L_7_General_Ed_Science_Stream

I MATHEMATICS

PAPER I : ANALYSIS

PAPER II : ABSTRACT ALGEBRA

PAPER III :NUMERICAL ANALYSIS AND OPTIMIZATION

PAPER III : COMPUTATIONAL MATHEMATICS LABORATORY

PAPER I : ANALYSIS

1. Real Analysis
2. Riemann integral. Integrability of continuous and monotnic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus.

   Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests. Integral as a function of a parameter. Continuity, derivability and integrability of an integral of a function of a parameter.

   Partial derivative and differentiability of real-valued functions of two variables. Schwarz and Young's theorem. Implicit function theorem.

   Fourier series. Fourier expansion of piecewise monotonic functions.
3. Complex Analysis
4. Complex numbers as ordered pairs. Geometric representation of Complex numbers. Stereographic projection.

   Continuity and differentiability of Complex functions. Analytic functions. Cauchy-Riemann equations. Harmonic functions.

   Elementary functions. Mapping by elementary functions.

   Simple & Mobius transformations. Fixed points. Inverse points and critical mappings. Conformal mappings.
5. Metric Spaces

   Definition and examples of metric spaces. Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure and interior. Boundary points. Sub-space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem.

Contraction principle. Construction of real numbers as the completion of the incomplete metric space of rationals. Real numbers as a complete ordered field. Dense subsets. Baire Category theorem. Separable, second countable and first countable spaces. Continuous functions. Extension theorem. Uniform continuity. Isometry and homeomorphism. Equivalent metrics. Compactness. Sequential compactness. Totally bounded spaces. Finite intersection property. Continuous functions and compact sets. Connectedness. Components. Continuous function and connected sets.

PAPER II : ABSTRACT ALGEBRA

Group Theory

Group-Automorphisms, inner automorphism. Automorphism groups and their computations. Conjugacy relation. Normaliser. Counting principle and the class equation of a finite group. Centre for Group of prime-order. Abelianizing of a group and its universal property. Sylow's theorems. p-Sylow subgroup.

1. Ring & Ideal Theory

   Ring theory-Ring homomorphism. Ideals and Quotient Rings. Field of Quotients of an Integral Domain. Euclidean Rings. Polynomial Rings. Polynomials over the Rational Field. The Eisenstien Criterion. Polynomial Rings over Commutative Rings. Unique factorization domain.

2. Vector Spaces

   Definition and examples of vector spaces. Subspaces. Sum and direct sum of subspaces. Linear span. Linear dependence, independence and their basic properties. Basis. Finite dimensional vector spaces. Existence theorem for bases. Invariance of the number of elements of a basis set. Dimension. Existence of complementary subspace of a subspace of a finite dimensional vector space. Dimension of sums of subspaces. Quotient space and its dimension. Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space. Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigenvalues and eigenvectors of a linear transformation. Diagonalisation. Annihilator of a subspace. Bilinear, Quardratic and Hermitian forms.

PAPER III : NUMERICAL ANALYSIS AND OPTIMIZATION

Numerical Analysis Solution of Equations: Bisection, Secant, Regula Falsi, Newton's Method, Roots of Polynomials.
Interpolation: Lagrange and Hermite Interpolation, Divided Differences, Difference Schemes, Interpolation Formulas using Differences.
Numerical Differentiation.

Numerical Quadrature: Newton-Cote's Formulas, Gauss Quadrature Formulas, Chebychev's Formulas.
Linear Equations: Direct Methods for Solving Systems of Linear Equations (Guass Elimination, LU Decomposition, Cholesky Decomposition), Iterative Methods (Jacobi, Gauss-Seidel, Relaxation Methods).
The Algebraic Eigenvalue problem: Jacobi's Method, Givens' Method, Householder's Method, Power Method, QR Method, Lanczos' Method.
Ordinary Differential Equations: Euler Method, Single-step Methods, Runge-Kutta's Method, Multi-step Methods, Milne-Simpson Method, Boundary Value Problems, Eigenvalue Problems.
Optimization The Basic Concepts. Proble m formulation. Linear programming in matrix notation. Graphical solution of linear programming problems. Some basic properties of convex sets, convex functions and concave functions. Simplex method of solution of a linear programming problem. Charne's M-Technique. The two phase method. Principle of duality in linear programming problem. Fundamental duality theorem. Simple problems. The Transportation and Assignment problems.

PAPER III : COMPUTATIONAL MATHEMATICS LABORATORY

Computational Mathematics Laboratory

The student is expected to familiarize himself / herself with popular softwares for numerical computation and optimization. Real life problems requiring knowledge of numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems, Finite difference methods, Interpolation, Differentiation etc. Should be attempted. Capabilities to deal with linear, integer and nonlinear optimization problems need to be developed. The objective of such a laboratory is to equip students to model and simulate large-scale systems using optimization modelling languages. (The concerned teacher is expected to provide the necessary theoretical background before the student does the corresponding practical). To this end softwares like MATLAB, MATHEMATICA can be adopted.

Basic concepts of MATHEMATICA, MATLAB.

1. Plotting of functions.
2. Matrix operations, vector and matrix manipulations, matrix function.
3. Data analysis and curve fitting.
4. Numerical integration.
5. Nonlinear equations and optimization functions.
6. Differential equations.
7. 2-D Graphics and 3-D Graphics – general purpose graphics functions, colour maps and colour controls.

8. Modelling techniques
9. Applications to real life problems.

II PHYSICS

Paper A : CONDENSED MATTER PHYSICS

UNIT-I

Crystal structure, Symmetry operations for a two dimensional crystal. Two dimensional Bravais lattices, Three dimensional Bravais lattices, Basic primitive cells, Crystal planes and Miller indices, Diamond and NaCl structure. Crystal diffraction : Bragg's Law, Experimental methods for crystal structure studies, Laue equations, Reciprocal lattices of SC, BCC and FCC, Bragg's law in reciprocal lattice, Brillouin zones and its derivation in two dimensions, structure factor and atomic form factor.

Determination of crystal structure.

UNIT-II

Lattice vibrations, concepts of phonons, Scattering of photons by phonons, vibrations of mono and diatomic, linear chains, Density of modes, Einstein and Debye models of specific heat, Free electron model of metals, Free electron, Fermi gas and Fermi energy.

UNIT-III

Band Theory : Kronig-Penney model, metals and insulators, conductivity and its variation with temperature in semi-conductors, Fermi levels in intrinsic and extrinsic semi-conductors, Qualitative discussion of band gap in semi-conductors. Dielectric constant & polarisability, frequency dependence, ferroelectrics and piezoelectrics.

UNIT-IV

Magnetic classification of solids (Dia, para, ferro, ferri, antiferro), Langevin theory, Quantum theory, Weiss theory, temperature dependence, hysteresis of ferromagnetic materials. Superconductivity, Meisner effect, penetration depth, critical field and temperature, BCS theory (formation of cooper pairs, ground state and energy gap.

UNIT-V

Spread over the entire syllabi of all the four units above.

Paper-B : ELECTRONICS AND SOLID STATE DEVICES

UNIT-I

Concepts of current and voltage sources, p-n junction, biasing of diode, V-A characteristics, zener diode, LED, LCD, rectification : half wave, full wave rectifiers and bridge rectifiers, filter circuits (RC, LC and filters), efficiency, ripple factor, voltage regulation, voltage multiplier circuits.

UNIT-II

Junction Transistor : Structure and working, relation between different currents in transistor, sign conventions, amplifying action. Different configurations of a transistor and their comparison, CB and CE characteristics, structure of JEFT and MOSFET, Transistor biasing and stabilization of operating point, fixed bias, collector to base bias, bias circuit with emitter resistor, voltage divider biasing circuit.

UNIT-III

Working of CE amplifier, Amplifier analysis using h-parameters, equivalent circuits, determination of current gain, power gain, input impedance, FET amplifier and its voltage gain, operational amplifier, characteristics and applications, feed back in amplifiers, different types, voltage gain, advantages of negative feed back, emitter follower as negative feed back circuit.

UNIT-IV

Barkhausen criterion of sustained oscillations, LC oscillator (tuned collector, tuned grid, Hartley), RC oscillators, phase shift and wein bridge, Modulation and detection, AM and FM, Power in AM and generation of AM detector, Radio transmitter, Radio wave propagation, Ionosphere, radio receiver, TV receiver.

UNIT-V

Spread over the entire syllabi of all the four units above.

Paper-C : NUCLEAR AND PARTICLE PHYSICS

UNIT-I

Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge, binding energy, angular momentum, magnetic moment and electric multipole moments of the nucleus, Wave mechanical properties of nucleus, Average Binding energy and its variation with mass number, properties of nuclear forces and saturation, Non-existence of electrons in the nucleus and neutron- proton model, Assumptions of liquid drop model, semi-empirical mass formula, conditions of nuclear stability, Fermi gas model, Nuclear Shell Model, Experimental evidence of magic numbers and its explanation.

UNIT-II

Radioactivity, Modes of decay, and successive radioactivity, Aplha emission, electron

emission, positron emission, electron capture, gamma-ray emission, internal conversion, Qualitative discussion of alpha, beta and gamma-ray spectra, Geiger-Nuttal rule, Neutrino hypothesis of beta decay, Evidence of existence of Neutrino, Qualitative discussion of alpha and beta decay theories. Nuclear Reactions, Reaction cross section, conservation laws, Kinematics of nuclear reaction, Q-value and its physical significance, compound nucleus, possible reaction with high energy particles.

UNIT-III

Energy loss due to ionization (Bethe Block formula), Energy loss of electrons, Bremsstrahlung, Multiple Coulomb scattering, Gamma-ray through matter, pair production, radiation loss by fast electrons, radiation length, electron-positron annihilation, Cyclotron, Betatron, Qualitative discussion of Synchrotron, Collider machines and Linear accelerators.

UNIT-IV

Ionization chamber, proportional counter, G.M. counter, Scintillation counter, Solid State detectors. Subatomic particles and their masses, lifetimes, decay modes, classification of these particles, types of interactions, Conservation laws and quantum numbers, concepts of isospin, strangeness, charge conjugation, antiparticles, introduction to quarks and qualitative discussion of the quark model.

UNIT-V

Spread over the entire syllabi of all the four units above.

PHYSICS PRACTICALS

LIST OF EXPERIMENTS :

I CONDENSED MATTER PHYSICS :

Activities :

(i) Measurement of reverse saturation current in p-n junction diode at various temperatures and to find the approximate value of energy gap.
(ii) To draw forward and reverse bias characteristics of a p-n junction diode and draw a load line.
(iii) Study of a diode as a clipping element.
(iv) To measure the magnetic susceptibility of $FeCl_2$ solution by Quincke's method.
(v) To trace the B-H curves for different materials using CRO and find the magnetic parameters from these.
(vi) To find the conductivity of a given semi-conductor crystal using four probe method.
(vii) To determine the Hall coefficient for a given semiconductor.

II ELECTRONICS AND SOLID STATE DEVICES :

Activities :

(i) To study the response of RC-circuit to various input voltages (square, sine and triangular).
(ii) To measure the efficiency and ripple factors for (a) Half-wave, (b) Full wave, and (c) Bridge rectifier circuits.
(iii) To study the reduction in the ripples in the rectified output with RC, LC and π-filters.
(iv) To draw the characteristics of a Zener diode.
(v) To study the stabilization of output voltage of a power supply with Zener diode.
(vi) To measure and plot Common Emitter Characteristics of a transistor (pnp or npn).
(vii) To plot Common Base Characteristics and determine h-parameters of a given transistor.
(viii) To draw output and mutual characteristics of an FET and determine its parameters.
(ix) To study the gain of an amplifier at different frequencies and to find band-width and gain-band- width product.
(x) To set up an oscillator and study its output on CRO for different V values.
(xi) To study the characteristics of a thermistor and find its parameters.

III NUCLEAR PHYSICS : Activities :

(i) To draw the Plateau of a GM counter and find its dead time.
(ii) To study the statistical fluctuations using GM counter.
(iii) To study the absorption of beta-particles and determine the end point energy using GM counter. Also determine the absorption co-effficient (for aluminium) from it.
(iv) Verification of Rutherford Scattering experiment-mechanical analogue.

Computer based Activities :

2. To solve simultaneous equations by elimination method.
3. Fitting a straight line or a simple curve of a given data.
4. Convert a given integer into binary and octal systems and vice versa.
5. Inverse of a matrix.
6. Spiral array.

III CHEMISTRY

PAPER IX Inorganic Chemistry – Ill

I Hard and Soft Acids and Bases (HSAB) Classification of acids and bases as hard and soft.Pearson's HSAB concept, acid-base strength and hardness and softness.Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

II Metal-ligand Bonding in Transition Metal Complexes

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal fieldsplitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

III Magnetic Properties of Transition Metal Complexes

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula.L-S coupling, correlation of μ_s and μ_{eff}values, orbital contribution to magneticmoments, application of magnetic moment data for 3d-metal complexes.

IV Electron Spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states discussion of the electronic spectrum of $[Tl(H_2O)_6]^{3+}$ complex ion.

V Chemistry of Lanthanides and Actinides

Electronic structure, oxidation states and ionic radii; lanthanide contraction;Chemistry of separation of Np, Pu and Am from U.

VI Thermodynamic and Kinetic Aspects of Metal Complexes

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

VII Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of meta\-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

VIII Bioinorganic Chemistry

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin.Biological role of alkali and alkaline earth metalions with special reference to Ca^{2+}. Nitrogen fixation.

IX Silicones and Phosphazenes

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding intriphosphazenes.

PAPER X Organic Chemistry – III

I Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy.
Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas ofsignals, 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.

II Organometallic Compounds

Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions.
Organozinc compounds: formation and chemical reactions.
Organolithium compounds: formation and chemical reactions.

III Organosulphur Compounds

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

IV Heterocyclic 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, piperidineand pyrrole.

Introduction to condensed five and six- membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis.Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

V Organic Synthesis via Enolates

Acidity of a-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis ofethyl acetoacetate: the Claisen condensation. Keto-encltautomerism of ethyl aceloacetate.

Alkylation of 1,3-dithianes. Alkylation and acytation of enamines

VI Carbohydrates

Classification and nomenclature.Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides.Erythro and threodiastereomers.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.

Structures of ribose and deoxyribose.An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

VII Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids.Acid-base behavior, isoelectric point and electrophoresis.Preparation and reactions of a-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.

VIII Fats, Oils and Detergents

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides,hydrogenation of unsaturated oils. Saponification value, iodine value, acid value.Soaps,synthetic detergents, alkyl and aryl sulphonates.

IX Synthetic Polymers

Addition or chain-growth polymerization.Free radical vinyl polymerization, ionic vinylpolymerization, Ziegler-Nana polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol

X Synthetic Dyes

Colour and constitution (electronic concept).Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crysta! violet, Phenolphthalein, Fluorescein, Alizarin and Indigo

PAPER XI Physical Chemistry – III

I Elementary Quantum Mechanics

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect.

De Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation,
Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one imensional box.

Schrödinger 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.

Molecular orbital theory, basic ideas - criteria for forming M.O from A.O, construction of
M.O's by LCAO - H_2^+ ion,calculation of energy levels from wave functions, physical picture of bonding and ant|bonding wave functions, concept of ó, ó*, π, π* orbitals and their characteristics. Hybrid orbitals - sp, Sp^2 sp^3; calculation of coefficients of A.O 's used in these hybrid orbitals.

Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

ll Spectroscopy

Introduction: electromagnetic radiation, regions of the spectrum, basic features of differentspectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi`-classical principles), selection
rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann
distribution) determination of bond length, qualitative description of non-rigid rotor, isotope
effect.

Vibrational Spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, 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 of diatomic molecules, selection rules.

Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of ó, π- and n M.O., their energy levels and the respective transitions.

III Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus - Drapper law, Stark - Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions –energy transfer processes (simple examples).

IV Physical Properties and Molecular Structure

Optical activity, polarization - (Clausius - Mossotti equation), 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 -paramagnet|Sm, diamagnetism and ferromagnetics.

V Phase Equilibrium

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system - water, CO2 and S systems.

Phase equilibria of two component system - solid-liquid equilibria, simple eutectic - Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions - compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_20), ($FeCl_3$-H_2O) and $CuSO_4$-H_2O) system. Freezing mixtures, acetone -dry ice.

Liquid - liquid mixtures Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system-azeotropes - HCI-H_2O and ethanol - water systems.

Partially miscible liquids - Phenol-water, trimethylamine-water, nicotine-water systems.
Lower and upper consolute temperature.Effect of impurity on consolute temperature.

Immiscible liquids, steam distillation.

Nernst distribution law - thermodynamic derivation, applications.

VI Solutions, Dilute Solutions and Colligative Properties

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

PAPER XII Laboratory Course – III

INORGANIC CHEMISTRY

Synthesis and Analysis

a) Preparation of sodium trioxalato ferrate (III), $Na_3[Fe(C_20_4)_3]$ and determination of its composition by permaganometry.
b) Preparation of Ni-DMG complex, $[Ni(DMG)_2]$.
c) Preparation of copper tetraammine complex. $[Cu(NH_3)_4]SO_4$.
d) Preparation of cis- and trans- bisoxalatodiaquachromate(III) ion.

Instrumentation Colorimetry

- Job's method
- Mole-ratio method
  Adulteration -Food stuffs.
  Effluent analysis, water analysis.
- Solvent Extraction
- Separation and estimation of Mg(ll) and Fe(II))
- Ion Exchange Method
- Separation and estimation of Mg(II) and Zn(II).

ORGANIC CHEMISTRY

- Laboratory Techniques
- Steam Distillation
- Naphthalene from its suspension in water
  Clove oil from cloves
  Separation of o-and p-nitrophenols

- Column Chromatography
- Separation of fluorescein and methylene blue
  Separation of leaf pigments from spinach leaves
  Resolution of racemic mixture of (±) 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.

Synthesis of Organic Compounds

(a) Acetytation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of anilineand phenol

(b) Aliphatic electrophilic substitution Preparation of iodoform from ethanol and acetone

(c) Aromatic electrophilic substitution Nitration

Preparation of m-dinitrobenzene
Preparation of p-nitroacetanilide Halogenation

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

(d) Diazotizatoin/Coupling, Preparation of methyl orange and methyl red

(e) Oxidation, Preparation of benzoic acid from toluene

(f) Reduction, Preparation of aniline from nitrobenzene Preparation of m-nitroaniline from m-dinitrobenzene.

Stereochemical Study of Organic Compounds via Models

R and S configuration of optical isomers.
E, Z configuration of geometrical isomers.
Conformational analysis of cyclohexanes and substituted cyclohexanes.

PHYSICAL CHEMISTRY

Electrochemistry

(a) To determine the strength of the given acid conductometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

(c) To study the saponification of ethyl acetate conductometrically.

(d) To determine the ionisation constant of a weak acid conductometrically.

(e) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_20_7$ as titrant and calculate the redox potential of Fe++/Fe+++ system on the hydrogen scale.

Phase Equilibrium

(a) To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
(b) To construct the phase diagram of two component (e.g diphenylamine - benzophenone) system by cooling curve method.

Refractometry, Polarimetry

(a) To verify law of refraction of mixtures (e.g., of glycerol and water) using Abbe's refractometer.

To determine the specific rotation of a given optically active compound.
Molecular Weight Determination

(a) Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

To verify Beer - Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

IV COMPUTER SCIENCE

Paper-A : BUSINESS DATA PROCESSING AND DATA BASE MANAGEMENT
SECTION-A

1. Introduction to Data Processing : Records and files : Data collection, preparation, verification, editing and checking.
2. Business Files : Master and transaction files, file generations, backups and file recovery procedures.
3. File sorting, searching, merging and matching.

SECTION-B

4. DBMS and its advantages; Data independence, data models; network model. DBTG proposal; data definition and manipulation languages, hierarchical and relational models, storage organisation for relations, relational algebra and calculus, relational query, languages query, processor and optimizer.

SECTION-C

5. Design of a Database : Normalization theory for design of relational databases. Functional dependencies, normal forms, multivalued dependencies, decomposition, integrity, protection, security, concurrency, recovery, distributed data bases, available data base system.

SECTION-D

6. Visual FoxPro : Getting started with FoxPro, data types, file handling commands, database control commands, indexing and sorting of a database file, searching and indexed file with FIND and SEEK. Summarizing database with count, sum, average, total. Creating and printing formatted reports.

Paper B : WEB PROGRAMMING

SECTION-A

1. Internet : Evolution of Internet, Future of Internet, Services provided on the Internet, Internet Access Methods.
2. World Wide Web : Evolution of www, Future of www, Fundamentals of web.
3. Installing Netscape Communicator : Browising Internet using Netscape, Netscape Messenger.
4. Hypertext Markup Language : Introduction to HTML, Building Vlocks of HTML, HTML Lists, HTML Links, Images in HTML.

SECTION-B

5. Advanced HTML : HTML Tables, Frames, Layers, Forms, Editors.
6. Cascading Style Sheets : Introduction to CSS, Limitation of HTML, CSS Positioning.
7. Front Page : Installing Front Page, Front Page Editor, Create a Sample Website, Frames in Front Page, Front Page Components, Forms, Database pages.

SECTION-C

8. Dynamic HTML : Moving elements and images, changing colours and hiding elements, moving between layers, mouse rollovers.
9. Java Scripting : Features, tokens, data types, variables, operators, control structs, strings, arrays, functions, core language objects, client side objects, event handling, application related to client side from validation.

SECTION-D

10. Fundamentals of Java Programming Language : Java vs. C++, bytecode, java virtual machine, constants, variables, data types, operators, expressions, control structures, defining class, creating objects, accessing class members, constructors, method overloading.

PAPER-C : PRACTICAL : Practical based on Paper A and Paper B.

V APPLIED STATISTICS

Paper- A: ESTIMATION AND TESTING OF HYPOTHESIS
SECTION-I

Estimators and estimates, unbiased, consistent, efficient estimators. Methods of

moments, maximum likelihood estimators for the parameters of Binomial, Poisson and normal distributions, confidence intervals.

Tests of a statistical hypothesis, two types of errors, power of a test, Tests for the parameters of Binomial, Poisson and normal distributions, Chi-squared tests of goodness of fit. Wilcoxon, and sign test.

SECTION-II

Analysis of variance, one and two way classifications. Estimates of main effects, tests of significance for equality of effects.

Principles of design of experiments - Randomization, replication and local control. Completely randomized and randomized block designs.

Multivariate Techniques (upto 4 variables only). Estimators of mean vector and variance - covariance matrix of multivariate (upto 4) normal distribution, multiple regression, multiple correlation and partial correlation.

Paper-B : ECONOMICS AND INDUSTRIAL STATISTICS

SECTION-I

Sampling	:	Simple random and stratified sampling, optimum allocation in stratified sampling. Ratio and regression estimates.
Index Numbers	:	Index Numbers-as weighted averages, Price Index numbers, Quantity index numbers, Fisher's tests for index numbers.
Time Series	:	The four components of a time series, moving average, the Slutsky Yule effect, determination of trend by curve fitting and moving average methods.

SECTION-II

Quality Control	:	Construction, use and interpretation of control charts for mean, range, fraction defective and number of defects. Single sampling inspection plans. Concepts of producer's and consumer's risks, O.C. and A.O.Q. Curves.
Vital Statistics	:	Rates and ratios, crude death rate, age specific death rate, infant mortality rates, standardized death rates, direct and indirect methods. Measurement of fertility, crude birth rate, general, specific and total fertility rates. Standardized birth rates. Calendar Year rates. Fundamentals of Statistics, Vol. II , Ch. 3, 4, 6, 7, 9. (Only the

relevant portion from these chapters as suggested by the body of the syllabus).

VI BOTANY

Paper-A : PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOTECHNOLOGY

UNIT-I

1. Solutions and Colloids : True solutions, electrolytes and non-electrolytes; Colloidal solutions and colloids, types of colloids, characteristics, gels and emulsions.
2. Plant Water Relations : Importance of water to plant life; physical properties of water; imbibition, diffusion, osmosis, plasmolysis and deplasmolysis, concept of osmotic potential, water potential and pressure potential; absorption of water, active and passive mechanism of water absorption; transport of water, mechanism and theories to explain ascent of sap; transpiration types, mechanism of opening and closing of stomata, mechanism of transpiration, factors affecting transpiration, antitranspirants.
3. Mineral Nutrition : Essential macro and micro elements and their role; mineral uptake; mechanism of mineral uptake.

UNIT-II

1. Nitrogen and Lipid Metabolism : Biological nitrogen fixation; Importance of nitrate reductase and its regulation; ammonia assimilation; structure and function of lipids; fatty acid biosynthesis; β–oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.
2. Proteins : Classification, role and structure (primary, secondary and tertiary) synthesis of amino acids.
3. Basics of Enzymology : Discovery and nomenclature; classification, structure, properties, factors affecting enzyme activity, mechanism of enzyme action.

UNIT-III

1. Photosynthesis : Significance, historical aspect; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems, cyclic and non-cyclic photophosphorylation; Calvin cycle; C_4 pathway; CAM plants; photorespiration; factors affecting photosynthesis; Transport of organic substances : Mechanism of phloem transport, source-sink relationship, factors affecting translocation.
2. Respiration : ATP—The biological energy currency; aerobic and anaerobic respiration; Kreb's cycle; electron transport mechanism (Chemi-osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway;

Respiratory quotient.

UNIT-IV

1. Growth and Development : Definitions; phases of growth and development; kinetics of growth, factors affecting growth; seed dormancy, seed germination and factors of their regulation; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; physiology of senescence, fruit ripening; plant hormones—auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.
2. Biotechnology : Functional definition; basic aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis.

Paper B : ECOLOGY AND UTILIZATION OF PLANTS

SECTION-I :
ECOLOGY

UNIT-I

1. Definition, scope, relationship with other sciences.
2. Plant Environment : Climatic, edaphic, topographic and biotic factors affecting growth and istribution of plants.
3. Ecosystem : Concept, structure; abiotic and biotic components; trophic levels, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen and water.

UNIT-II

1. Community Ecology : Community characteristics, frequency, density cover, life forms, biological spectrum; ecological succession – Hydrosere and Xerosere.

2.Applied Ecology: (a) Air, water and soil pollution and their control.

(b) Conservation and management of natural resources (renewable and non-renewable)

SECTION-II : UTILIZATION OF PLANTS

UNIT-III

1. Crop Production : Area of cultivation, soil requirement, cultivation practices and high yielding varieties of :

(i) Cereals (Wheat, Rice and Maize).
(ii) Fibres (Cotton).

(iii) Vegetables (Potato).
(iv) Fruits (Mango, Grapes, Lemon).
(v) Sugar-yielding plants (Sugarcane).
(vi) Oil-yielding plants (Groundnut, Mustard).

2. Brief introduction on genetically modified crops.

UNIT-IV

1. Elementary Knowledge of the following plants (Botanical names, families, parts used and economic importance)

(i) Wheat, Maize, Rice, Moong, Gram (Food).
(ii) Teak, Shisham, Deodar, Sal (Timbers).
(iii) Cotton, Jute, Coir, Flax (Fibres).
(iv) Fennel, Coriander, Turmeric, Ginger, Mint, Clove (Spices and Condiments).
(v) Bamboo, Eucalyptus (Pulp plants).
(vi) Liquorice, Belladona, Aconite, Ashwagandha, Arjun, Poppy, Amla (Medicinal plants).
(vii) Tea and Coffee (Beverages).

2. Forestry : Forest conservation, wood seasoning and its preservation.

Suggested Laboratory Exercises :

Plant Physiology :

1. To determine osmotic pressure of cell sap by plasmolytic method.
2. To demonstrate imbibition pressure using :
   (i) Imbibition pressure apparatus. (ii) Plaster of Paris cone.
3. To demonstrate osmosis through animal membrane/potato osmoscope.
4. To demonstrate plasmolysis and deplasmolysis.
5. To demonstrate mechanical and electrical adsorption.
6. To demonstrate the measurement of transpiration using simple photometer.
7. To demonstrate transpiration pull.
8. To study the effect of light intensity, and wind velocity on the rate of transpiration using Ganong's photometer.
9. To compare the rate of transpiration from the two sides of a leaf using :
   (i) Vaseline method. (ii) Cobalt chloride method.
10. To demonstrate the mechanism of opening and closing of stomata.
11. To demonstrate the path of ascent of sap.
12. To demonstrate that chlorophyll is necessary for photosynthesis.
13. To demonstrate that light is necessary for photosynthesis.
14. To demonstrate that CO_2 is essential for photosynthesis.
15. To demonstrate evolution of oxygen during photosynthesis in an aquatic plant.

16. To study the effect of light intensity and CO_2 concentration on the rate of photosynthesis using an aquatic plant.
17. To demonstrate aerobic respiration using flask method.
18. To demonstrate anaerobic respiration in germinating seeds or yeast.
19. To demonstrate the measurement of respiratory quotient using Ganong's respirometer.
20. To demonstrate the activity of amylase.
21. To demonstrate the activity of catalase in plant tissue (germinating seeds).
22. To demonstrate phototropism.
23. To demonstrate geotropism using clinostat.
24. To separate chlorophyll pigments by solvent method.
25. To perform chemical analysis of plant ash for K, Ca, Fe^{++}, Fe^{+++},B, Mn, S and Mg.
26. To test for the presence of starch, proteins, amino acids and reducing sugars in plant material.

Ecology and Utilization of Plants :

1. Study of ecological adaptations in external characters of :
   Hydrilla, Potamogeton, Ceratophyllum, Vallisneria, Lemna, Eichhornia, Nelumbium, Calotropis, Nerium, Acacia, Zizyphus, Casuarina, Capparis, Asparagus, Ruscus, Opuntia, Euphorbia royleana.
2. To prepare permanent stained slide to show ecological adaptations in the internal structure of the following :
   (a)T.S. stem of Hydrilla.
   (b)T.S. leaf of Potamogeton and Vallisneria. (c)T.S. leaf and petiole of Eichhornia.
   (d)T.S. leaf and petiole of Nelumbium.
   (e)T.S. leaf of Nerium.
   (f)T.S. stem of Casuarina and Capparis.
3. Identification and morphology of economically important part/s of crop plants mentioned below : Cereals (wheat, rice); Fibres (cotton); Vegetables (potato); Fruits (mango, grapes, lemon); sugar- yielding plants (sugarcane) and oil-yielding plants (groundnut, mustard).
4. To determine soil pH using pH paper/solution/pH meter.
5. To determine water holding capacity of soil.
6. To assess soil texture through ball-making technique.

Guidelines for Botany Practical Examination :

1. Write material required, procedure and precautions for physiology experiments A (to be 11 announced by the examiner). Perform the experiment, record observations, calculations if any, and results and show the experiment to the examiner.

2. Write procedure of physiology experiment B (minor experiment to be announced by the examiner). Perform the experiment and show it to the examiner after recording observations. 5

(a) Identify and write illustrated ecological note pertaining to external characters of specimen C. 4

(b) Identify and cut T.S. of stem, leaf or petiole (to be announced by the examiner) of specimen D. Make its permanent stained slide and show it to the examiner. Draw its labelled diagram and write its anatomical characters of ecological importance.

Identify and write illustrated morphological notes on specimens E and F giving their economic importance. 8

VII ZOOLOGY

Paper-A : DEVELOPMENTAL BIOLOGY AND GENETICS

UNIT-I

Gametogenesis with particular reference to differentiation of spermatozoa : vitellogenesis; role of follicle/subtesticular cells in gametogenesis.

Egg maturation : egg membranes : polarity of egg. Fertilization; parthenogenesis.
Fate maps of chick and frog embryos.

UNIT-II

- Cleavage patterns; Cleavage; determination and differentiation, development upto three germ layers and their fate in Herdmania, Amphioxus, frog chick and rabbit.
- Foetal membranes, their formation and role. Mammalian placenta – Its formation, types and functions. Tissue interactions, basic concepts of organizers and inductors and their role.
- Metamorphosis in Herdmania and Rana (frog).

UNIT-III

- Modification of Mendelian ratios :
- Non-allelic gene interaction, Modified F_2 ratios. (9:7, 9:3:3:1, 12:3:1, 13:3,15:1,9:6:1).
- Gene modifications due to incomplete dominance, lethal factors (2:1), Pleiotropic genes. Multiple Alleles : Blood group inheritance, eye colour in Drosophila, pseudo-allelism.
- Multiple Factors : Qualitative and quantitative characters, inheritance of quantitative traits (skin colour in man).
- Linkage, crossing over and recombination : Linkage, sex-linked characters, crossing over, frequency of crossing over, cytological basis of crossing over, synaptonemal complex. Recombination in Fungi (tetrad analysis).

- Gene and Genetic Code : Structure of nucleic acids (DNA & RNA). Replication of DNA and transcription. Expression of gene (protein synthesis in Prokaryotes and Eukaryotes). Properties of genetic code, codon assignment, wobble hypothesis, split and over-lapping genes. Evolution of genes.
- Extranuclear inheritance : Chloroplast with special reference to Mirabilis jalapa and kappa particles in Paramoecium.

UNIT-IV

- Mutations : Spontaneous and induced mutations, physical and chemical mutagens. Detection of mutations in Maize and Drosophila. Inborn errors of metabolism in man (Phenylketonuria, Alcaptonuria, Albinism). Somatic mutations and carcinogenesis.
- Regulation of gene expression in prokaryotes (Operon model) and in eukaryotes.
- Population genetics : Equilibrium of gene frequencies and Hardy Weinberg Law.
- Genetic recombination in bacteria (conjugation, transduction and transformation) plasmids.
- Applied Genetics : Recombinant DNA, genetic cloning and its applications in medicine and agriculture, DNA finger printing.

PRACTICALS : Practical based on Theory Paper ZOO 301 (ZOO 351)

A. Genetics :

1. Demonstration of Law of segregation, Independent assortment and epistasis (use of coloured beads or capsules etc.). Numericals for segregation and Independent assortment.
2. Segregation demonstration in preserved material (Maize).
3. Cytoplasmic inheritance in Mirabilis jalapa.
4. Inheritance of other human characteristics, ability to taste, PTC, thiourea.
5. Comparison of variance in respect of pod length and number of seeds/pods.
6. Calculation of gene frequencies and random mating (coloured beads or capsules).
7. Study of polytene chromosomes of Chironomus/Drosophila through permanent slide.
8. Dermatographics : Palm print taking and finger tip patterns.

B. Frog Embryology :

1. Collection of spawn.
2. Identification of stages and preservation.
3. Preparation of permanent/temporary slide of representative developmental stages of frog.
4. Study of the development of frog from permanent slides.
5. Window preparation and identification of stages of development in chick egg.
6. Study of the development of chick embryo from permanent slides upto 96 hours.
7. Study of the following prepared slides :

a. Stages of gametogenesis, structure of egg and sperm of a mammal.
b. Larva of Herdmania.

Paper-B : APPLIED ZOOLOGY

OPTION-I : MEDICAL ZOOLOGY & MEDICAL LABORATORY TECHNOLOGY

UNIT-I

- Introduction to parasitology (pertaining to various terminologies in use).
- Brief introduction to pathogenic microbes. Viruses, Rickettsiae, Spirochaetes and Bacteria.
- Brief accounts of life history, mode of infection and pathogenicity of the following pathogens with reference to man; prophylaxis and treatment:
- Pathogenic protozoans : Entamoeba,Trypanosoma, Leishmania, Giardia, Trichomonas; and Plasmodium.
- Pathogenic helminthes:Fasciolopsis, Schistosoma, Echinococcus, Ancylostoma, Trichinella, Wuchereria, Dracunculus and Oxyuris.
- Life cycle, disease caused and control measures of arthropod vectors :
- Anopheles stephensi, A culicifaces, Aedes aegypti A. albopictus, Culex pipien satigeans, (C.trinaenilorhynchus), Mansonia sp. Xenosylla, Cheopsis, Pediculus.

UNIT-II

- Epidemic diseases, such as typhoid, cholera, small pox; their occurrence and eradication programmes. Brief introduction to human defence mechanisms.
- Humoral and cell mediated immune-response, Antigens-physical & chemical properties, Antibodies - structure and function of immunoglobulin M, G, A, E and D.
- Antigen and antibody interactions : Serodiagnostic assays. Vaccines.

UNIT-III

- Laboratory safety rules, hazards and precautions during sample collection and laboratory investigations. Laboratory techniques : Colorimetry, Microscopy, Autoclaving. Centrifugation, Spectrophotometry.
- Haematology : Collection of blood (Venous and Capillary), Anticoagulants (merits and demerits), Romanowsky's stains, Total RBC count, Erythrocyte sedimentation rate, TLC, DLC, Eosinophil count, Platelet Count, Reticulocyte count.

UNIT-IV

- Bacteriology : Sterilisation, (dry heat, moist heat, autoclave, filtration), Disinfection, Staining techniques (gram's stain, AFB stain, etc.), Culture media (Defined & Synthetic media & routine laboratory media), Bacterial culture (aerobic and anaerobic), Antibiotic sensitivity.

- Biochemistry : Protein estimation, Estimation of blood, urea, sugar and urine analysis.
- Histopathology : Common fixatives and staining techniques, Histochemistry : Principle and method :
- Staining of carbohydrates, proteins and fats with bromo phenol blue, Periodic acid Schiff, Sudan Black blue and Feulgen reaction.
- Practical based on Theory Paper ZOO 302 (ZOO 352)
- Demonstration of safety rules in laboratory like proper handling of patients specimens and disposal of syringes, needles etc.
- Demonstration of the use of autoclave, centrifuge and spectrophotometer.
- Cleaning and sterilization of glassware using hot air oven, autoclave etc.
- Demonstration of parts of microscope, its functioning and care.
- Processing of clinical samples for culture and identification of pathogens : blood, urine and stool.
- Estimation of haemoglobin using Sahli's haemometer.
- Preparation of thick and thin film for malarial parasite.
- Counting of WBC, RBC & DLC.
- Examination of stool for demonstration of intestinal parasites.
- Study of permanent slides and specimens of parasitic protozoans, helminthes and arthropods mentioned in theory syllabus.
- Analysis of blood group, A, B, AB, O and Rh.
- ESR, haematocrit, bleeding time, coagulation time, prothrombin time.
- Estimation of blood sugar and protein.
- Fixation, embedding, cutting of tissue sections and their staining (Routine Haematoxytin and Eosin and special staining with BPB, PAS, SBB and Feulgen reaction).

UNIT-I

- Systematic position, habits and nature of damage of the following pests of crops and vegetables :

I. Sugarcane :

1. Sugarcane leaf hopper (Pyrilia perpusila) alongwith life cycle and control measures.
2. Sugarcane top borer (Scirpophaga nivella)
3. Sugarcane stem borer (Chilotrea infuscatellus)

II. Cotton :

1. Pink bollworm (Pectinophora gossypiella) alongwith life cycle and control measures.
2. Red cotton bug (Dysdercus cinglulatus)
3. Cotton grey weevil (Myllocerus maculosus)
4. Surface grasshopper (Chrotogonus trachypterus)
5. Cotton jassid (Empoasca devastans)

III. Paddy :

1. Rice Gundhy Bug (Leptocorisa varicornis) alongwith life cycle and control measures.

2. Rice grasshopper (Hieroglyphyus banian)
3. Rice Hispa (Dicladispa armigera)

IV. Wheat :

1. Wheat stem borer (Sesamia inferens) alongwith life cycle and control measures.
2. Termites
3. Aphids, Jassids

V. Vegetables :

1. Red pumpkin beetle (Aulacophora foveicollis)
2. Pumpkin fruit fly (Dacus cucurbitae) alongwith life cycle and control measures.
3. Hadda beetle (Epilachna vigintioctopunctata)

UNIT-II

VI. Pests of Stored Grains : Systematic position, habits and nature of damage of the following pests of stored grains

1. Pulse Beetle (Callosobruchus maculates) along with life cycle and control.
2. Rice weevil (Sitophilus oryzae)
3. Khapra beetle (Trogoderma granarium)
4. Rust red flour beetle (Tribolum castaneum)
5. Lesser grain borer (Rhizopertha dominica)
6. Rice moth (Corcyra cephalonica)

- Systematic position, disease caused and control of the following insects of Medical and Veterinary importance

1. Mosquitoes
2. Sand fly (Phlebotomus minutus)
3. House fly (Musca domestica) along with life cycle of house fly.
4. Horse fly (Tabanus striatus)
5. Blow fly (Calliphora erythrocephala)
6. Warble fly (Hypoderma lineatum)
7. Poultry louse (Menopon gallinae)
8. Sucking louse/(Haematopinus surysternus)
9. Fleas

UNIT-III

- Development of Insects : Different types of metamorphosis along with a study of different kinds of larvae and pupae.
- Comparative studies of mouth parts in Grasshopper, Honeybee, Butterfly, Red-Cotton bug and Mosquito. Major modifications in the antennae and legs of insects.

1. Sericulture

1. Species of silkworm
2. Requirements of Sericulture Industry
3. Grainage Management
4. Pre and Post-cocoon processing (Stifling & Reeling)
5. Diseases of silkworm.

2. Apiculture
   (i) Species of Honeybees
   (ii) Flora for Apiculture
   (iii) Methods & Appliances of Bee Keeping
   (iv) Products - (a) Honey (b) Bee wax (c) Propolis (d) Pollen (e) Royal Jelly (f) Bee Venom
   (v) Diseases of Honey bee
3. Lac Culture :
   (i) Species of Lac culture (ii) Host Plants (iii) Cultivation of Lac (iv) Processing of Lac Industry (v) Diseases of Lac Cultivation.

UNIT-IV

I. Biological Control : History; Techniques in biological control, Agents of biological Control (a) Vertebrates (b) Nemathelminthes (c) Arthropods (d) Protozoan; Microbial control with the help of Bacteria, Virus and Fungi.

II. Chemical Control :
History; Types and Classification of Insecticides (a) Insecticides of plant origin with special reference to vicotine; Pyrethrum; Rotenone and Azadirachtin (b) Chlorinated Hydrocarbons insecticides with special reference to DDT; Toxaphene; BNC; Chlordane; Aldrin; Endrin and Endosulfan (c) Organophosphorus Insecticides with special reference to Malathion; TEPP; Parathion and DDVP (d) Carbamate Insecticides with reference to Carbaryl and Carbofuran (e) Fumigants with reference to Hydrogen cyanide; Methyl bromide; Ethylene dichloride; Carbon tetrachloride and Aluminium phosphide.

III. Recent Methods of Pest Control :
(a) Sterile insect release methods
(b) Behavioural control involving use of Pheromones
(c) Integrated pest control : Introduction of IPM : Pre-requisites; Implementation Strategy; Framework of IPM programme and perspectives in IPM.

Practical based on Theory Paper ZOO 303 (ZOO 353)

1. Feeding apparatus : Mouth parts of honey bee, butterfly and red cotton bug by preparing permanent mounts.
2. A study of different types of larvae and pupae of insects.
3. External morphology and identification marks of the crops and vegetables pests : Pyrilla perpusilla (Sugarcane leaf hopper), Pectinophora gossypiella (Pink bollworm), Leptocorisa varicornis (Gundhy bug) Hieroglyphus banian (Paddy grass hopper), Dacus cucurbitae (Pumpkin fruit fly).
4. External morphology and identification marks of the following stored grain pests : Sitophilus oryzae (Rice weevil), Tribolium castaneum (Rustred flour beetle),

Rhizopertha dominica (Lesser grain borer/susri),Trogoderma granarium (Khapra beetle), Callosobruchus maculatus (Pulse beetle/Dhora).

5. External morphology and identification marks of the following insects of Medical/Veterinary importance-Mosquitoes (Culex, Anopheles and Aedes), house fly, blow fly, warble fly, and horse fly.
6. A study of life stages of silk worm and honey bees.
7. Collection of insects representing different orders; storage and preservation of insect material.
8. Structure and working of common sprayers : Hand Compression sprayer, Knap sack sprayer.
9. Visit to apiary and godowns for study of infestation.

Option-III : AQUACULTURE

UNIT-
History of inland fisheries in India.
Morphology of a typical fish (carp, cat-fish, freshwater eel, perch). Structure of mouth of different fishes in relation to feeding habits.
Identification and classification of important fishes of Punjab, Haryana & Himachal Pradesh. Bionomics of Labeo rohita, Catla Catla, Cirrhinus mrigala, Wallago attu.

UNIT-II
Exotic Fishes : History, their introduction, morphology, their role in fish culture, impact on native fish fauna.
Induced Breeding : History, technique, chemicals involved in induced breeding, impact on fish culture Pond Culture : Construction of pond, types of pond, hydrobiological factors of water and soil of a fish pond, fertilization of pond, maintenance of pond.
Aquatic weeds and their control both biological and chemical.

UNIT-III
Riverine fisheries of river Sutlej and Beas. Reservoir fisheries : Gobindsagar, Pong Dam.
Culture Systems : Conventional, extensive, intensive, monoculture,polyculture.
Integrated fish farming : Duck-cum-fish farming, Dairy-cum-fish farming, Cattle-cum-fish farming and
Poultry-cum-fish farming.

UNIT-IV
Sewage fed fisheries Cold water fisheries : Mahseer fisheries and trout fisheries Fish Diseases and their control : Viral, bacterial, fungal, helminth, crustacean,diseases due to unhygienic conditions, diseases during transportation.
Fish by-products
Marketing of fish : Fresh fish and preservation of fish.

PRACTICALS : Practical based on Theory Paper ZOO

1. Morphology of a Carp, Cat fish and Perch.
2. Morphometric and meristic characters of a typical fish.
3. Identification of the following fishes using keys to the species :
   Notopterus spp. ; Labeo rohita, L. colbasu, L. bata, Cirrhinus mrigala, Catla Catla, Puntius sarana, Tor putitora, Schizothorax, Aorichthys seenghala, Wallago attu, Callichrous padda, Bagarius bagarius, Heterpneustus fossilis, Channa maruluis, C. striatus, Xenentondon cancila, Cyprinus carpio, Hypophthalmichthys molitrix,Ctenopharyngodon idella, Colisa fasciatus, Mastacembelus armatus.
   For the identification of the fishes, the students can use already prepared keys or can prepare their own keys.
4. Determination of food and feeding habits of locally available fishes on the basis of stomach analysis adopting the following methods :
   a. Frequency occurrence method
   b. Feeding intensity
   c. Point method.
5. Determination of maturity stages (both male and female) of any commercial fish (preserved specimens).
6. Preparation of permanant slides of phytoplanktons and zooplanktons which constitute the food of commercial fishes. Their identification and study of important characters.
7. Identification of aquatic weeds of a fish pond.
8. Estimation of following chemical parameters of the water of a fish pond:
   a. Temperature
   b. pH
   c. Dissolved oxygen
   d. Phosphates
   e. Total dissolved solids
   f. Nitrates
   g. Hardness
   h. Chlorides
   9. Examination of diseased fishes.
   10. Visits to various fish ponds and fish market.

VIII BIO-CHEMISTRY

Paper-A: MOLECULAR BIOLOGY
SECTION-I

DNA Organization: Structure of chromatin – Histones and Nucleosomes. Active and inactive chromatin. Compaction of Chromatin. Chromosomes, Structure of Genome in

eukaryotes. Rearrangements in Genetic Material. Integration of Chromosomes with viruses. Transposition, Experimental proofs for DNA as genetic material.

SECTION-II

DNA Replication : Semiconservative replication-proof. Molecular events and enzymes involved in DNA replication. DNA repair mechanisms. Mutations.

RNA Synthesis : Initiation, elongation and termination during RNA synthesis. Transcription signals. Processing of RNA. Introns and Exons. Nucleases.

Genetic Code and Protein Biosynthesis : Characteristics of Genetic code, Deciphering of Genetic Code. Initiation, elongation and termination of protein chains. Post translational modifications in proteins. Inhibitors of protein biosynthesis.

SECTION-III

Regulation of Gene Expression : Temporal Responses, Lac operon-Jacob Monod Hypothesis. Eukaryotic

Gene Expression.

Recombinant DNA Technology : Restriction endonucleases. Chimeric DNA. Gene Library, Basic Principles in Gene Cloning. Applications of Biotechnology.

SECTION-IV

Membranes : Structure and functions of biological membranes, various models of membrane structure. Transport of solutes across membranes, Sodium pump.

Elementary aspects of the Molecular Biology of cancer and introduction to stem cells. Molecular basis of the Origin and Evolution of Life.

Paper-B : APPLIED BIOCHEMISTRY

SECTION-I

Nutritional functions of water soluble Vitamins: B_1, B_2, Niacin, Pantothenic acid, B_6, Biotin, Folic Acid, B_{12} and Vitamin C. The role of water soluble vitamins as co-enzymes.

General characteristics and classifications of hormones .

Mechanism of Blood coagulation. Blood buffers and role of the kidneys in Acid Base regulation, Role of liver in detoxification of endogenous and exogenous substances.

Structure of voluntary muscle and mechanism of muscle contraction. Mechanism of nerve impulse transmission.

SECTION-II

Essential nutrients. Protein energy malnutrition, starvation and obesity. Respiratory Quotient (R.Q.) of carbohydrates, proteins and lipids. Basic metabolic rates and factors

influencing it. Specific dynamic action of foods.

Protein quality and Nitrogen balance studies. Role of essential amino acids and fatty acid in human diet. Role of dietary fibers in Nutrition. Requirement of minerals (Macro & Micro) and their major Physiological functions.

SECTION-III

Definition of immune system and antigens. Cells involved in immune response. T-cell and B-cells, Immunoglobulins, chemical structure of the Antibody molecule. Haptens and carrier molecules, cell mediated immune response. Complement system, activation and its role in defense.

Brief discussion of various immunological techniques; Precipitation reactions in gels Haemagglutination, Immuno-fluorescence, radio-immunoassay (RIA), enzyme liked immunoadsorbent assay (ELISA) and immunoblotting.

SECTION-IV

Biochemical Principles of Toxicology. Phase I reactions and Cytochrome P 450 enzyme systems. Phase II reactions and various conjugation systems. Effects of nutritional status and metabolic induction on xenobiotic toxicity; Importance of Physico –chemical.

Properties of toxic chemicals. Biochemical basis of organophosphate and carbamate pesticides toxicity.

PRACTICALS

One Practical of three hours per week.

1. Estimation of DNA by diphenylamine method.
2. Effect of temperature on the Viscosity of DNA using Oswald's viscometer.
3. Assays of SGPT and SGOT in serum.
4. Extraction of RNA from yeast and its estimation by Orcinol method.
5. Determination of total protein and A/G ratio in serum.
6. Separation of serum proteins using paper electrophoresis.
7. Estimation of creatinine in urine.
8. Estimation of haemoglobin in blood.
9. Separation of proteins by SDS-Polyacrylamide Gel Electrophoresis.
10. Identification of Sugars in fruit juice using paper chromatography.
11. Determination of nature of inhibition of alkaline phosphatase by cysteine.
12. Determination of proteins by dye binding assay.

IX MICROBIOLOGY

PATHOGENIC MICROBIOLOGY

SECTION-A

Introduction to important diseases caused by Streptococcus, Pneumococcus, Neisseria,

Corynebacterium, Bacillus, Ciostridium, enterobacteriaceae (Proteus, Shigella, Salmonella), Vibrio, Yersinia, Hemophilus, Mycobacterium, The operative pathogenic mechanisms, laboratory diagnosis, prevention and control of these diseases.

SECTION-B

Morphology, pathogenesis, life cycle, laboratory diagnosis, prevention and control of viral diseases viz. Rabies, Polio, Small pox, Herpes, Measles, Influenza and AIDS.

SECTION-C

Introduction to Human mycotic infections viz Cryptococcosis, Dermatophytosis, Blastomycosis, Opportunisitc Mycosis; Candidiasis and Aspergillosis.

SECTION-D

Life cycle, pathogenic, mechanisms and control of parasitic infections viz. amoebiasis, Kala-azar, toxoplasmosis, ascariasis, filarasis, hook worm infections.

FOOD & INDUSTRIAL MICROBIOLOGY

SECTION-A

Food as a substrate for microorganisms, Nutritive value of food stuffs, effect of Hydrogen ion concentration (pH), moisture requirement on food, Important food borne diseases viz. Staphyococcal intoxication, Botulism. Salmonellosis, Shigillosis, Qualitative and Quantitative analysis of food components (proteins, fats, lipids, carbohydrates), Microbiological examination of food products including dairy products, food poisoning caused by bacteria and fungi.

SECTION-B

Contamination, preservation and spoilage in various foods viz. cereals & cereal products (cereal grains, flour, bread, pasta, macroni), sugars & sugars products (Maple, Syrup, Honey, Candy), Vegetables & Fruits, Meat (Fresh meat, fresh beef, hamburger, fish), Milk and Milk products (cheese, butter).

SECTION-C

Production strains Isolation & screening techniques, preservation and genetic modification of Industrial Microorganisms, Fermentation Media, characteristics of ideal production media, common substrateds used in ideal fermentations, Batch and continuous fermentations.

SECTION-D

Yeasts (Baker's) and its uses, fermentation of Beer, Wine and Alcohol, Production of organic acids viz. acetic acid, lactic acid, propionic and butyric acid and mixed acids. Mass transfer in aerobic fermentation.

PRACTICALS

1.Identification of both gram positive and gram negative microorganisms on the basis of :

(i) Morphology.
(ii) Bio-chemical characteristics.
(iii) Serological reactions.

2. Demonstration of pathogens (Viruses, fungi, parasites) in permanent mounted slides.
3. Demonstration of cysts/ovas of protozoa/Helminths.
4. Demonstration of Laboratory grown fungi on sabauraud's agar.
5. Germ tube test for candida albicans.
6. Demonstration of fungi through normal saline/KOH preparation.
7. Quantitative examination of microbial types in raw processed preserved food stuffs.
8. Direct microscopic determination of bacteria in raw, pasteurized milk and reductase test.
9. Various biochemical tests and their importance in Food Microbiology.

X ELECTRONICS

Distribution of marks and total teaching hours will be as under :

UNIT-I :There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry ten marks.

UNIT-II :There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry ten marks.

UNIT-III : There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry ten marks.

UNIT-IV :There will be two questions from this unit. Each question will have two parts. Only one question is to be attempted. Each question will carry ten marks.

UNIT-V :There will be eight questions of small answer type covering the syllabi of all the four units (I-IV). Five questions are to be attempted. Each question will carry two marks.

Paper–A : DATA ACQUISITION SYSTEMS Objectives :

The objective of Data Acquisition Systems course is to familiarize the students with various kinds of Transducers, instrumentation amplifiers, data acquisition system.

Understanding of Power conditioning equipment and Programmable Logic controllers.

UNIT-I

Transducers :Classification, Electrical Transducer, Selecting a transducer, Resistive transducer, Inductive transducer, Capacitive transducer, Piezo-electric transducer, Photoelectric, Phototransistor and thermoelectric transducer.

UNIT-II

Signal Conditioning :OP-AMP, Basic Instrumentation Amplifier and its application. Concept of Filtering.

UNIT-III

Data Acquisition Systems :Objective, Block diagram and functioning of various blocks, types of DAS, Case study (possibly through field visit).

UNIT-IV

Power Conditioning Equipment :Operation, Block diagram of CVT, UPS, SMPS and Inverter with their applications.

Programmable Logic Controllers :Introduction, PLC operation, Architecture and applications, Relays Timers, Counters, Sequencers, Ladder diagram programming, Case Study.

Paper-B : MICROCONTROLLERS AND APPLICATIONS

Objectives :

The objective of Microcontrollers and Applications course is to cover various aspects of 8051 hardware and instruction architecture, basic assembly language programming, and applications.

UNIT-I

Microcontroller 8051 Architecture : Microcontrollers—Evolution and comparison with microprocessor. Microcontroller 8051 Hardware-Oscillator and Clock, Registers, RAM, ROM, I/O ports; External Memory- Connecting, COUNTERS and TIMERS—Timer Counter Interrupts, Timing, Timer Modes of Operation, Counting.

Transmission Modes :Serial Data Input/Output : Serial Data Interrupts, Data Transmission, Data Reception, Serial Data.

UNIT-II

Interrupts :Timer Flag Interrupt, Serial Port Interrupt, External Interrupts, Reset, Interrupt Control, Interrupt Priority, Interrupt destination, Software Generated Interrupts.

Basic Assembly Language Programming :Why assembly language, Flow Charts, Writing and Testing the Program, Programming 8051—lines of code, 8051 instruction set.

Addressing Modes :Immediate, Register, Direct, Indirect, External data moves, Code memory—read only data moves; Opcodes—Push, Pop.

UNIT-III

Logical Operations :Byte-level, Bit-level : Internal RAM, SFR, Boolean operations.

Arithmetic Operations :Flags, Instructions Affecting, Flags, Incrementing and Decrementing. Addition—Unsigned and signed, Unsigned, Signed, Multiple-Byte Signed Arithmetic.

Subtraction : Unsigned and signed, Unsigned, Signed; Multiplication and Division, Decimal Arithmetic.

UNIT-IV

Jump and Call Instructions :

JUMP and CALL program range, Relative, Short absolute, Long absolute; Jumps-Bit, Byte, Unconditional; Calls and Subroutines-subroutines, Calls & the stack, Calls and returns.

Applications of Microcontroller 8051 : 7-segment display, Traffic Lights.

PRACTICALS

Note : Atleast 15 practicals as per availability of apparatus.

1. To interface a toggle switch and an LED with Microcontroller.
2. To generate 1kHz square wave at P 1.1 using timer.
3. To generate I kHz square wave at P 1.1 using timer and 10 kHz at P 1.7 using interrupts.
4. To transmit and receive a character using serial I/O.
5. To copy the contents of register R7 to external RAM location.
6. To interface 4 DIP switches and to drive 7-segment display.
7. To interface a loudspeaker to generate a tone of 440 Hz.
8. To interface a Hex/calculator keypad to microcontroller.
9. To interface a DAC and DAC to microcontroller.
10. To study various active and passive transducers (4 turns).

11. To design an LPF/HPF.
12. To design an LPF using OPAMP.
13. To study load/voltage regulation of a UPS.
14. To study load/voltage regulation of a CVT.
15. To realize AND, OR, NOT, NAND and NOR gates using PLCs.
16. To use single push button to switch ON/OFF of a motor using PLCs.
17. To use a single push button switch ON/OFF of a conveyor and switch off after 20s with PLCs.
18. To realize an astable multivibrator using PLCs.
19. To demonstrate traffic light control using PLCs.
20. To realize a control for an elevator.
21. To realize a paid car parking.
22. To realize the working of a bottling plant.

Proposed Projects (Using Microcontroller/PLCs) : Note : Any one project for one student.

1. Intrusion Alarm System.
2. Furnace Temperature Controller.
3. Traffic Light Controller.
4. Washing Machine Controller.
5. Micro wave Oven Controller.
6. SMPS
7. CVT.
8. Inverter.
9. UPS.