max. Marks |
| 1 | CHL031-I | Inorganic Chemistry | 18 | 50 |
| 2 | CHL031-II | Organic Chemistry | 18 | 50 |
| 3 | CHL031-III | Physical Chemistry | 18 | 50 |
| 4 | CHP031 | Chemistry Practical | 27 | 75 |
| 5 | MAL031-I | Linear Algebra and Complex Analysis | 27 | 75 |
| 6 | MAL031-II | Mathematical Statistics and Linear Programming | 27 | 75 |
| 7 | MAL031-III | Numerical Analysis and C-Programming | 18 | 50 |
| 8 | MAP031 | Maths Practical | 9 | 25 |
| 9 | PHL031-I | Solid State Physics | 18 | 50 |
| 10 | PHL031-II | Nuclear Physics | 18 | 50 |
| 11 | PHL031-III | Elementary Quantum Mechanics& Spectroscopy | 18 | 50 |
| 12 | PHP031 | Physics Practical | 27 | 75 |
| | | | | G.T. 675 |

## CHL031-I: Inorganic Chemistry

**Unit-I**

**Hard and Soft Acids and Bases (HSAB):** Classification of acids and bases as hard and soft. Pearson'sHSAB concept acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness.

**Unit-II**

**Metal-Ligand Bonding in Transition Metal complexes:** Limitations of valence bond theory, anelementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.
**Magnetic Properties of Transition Metal Complexes:**Types of magnetic behaviour, methods ofdetermining magnetic susceptibility, spin-only formula. L-S coupling, correlation of s and eff and values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

**Unit-III**

**Electronic Spectra of Transition Metal Complexes:** Types of electronic transitions, selection rules ford-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of [(Ti(H2O)6)3+ complexion.
**Thermodynamic and Kinetic Aspects of Metal Complexes:** A brief outline of thermodynamicstability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

**Unit-IV**

**OrganometallicChemistry:**Definition, nomenclature and classification of organometallic compounds.Preparation, properties, bonding and applications of alkyl and aryls of Li, AI, Hg, Sn and Ti, a brief account of metal ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

**Unit-V**

**Bioinorganic Chemistry:** Essential and trace elements inBiological processes, metalloporphyrinswithspecial reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca.+2, Mg+2 Nitrogen fixation.

## CHL031-II Organic Chemistry

**Unit-I**

**Spectroscopy:**Nuclear magnetic resonance (NMR) spectroscopy. (Proton MagneticResonance(HNMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2 - tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

**Unit-II**

**Organometallic Compounds:**Organometallic Compounds: The Grignard reagents-formation,structureand chemical reactions.
**Organozinc Compounds:** Formation and chemical reactions.
**Organolithium compounds:** Formation and chemical reactions. Organosulphur compounds Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

**Unit-III**

**Heterocylic Compounds:**
**Introduction:** Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions, with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.Introduction to condensed five and six-membered heterocyles. Preparation and reactions of indole, quauinoline and isoquinoline with special reference to Fisher Indole synthesis, Skraup's synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic subStitution reactions of indole, quinoline and isoquionoline.

**Unit-IV**

**Organic Synthesis via Enolates:** Acidity of α Hydrogens, alkylation of diethyl malonate and ethylacetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3 - dithianes. Alkylation and Acylation of enamines

**Carbohydrates:**Classification and nomenclature monosaccharides, mechanism of osazoneformation,interconversion of glucose and fructose, chain lengthening and chain shortening. of aldoses. Configuration of monosaccharides. Erythro and threo.diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose. Mechanism of mutarotation. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving strcture determination.

**Unit-V**

**Amino Acids, Peptides, Proteins and Nucleic Acids:** Classification, structure and stereochemistry ofamino acids. Acid-base behaviour, is electric point and electrophoresis. Preparation and reactions of α - amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.
**Nucleic acids:** Introduction. constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.
**Fats, Oils and Detergents:**Natural fats, edible and industrial oils of vegetable origin, common fattyacids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value, Soaps, synthetic detergents, alkyl and aryl sulphonates.
**Synthetic Polymers:**Addition or chain-growth polymerization. Free radical vinyl polymerization,ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers.
Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.
**Synthetic Dyes:**Colour and constitution (electronic concept). Classification of dyes.
Synthesis of Methyl orange. Congo red. Malachite green. Crystal violet, Phenolphthalein. Fluorescein. Alizarin and Indigo

## CHL031-III: Physical Chemistry

**Unit-I**

**Elementary quantum Mechanics:** Black-body, radiation, Planck's radiation law, photoelectric effect,heat capacity of solids, Bohr's mode of hydrogen atom (no derivation) and its defects. Compton effect. Luis De Broglie hypothesis Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

**Schrodinger wave equation for H-atom;** separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave, functions.

**Unit-II**

**Molecular orbital theory:**Basic ideas-criteria for forming M.O. from A.O. construction of M.O's byLCAO. H2+ ion calculation of energy level from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ*, π, π* orbitals and their characteristics. Hybrid orbitals - sp, sp2, sp3, calculation of

coefficients of A. O's used in these hybrid orbitals. Introduction to valence bond model of H2, comparison of M.O. and V.B. models.

**Unit-III**

**Spectroscopy:** Introduction: Electromagnetic radiation, spectrum, basic features of differentspectrometers, statement of the Born-Openheimer approximation, degrees of freedom.
Diatomic molecules, Energy levels of a rigid rotator (semi-classical principles),selection rules, spectral intensity, using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotator, isotope effect

**Vibrational Spectrum: Infrared spectrum:** Energy levels of simple harmonic oscillator, selectionrules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

**Raman Spectrum:** concept of polarizability, pure rotational and pure vibrational Raman Spectra ofdiatomic molecules, selection rules.

**Electronic Spectrum:** Concept of Potential Energy curves for bonding and antibonding molecularorbitals, qualitative description of selection rules and Frank Condon principle. qualitative description of σ, π and n M.O. their energy levels and the respective transitions.

**Unit-IV**

**Photochemistry:**Interaction of radiation with matter, difference between thermal and photochemicalprocesses. Laws of photochemistry: Grothus-Drapper law, Stark -Einstein law, Jablonski diagram depicting various processes occuring in the exited sate, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simplex examples

**Unit- V**

Physical Properties and Molecular Structure: Optical activity, polarization -(Calusius-Mossottiequation), orientation of dipoles in an electric field, dipole moment, induced dipole moment,measurement of dipole moment temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetics.

**Solutions, Dilute Solutions and Colligative Properties:** Ideal and non-ideal solutions, methods ofexpressing concentrations of solutions, activity and activity coefficient.

**Dilute solution:** colligative properties, Raoult's law, relative lowering of vapour pressure, molecularweight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

**Books Suggested:**


1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley.
2. Concise Inorganic Chemistry, J.D. Lee ELBS.
3. Concepts of Models Inorganic Chemistry B. Douglas. D.McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver P.W. Atkins and C.H. Langfor, Oxford.
5. Inorganic Chemistry, W.W. Porterfield Addison Wesley.
6. Inorganic Chemistry, A.G. Sharpe. ELBS.
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Group Theory and Its Chemical Applications: P. K. Bhattacharya
9. Inorganic Chemistry: J. E. Huyee, Principles of Structure & Reactivity, 3rd Ed.
10. Selected Topics in Inorganic Chemistry: W. U. Malik, G. D. Tuli and R. Madan
11. Principles of Inorganic chemistry: D. Banerje
12. Modern Aspect of Inorganic Chemistry: H. J. Emeleus and A. G. Sharpe
13. Organic Chemistry, Morrison and Boyd, Prentice Hall.
14. Organic Chemistry, L.G. Wade Jr. Prentice Hall.

15. Fundamentals of Organic Chemistry, Solomons, John Wiley.
16. Organic Chemistry Vol. I, II, III S.M. Mukerji, S.P. Singh and RP. Kappor, Wiley Eastern Ltd. (New Age International)
17. Organic Chemistry, F.A. Carey, McGraw Hill, Inc.
18. Introduction to Organic Chemistry. Streitwieser, Heathcock and Kosover. Macmilan.
19. Organic Chemistry (Vol. I & II): S. M. Mukherji, S. P. Singh and R. P. Kapoor, Wiley Eastern Ltd.
20. A Text Book of Organic Chemistry (Vol. I & II): K. S. Tiwari, S. N. Mehrortra& N. K. Vishnoi
21. Organic Chemistry: M. K. Jain and S. Sharma
22. A Text Book of Organic Chemistry (Vol. I & II): O. P. Agarwal
23. A Text Book of Organic Chemistry: R. K. Bansal
24. Organic Chemistry (Vol. I & II): I. L. Finar
25. Organic Reaction and Their Mechanisms: P. S. Kalsi
26. Introduction of Petrochemicals: Sukumar Maiti,
27. Organic Chemistry: P. L. Soni
28. A Text Book of Organic Chemistry: V. K. Ahluwalia and MaduriFoyal, Narosa Publishing House Pvt. Ltd.
29. Physical Chemistry, G.M. Barrow. International Student Edition, McGraw Hill.
30. Basic Programming with Application, V.K. Jain. Tata McGraw Hill.
31. Computers and Common Sense. R Hunt and Shelly, Prentice Hall.
32. University General Chemistry, C.N.R Rao, Mac Millan.
33. Physical Chemistry, RA. Alberty, Wiley Eastern Ltd.
34. The elements of Physical Chemistry, P.W. Atkins, Oxford.
35. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
39. Principles of Physical Chemistry: B. R. Puri Sharma and M. S. Pathania
40. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand
41. A Text Book of Physical Chemistry: Kundu and Jain

## Chemistry Practical

**Inorganic Chemistry**

**Synthesis and Analysis**

- Preparation of sodium tri oxalate ferrate (III) Na3[Fe(C2O4)3] and determination of its composition by permagnomotry.
- Preparation of Ni-DMG complex [Ni(DMG)2].
- Preparation of copper tetraammine complex [Cu(NH3)3]SO4.
- Preparation of cis-and trans-bisoxalatodiaquachromate (III) ion. Instrumentation
- Colorimetry - Job's method and Mole-ratio method.
- Adulteration - Food stuff.
- Effluent analysis - water analysis.
- Solvent Extraction - Separation and estimation of Mg(II) and Fe(II)
- Ion Exchange Method - Separation and estimation of Mg(II) and Zn(II) Volumetric Analysis
- Iodimetric&Iodimetric titrations.

**Organic Chemistry**

**Section-A**

**Laboratory Techniques:**

(i) Steam Distillation:

- Naphthalene from its suspension in water.
- Clove oil from Clove
- Separation of o-and p-nitrophenols

(ii) Column Chromatography:

- Separation of fluoressein and methylene blue.
- Separation of leaf pigments from spinach leaves.

- Resolution of racemic mixture of (Z)-mandelic acid.

**Qualitative Analysis:**

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, NaOH for separation and preparation of suitable derivatives.

**Section-B**

**Synthesis of Organic Compounds**

- Acetylation: Salicylic acid, aniline, glucose and hydroquinone.
- Benzoylation: Aniline and phenol.
- Aliphatic Electrophilic Substitution: Preparation of Iodoform from ethanol and acetone.
- Aromatic Electrophilic Substitution:

**o Nitration:**

Preparation of m-dinitrobenzene,

Preparation of p-nitroacetanilide o Halogenation:

Preparation of p-bromoacetanilide Preparation of 2,4,6-tribromophenol.

- Diazotization/coupling:

Preparation of methyl orange and methyl red.

- Oxidation: Preparation of benzoic acid from toulene.
- Reduction: Preparation of aniline from nitrobenzene and m-nitroaniline from m-dinitrobenzene. Stereo-chemical study of Organic Compounds via Models
- R and S configuration of optical isomers.
- E and Z configuration of geometrical isomers.
- Conformational analysis of cyclohexanes and substituted cyc1ohexanes.

**Section-C**

**Organic estimation**:

Amino group, phenolic group, carboxylic acid group and glucose.

**Physical Chemistry**

**Electrochemistry**

- To determine the strength of the given acid condcutometrically using standard alkali solution.
- To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
- To study the saponification of ethyl acetate conductometrically.
- To determine the ionization constant of a weak acid conductometrically.
- To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4$ / $K_2Cr_2O_7$ as titmate and calculate the redox potential of $Fe^{2+}/Fe^{3+}$ system on the hydrogen scale. Refractometry and Polarimetry
- To verify law of refraction of mixtures for ego of glycerol and water) using Abe's refractometer.
- To determine the specific rotation of a given optically active compound. Molecular Weight Determination
- Determination of molecular weight of a non-volatile solute by Rast method / Beckmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g. NaCl) in aqueous solution at different concentrations by ebulliscopy. Colorimetry
- To verify Beer-Lambert law $KMnO_4$ / $K_2Cr_2O_7$ and determined the concentration of the given solution of the substance.

## PHL031-I: Solid State Physics

**Unit-I**

**Crystal Binding and Crystal Structure:** Crystal bonding, ionic bond, binding energy of ionic crystal, determination of the repulsive exponent, covalent bonding, metallic bonding, molecular or Vander Waal's bonding, hydrogen bonding, Space lattice and Crystal structure, reciprocal lattice, Bravis lattice, Miller indices and crystal structure, Spacing of planes in Crystal Lattice, Atomic Packing, Simple cubic structure, Face centered cubic structure, Hexagonal closed packed structure, Pervoskite structure, X-ray diffraction and Bragg's law, Laue pattern.

**Unit-II**

**Thermal Properties of Solids**, Concepts of Thermal Energy and Phonons, Internal Energy and Specific Heat, The Various theories of Lattice specific Heat of Solids, The Einstein Model, Vibrational Modes of Continuous Medium, Debye Model, Electronic Contribution of the internal Energy to the Specific Heat of Metals, Thermal Conductivity of the Lattice.

**Unit-III**

**Band Theory of Solids**, Formation of bands, a Periodic Lattice and Bloch Theorem, Periodic Potential of a solid, Wave function in Numberof States in the Band, Kronig Penny model, Velocity of the Bloch electrons and Dynamical effective mass, Momentum, Crystal Momentum and Physical Origin of the Effective Mass, Negative Effective Mass and Holes, The distinction between metals, insulators and intrinsic semiconductors.

**Unit-IV**

**Electrical Conductivity,**Drude-Lorentz Theory of Electrical Conductivity, Boltzman Transport Equation, Sommerfield Theory of Electrical Conductivity, Mathiessen's Rule, Thermal Conductivity and Widemann-Franz'sLaw, The Hall Effect.

**Superconductivity**, Introduction, Meisner's effect, The Isotope Effect and Electron-Phonon Interaction, The Effect of the Superconductivity Transition on properties, Special Features of Superconducting Materials, London's equation, Flux Quantization, Qualitative discussion of BCS Theory of Superconductivity, Cooper Pairs, Applications of Superconductors, Josephson Junction.

**Unit-V**

**Magnetic Properties,** Origin of Atomic Magnetism, Dynamic of Classical Dipole in Magnetic field, Magnetic Susceptibility, Phenomenon of Diamagnetism, Paramagnetism,Paramagnetism of Ionic Crystal, Ferromagnetism, Temperature Dependance of saturation of Spontaneous Magnetization, The Paramagnetic Region, The nature of ferromagnetism, Nature and Origin of Weiss Molecular Field, Heisenberg's Exchange Interaction, Quantum Theory of Ferromagnetism, Relation between Jo (Exchange Integral) and I (Weiss Constant), Ferromagnetism Domain.

## PHL031-II: Nuclear Physics

**Unit-I**

**Nuclear Properties:** Rutherford's theory of a particle scattering, Properties of Nuclei, Nuclear Magnetic Moment and Nuclear Ellipticity, Quadrupole Moment and Nuclear spin, Parity and Orbital angular momentum, Parity and its conservation, Nuclear Mass and Mass Spectroscopy, Nuclear Energy, Discovery of neutron and proton-neutron hypothesis, Neutron to proton Ration(n/z), The nuclear potential, Nuclear mass, Atomic Mass Unit (amu), Mass Defect and Binding energy, Nuclear forces, Theory of Nuclear forces, The Liquid Drop Model.

**Unit-II**

**Nuclear Fission:** The Discovery of Nuclear Fission, The Energy Release in Fission, The Fission products mass distribution of fission products, Charge distribution of fission products, ionic charge of fission products, Fission cross Section and threshold, Neutron emission in fission, The prompt neutron and delayed neutrons, Mechanism for the emission of delayed neutrons.

**Energy of fission Neutrons**, Theory of nuclear fission and Liquid Drop Model, Barrier Penetration-Theory of Spontaneous fission, Nuclear Energy Sources, Nuclear Fission as a source of Energy, The Nuclear Chain Reaction, condition of controlled chain Reaction, The principal of Nuclear Reactors, classification of Reactors,

Typical Reactors, Power of Nuclear Reactor, Critical size of Thermal Reactors, The Breeder Reactor, Reprocessing of the Spent Fuel, Radiation Damages and Fission Product Poisoning, Uses of Atomic Energy.

**Unit-III**

**Nuclear Fusion:** The sources of stellar Energy, The Plasma-Fourth State of the Matter, fusion Reaction, Energy Balance and Lawson Criterion, Magnetic Confinement of Plasma. Classical plasma Losses from the Magnetic Container, Anomalous Losses, Turbulence and plasma Instabilities, The Laser fusion Problem, fusion Reactor:

**Elementary particles:** Classification of Elementary Particles, Quantum Numbers, Fundamental Interactions, Unified approach (Basic ideas), The conservation Laws, Quarks basic idea of color and quark confinement.

**Unit-IV**

**Accelerators:** Ion sources, Cock-Craft-Walten High Voltage Generators, Van De- Graff Generators, Drift Tube Linear Accelerators, Wave Guide Accelerator, Magnetic Focussing In cyclotron, Synchrocyclotron, Betatron, the Electromagnetic Induction Accelerator, Electron Synchrotron, Proton Synchrotron.

**Unit-V**

**Particle and Radiation Detectors:** Ionisation Chamber, Region of Multiplicative Operation, Proportional Counter, Geiger-Muller Counter, Cloud Chamber.

**Cosmic Rays:** Discovery of Comic Rays, Nature of Cosmic Rays, soft and hard component variation in cosmic rays- (1) Latitude Effect (2) East-West Asymmetry Directional Effect Altitude Effect. Detection of cosmic Ray particles, Origin of Cosmic Rays

## PHL031-III: Elementary Quantum mechanics and Spectroscopy

**Unit-I**

**Experimental Evidence of Quantum Theory:** limitations of classical theory to explain and specific heat of solids, Black Body Radiation, Planck's quantum hypothesis and qualitative discussion of radiation law, photoelectric effect, Compton effect, Matter Waves, De Broglie relation, Davison Germer experiment, electron interference experiment,Uncertainity principle (i) Position & moments (ii) Energy & Time (iii) Angular displacement and momentum. its application such as (i) Non existence of electron in nucleus, (ii) Ground state energy of H–atom, (iii) Ground state energy of harmonic oscillator (iv) Natural width of spectral lines.

**Unit-II**

**Schrodinger's Wave Mechanics:** Schrodinger's equation, Its need and justification, time dependent and time independent forms, physical significance of the wave function and its interpretation, probability current density. Operators in quantum mechanics, Definition of an operator, linear and Hermitian operators, State function, Expectation value of dynamical variables, position momentum and energy, Fundamental postulates of quantum mechanics, Eigenfunction and eigen valuesDegenracy. Orthogonality of eigenfunction, Commutation relations, Ehrenfest's theorem and complementarity wave packet, group and phase velocities, Principle of superposition, construction of one dimensional wave packet, its momentum representation, (Fourier transform), Gaussian wave packet its momentum representation (Fourier transform) Gaussian wave packet, Diffraction at a single slit, Uncertainty principle.

**UNIT – III**

**Simple solution of Schrodinger's Equation:** Time independent Schrodinger equation and stationary state solution, Boundary and continuity conditions on the wave function, particle in onedimensional box, Eigenfunction and eigenvalues, discrete energy levels, generalisation to three dimensions and Degenracy of levels. Potential steps and rectangular potential barrier, calculation of reflection and transmission coefficient. Qualitative discussion of the application to alpha decay, Square well potential problem calculation of transmission coefficient and resonant scattering (Ramsaur–Townsent effect).

**Unit-IV**

**Bound state problems:** Particle in one dimensional infinite potential well and finite depth potentialwell–energy eigen–values and eigenfunction, transcedental equation and its solution, Simple harmonic oscillator (one dimensional case) and qualitative discussion of its eigenfunctions, energy eigenvalues. Zero point energy, parity symmetric and antisymmetric wave function's with graphical representation. Schrodinger equation for a

spherically symmetric potential, Schrodinger equation for a one electron atom in spherically coordinates, separation of variables, Orbital angular momentum and quantization spherical harmonics, energy levels of H–atom, Shapes of n = 1 and n = 2 wave functions, Average value of radius of H–atom.

**Unit-V**

**Applications of Quantum Theory to Atomic Spectroscopy:** Quantum features of spectra of oneelectron atoms, Frank–Hertz experiment and discrete energy states, Stern and Gerlach experiment, spin and magnetic moment, Spin orbit coupling and qualitative explanation of fine structure, Atoms in magnetic field Zeeman splitting of state Effect.

**Molecular Spectroscopy:** Qualitative features of molecular spectra, Rigid rotator discussion ofenergy, eigenvalues and eigenfunction, rotational energy levels of diatomic molecules, Rotational spectra, vibrational energy levels of diatomic molecules, vibrational spectra, vibrational rotational spectra.

**Books Suggested:**

1.Solid State Physics by M.P.Saxena, S.S. Rawat and P.R. Singh College Book House.(Medium: Hindi/English)
2.Nuclear Physics by M.P.Saxena, S.S. Rawat and P.R. Singh College Book House.(Medium: Hindi/English)
3.Elementary Quantum Mechanics& Spectroscopy by M.P.Saxena, S.S. Rawat and P.R. Singh College Book House.(Medium: Hindi/English)

## Physics Practical

**Section –A**

1. Determination of Planck's constant by photo cell (retarding potential method using optical filters, preferably five filters).

2. Determination of Plank's constant using solar cell.

3. Determination of Stefan's constant.

4. Study of the temperature dependance of resistance of semiconductor (four probe method).

5. Study of Iodine spectrum with the help of grating and spectrometer using ordinary bulb light.

6. Study of the characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.

7. Study of b- absorption in a foil using GM counter.

8. To find the magnetic susceptibility of a paramagnetic solution using Quinck'smethod.Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magneton. 9. Determination of coefficient of rigidity as a function of temperature using torsional oscillators (resonance method).

10. Study of polarization by reflection from a glass plate with the help of Nicol prism and photo cell and verification of Brewsters law of Malus.

11. e/m measurement by Helical method.

12. Measurement of magnetic field using ballistic galvanometer and search coil study of variation of magnetic field of an electromagnet with current.

13. Measurement of electronic charge by Millikan's oil drop method.

**Section-B**

1. Study of a R-C transmission line at 50 Hz.

2. Study of a L-C transmission line(i) at fixed frequency (ii) at variable frequency.

3. Study of resonance in an LCR circuit (using air core inductance and damping by metal plate).

(i)at fixed frequency by varying C and(ii) by varying frequency.

4. (i)Recovery time of a junction diode and point contact diode. (ii)Recovery time as a function of frequency of operation and switching.

5. Design a Zener regulated power supply and study the regulation with various loads.

6. Study the characteristic of field effect transistor (FET) and design and study amplifier of finite gain .

7. Study the frequency response of transistor amplifier and measure the input and output impedances (frequency response with change of value of R and C components).

8. Design and study of an R-C phase shift oscillator.

9. Study voltage multiplier circuit to generate high voltage D.C. from A.C.

10. Using discrete components, study OR, AND, NOT logic gates compare with TTL integrated circuits IC's.

11. Applications of operational amplifier as(minimum two of the following exercises):

(i) Inverter (ii) Non-Inverter (iii)Differentiator (iv) Integrator.

## MAL031-I: Linear Algebra and Complex

**Unit-I**

Definition and examples of a vector space, Subspace of a vector space, Linear combination and Linear span, Linear dependence and independence of vectors, direct sums of subspaces.

**Unit-II**

Basis and dimension of finitely generated spaces. Quotient space, Linear transformation, Rank and nullity of linear transformation.

**Unit-III**

Characteristic values and characteristic vectors of matrices, Eigenvalues and eigenvectors, Cayley-Hamilton theorem, Algebra of matrices, rank and determinant of matrices, linear equations.

**Unit-IV**

Complex numbers as ordered pairs. Geometric representation of complex numbers. Stereographic projection, Limit, Continuity and differentiability of a complex valued function. Analytic functions. Cauchy-Riemann equations. Harmonic functions. Determination of conjugate function.

**Unit-V**

Mapping or Transformation, Isogonal and conformal mappings necessary and sufficient conditions for a conformal mapping. Mobious Transformation, Fixed points, Cross ratio, Inverse points, Mapping.

## MAL031-II: Mathematical Statistics and Linear programming

**Unit-I**

Central moments, first four central moments in terms of raw moments and vise-versa. Karl-Pearson's Beta and Gamma coefficients. Measure of skewness and kurtosis. Random experiment. Sample space, Event, Types of events, Probability and Conditional probability of an event. Independent events, Theorems of compound and total probabilities, Baye's Theorem and its simple applications.

**Unit-II**

Random variable, discrete and continuous random variables, Probability distribution of a discrete random variable, Probability density function of a continuous random variable. Distribution functions, Mathematical expectation of a random variable and of a function of random variable, Moments and Moment generating function, Cumulant generating function and cumulants, Characteristic functions.

**Unit-III**

Discrete and continuous distributions with properties: Bernouli, Binomial, Poisson and Normal.

**Unit-IV**

Linear programming, Variables, Objective function, Constraints and Mathematical form of a LPP. Graphical method of solution of two variable linear programming problems. Line and line segment in the Euclidean space Rn, Convex set, Hyperplane convex combination, convexpolyhedron, Extreme point of a convex set. Basic solution of a system of linear equations. Slack and surplus variables. Standard form of a LPP. Feasible solution, BFS and optimal BFS of a LPP. Replacement of basis vector. Improved BFS. Unbounded solutions, Conditions of optimality. Simplex algorithm, Artificial variable, Charne's Big M-method.

**Unit-V**

Dual and primal. Problem Standard form of a primal problem. Formation of dual of a standard primal problem. Fundamental theorem of duality. Solution of a LPP by solving its dual by simplex method. Assignment problems.

## MAL03-III: Numerical and C- Programming

**Unit-I**

Principles of C Programming**:** Algorithms, Flowcharts, Constants, Variables, Data type, Declaration of storage class, assigning values of variables, symbolic constant. Operators and Expressions. Common I/O operators decision making, branching and loops: if, if-else, Nested if-else, WHILE, DO, for loop, while statement, switch-case statement. Array: One dimensional, Two dimensional. Initialization of two dimensional arrays.

**Unit-II**

**User defined function in C:** function declaration, calling a function, Category of function, nesting of functions recursion, Pointers.

**Operators:** forward difference, backward difference, Shift E, Inverse shift E-1, Differentiation D, Central - Difference, mean difference, Central sum, Divided difference, Inter relation between various operators, Forward and backward difference table. factorials notation.

**Unit-III**

Interpolation with equal and unequal intervals, Central difference interpolation, inverse interpolation.

**Unit-IV**

**Numerical differentiation and Numerical –Integration:** Gauss quadrature formula –Trapezoidal rule, Weddle rule, Simpson's 1/3 rules, Simpson's 3/8 rule, Boole's rule.

**Unit-V**

**Solution of equations:** Bisection method, regula-falsi method and Newton- Raphson method Solution of ordinary differential equations: Picard's method and Euler's method.

**Books Suggested:**

1. Linear Algebra by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)

2. Complex Analysis by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)
3. Mathematical Statistics by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)
4. Statistics by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)
5. Numerical Analysis by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)
6. C- Programming by Dr. D.C. Gokhroo, NavkarPrakashan.(Medium: Hindi/English)

## MathematicsPractical

1. To find the sum of HARMONIC SERIES.
2. To solve the quadratic Equation.
3. Evaluation of Binomial Coefficients Using do and while loops
4. To print a grouped frequency table using switch case statements.
5. To find minimum cost of operation which consists two components using Break and continue statements.
6. To Calculate the average of numbers.
7. To show a matrix using array.
8. To sort a list and calculate its median using array, If - then - else.
9. To find the Area of curve using trapezoidal rule.
10. To copy one string into another string.
11. Writing a string using % format.
12. To form a grouped frequency table using array and for loop.
13. To calculate the standard deviation of given data using array, If and break statements.
14. to open a file and appending using pointers.