

B.SC. B.ED.

(4 YEARS INTEGRATED COURSE)

UNIVERSITY OF PUNE

SYLLABUS OF S.Y.B.SC.B.ED.

Syllabus of S.Y.B.Sc. B.Ed

CHEMISTRY

Paper III

Physical chemistry (CH- 211)& Organic Chemistry (CH-212)

SECTION-I

Physical chemistry(CH- 211)

1. Thermodynamics (Lectures 08)

Recapitulation of entropy, Thermodynamics of mixing, Entropy change or mixing of ideal gases, Third law of thermodynamics, Statement, Limitation, Importance of third law, evaluation of absolute entropies, use of absolute entropies.

2. Free energy and equilibrium (Lectures 16)

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free energy change for chemical reaction, Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction. Gibb's – Helmholtz equation, properties and significance of Gibb's free energy change, free energy change for ideal gas, Standard

free energy change, Vant Hoff's reaction isotherm. The thermodynamic equilibrium constant, Relation between K_p and K_c for gaseous reactions, Variation of equilibrium constant with temperature, Criteria of chemical equilibrium, physical equilibria, Clapeyron equation and Clausius – Clapeyron equation, Applications

of Clapeyron and Clausius – Clapeyron equation, numericals. Le chatelier – Braun principle, Application of Le chatelier – Braun principle to the formation of ammonia and phosgene.

3. Colligative properties of solutions (Lectures 12)

Introduction, Solution, electrolytes and nonelectrolytes, Meaning of term colligative property, lowering of vapour pressure of solvent in solution, elevation of B.P. of solvent in solution, Landberger's method, freezing point depression, Beckmann's method, Osmosis and Osmotic pressure, Berkeley and Hertley method, Modern osmometer, application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight, Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property, Numericals.

4. Solutions of liquids in liquids (Lectures 9)

Types of solution, Ideal solution, Rault's law, Ideal dilute solution, Henry's law, Application of Henry's law, Vapour pressure – composition diagram of ideal and non ideal solution, Temperature – composition diagram of miscible binary solution, Distillation from temperature – composition diagram, Azeotropes, partially miscible liquid, immiscible liquids, distillation immiscible liquids, determination of molecular weight by steam distillation, numericals.

5. Distribution Law (Lectures 3)

Nernst distribution law, Statement and thermodynamic proof for Nernst distribution law, association and dissociation of solute in solvent, application of distribution law, numericals.

Reference books:

1. Principles of Physical Chemistry by S. H. Maron and C. Prutton 4th edition
2. Physical Chemistry by W. J. Moore 5th edition
3. Physical Chemistry by P. W. Atkins 4th edition
4. Physical Chemistry by D. Alberty

SECTION-II

Organic Chemistry (CH-212)

1 . Stereoisomerism : (Three dimensional aspects of sp³ hybridised carbon)(Lectures 08)

- i. Introduction – optical isomerism, chirality and optical activity. Three dimensional representation of chiral centre, enantiomers, Absolute configuration, R/S system and D/L Nomenclature.
- ii. Optical isomer with two chiral centers (AA and AB type) Erythro, threo, meso, diastereomers.
- iii. Stereoisomerism in cycloalkanes- Baeyer's strain theory, Heats of combustion and relative stability of cycloalkanes, factors affecting the stability of conformation, conformations of cyclohexane, Equatorial and axial bonds in cyclohexane. Monosubstituted cyclohexanes.

2 . Chemistry of Aldehyde and ketones (Lectures 06)

a) Structure of carbonyl groups. b) Nomenclature of Aldehyde and ketones c) Physical properties of aldehydes and ketones d) Preparations of aldehydes from primary alcohol, methyl benzenes, acid chlorides, phenols e) Preparation of ketones from – secondary alcohols, Friedel Craft acylation, nitriles f) Reaction of aldehydes and ketones – (i) Oxidation (ii) reduction – catalytic reduction, metal hydrides – LiAlH₄, NaBH₄. Clemmenson's reduction, Wolf kishner, Thioketal reduction, (iii) Addition of cyanides (iv) Addition of derivatives of ammonia (v) Addition of alcohols (vi) Cannizzaro reaction (vii) Addition of Grignard reagent (viii) Aldol condensation (ix) Perkins reaction (x) haloform reactions g) Analysis of aldehyde and ketones.

3 . Chemistry of Natural and Unnatural carboxylic acids and their derivatives(Lectures 04)

a) Introduction – Natural and unnatural carboxylic acid with example b) Structure of simple carboxylic acid c) Classification d) Nomenclature e) Physical properties f) preparation of carboxylic acid from – primary alcohol, oxidation of alkyl benzenes, carboxylation of Grignard reagent, hydrolysis of nitriles, Kolbe's reaction g) Reaction of carboxylic acids, acidity, salt formation, conversion into acid chlorides, esters, amides, acid anhydrides h) Hell-Volhard Zelinsky reaction (halogenation of aliphatic acids). i) Analysis of carboxylic acids j) Acid derivatives – structure nomenclature, preparations, properties of acid chloride, amides, ester and acid anhydrides.

4 . Aliphatic and Aromatic amines(Lectures 04)

a) Structure b) Classification c) nomenclature d) physical Properties – salt of amine e) preparation of amine from – reduction of nitro compounds, reductive amination, reduction of nitriles, Hoffmann degradation of amides f) Reactions of amines - basicity, salt formation, alkylation, conversion into amides, ring substitution in aromatic amines, Hoffmann elimination, reactions with nitrous acid g) Diazonium salts – preparation and reactions h) Sandmeyer reaction i) Replacement of nuclear 'H' by – I, –OH and H– j) Analysis of amines.

5 . Functional group Inter conversion C-C and C-heteroatom bond (Lectures 07)

Based upon the knowledge of the functional group chemistry studied at F. Y. B. Sc. and S. Y. B. Sc. level the student should be able to suggest – How to bring about the given organic conversions? The conversion should include -

- a) Functional groups inter conversion (FGI) - involving C-C and C-heteroatom bonds.
- b) Converting the given molecule into another molecule with more or less number of carbon atom (Step up and step down reactions)
- c) Suggesting synthetic routes to the given target molecules.
- d) Suggesting the set of reagents to bring about the conversion.
- e) Predict the products if the reactant and conditions are given, including the major and minor products.

6 . Chemistry of Homocyclic and Heterocyclic compounds(Lectures 04)

- a) Naphthalene and Anthracene. Numbering of carbon atoms, nomenclature of derivatives, preparation and reactions of naphthalene and anthracene.
- b) Heterocyclic compounds – Definition, classification, nomenclature of heterocyclic compounds.
- c) Five membered heterocyclic compounds - furan, pyrrole, Thiophene, nomenclature, preparation and reactions, 1, 4-diketones, reactions sulphonation, F. C. Acylation, Diazocoupling, Riemer – Tiemann reaction, catalytic hydrogenations.
- d) Six membered heterocyclic compounds, Pyridine, structure, preparation from picoline, acetylene, acrolein, reactions nitration, sulphonation, bromination, catalytic hydrogenation.

7 . Introduction to Biomolecules(Lectures 15)

a) Introduction : What are different Biomolecules found in and associated with living system?

How is biochemistry directly concern to life i.e. what is the scope and impact of biochemistry on living system? Importance of biochemistry.

b) Carbohydrates : Definition, classification, reactions of carbohydrates – oxidation, reduction osazone formation, ester formation, isomerization, Killiani Fischer synthesis, Ruff degradation, D/L configuration, configuration of D(+) Glucose, Fischer proof and mutarotation, cyclic structure of glucose-Fischer Haworth and chair configuration. Brief account of maltose, sucrose, lactose, cellobiose, polysaccharides - starch, cellobiose

c) Amino acids, proteins, enzymes :

i) α -amino acids : Fischer projection, relative configuration, classification, structure of amino acid, properties and reactions of α -amino acids.

ii) Proteins : Formation of peptide linkage, feature of peptide linkage, α -helical conformation, β -plated structure, primary, secondary, tertiary and quaternary structure of proteins.

iii) Enzymes : General information, co-enzymes, and vitamins hormones, prosthetic groups and their role, enzymes specificity, classification of enzymes with examples.

d) Nucleic acids : Structure of RNA and DNA

e) Lipids : General introduction, classification with examples.

Reference Books :

Ref. 1 : Organic Chemistry - 6h Ed. Morrison and Boyd Prentice Hall of India Pvt Ltd, New Delhi - 2001.

Ref. 2 : Outline of Biochemistry 5h Ed., Conn, Sumpf, Bruening and Roy Doi John wiley 1987.

Ref. 3 : Stereochemistry by Eliel

CHEMISTRY

Paper IV

Inorganic Chemistry (CH-221) & Analytical Chemistry (CH-222) SECTION-I

Inorganic Chemistry (CH-221)

1. Genral Principles of Metallurgy (Lectures 05)

Introduction occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, connentaion, various methods of concentration such as hand picking, gravity separation, magnetic separation. Froth flotation, Calcinations, Roasting etc. Reducation, various methods of reduction such as smelting, Aluminothermic process and electrolytic reduction, Refining of metals, various methods of refining such as poling, liquation, electrolytic and vapour phase refining.

(2) Metallurgy of Aluminium (Electrometallurgy) (Lectures 04)

Occurrence, physiochemical principles, Extraction of Aluminium, Purification of bauxite by Bayer's process, Electrolysis of alumina, application of aluminum and its alloys.

(3) Metallurgy of Iron and steel (Pyrometallurgy) (Lectures 06)

Occurrence, concentration, calcination, smelting physio-chemical principles, reactions in the blast furnace, wrought iron, manufacture of steel by Bessemer and L.D. process, its composition and applications.

(4) Chemistry of p-block elements (III A to VIII A groups) (Lectures 06)

Position of elements in the periodic table, electronic configuration of elements,

Reasoning of anomalous behaviour of first member of each group. Trends in the properties of the elements with respect to following points - size of atoms and ions, ionisation potential, electron negativity, oxidation state, reactivity. Bonding and shapes of following molecules – B₂H₆, PCl₅, Al₂Br₆, CO₂, SF₆, H₂SO₄, Allotropes of carbon diamond, graphite and fullerene.

(5) Chemistry of d-block Elements(Lectures 07)

Position of d-block in periodic table, trends in properties of these elements w.r.t. (a) size of atoms & ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex foramation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density, melting & boiling points.

6) Chemical Toxicology (Lectures 05)

- i) Toxic chemicals in the environment.
- ii) Impact of toxic chemistry on enzymes.
- iii) Biochemical effect of Arsenic.
- iv) Biochemical effect of cadmium.
- v) Biochemical effect of Lead.
- vi) Biochemical effect of Mercury.
- vii) Biological methylation.

7) Acids, Bases, Solvents and reactions in non-aqueous solvents (Lectures 08)

Acids Bases, Solvents and Reactions in non-aqueous solvents : (8)

Definition of acids and bases, Arrhenius theory, Lowry bronsted theory (in brief), Lewis concept, Lux-flood theory, strength of acids and bases. Trends in strength of hydracids and oxacids, properties of solvents - M. P., B. P. dipole-moments, dielectric constant, Lewis acid-base character, protonic acidity, Types of solvents. Hard & soft acids and bases

(8) Corrosion and Passivity (Lectures 07)

(a) Corrosion : Definition of corrosion, Types of corrosion, Atmospheric, Immersed, Mechanism of electrochemical corrosion, Factors affecting corrosion - position of metal in E. C. S., purity effect of moisture, effect of oxygen, pH, physical state of metal, alloy formation, making metal cathodic, controlling external condition. Coating - galvanising, Tinning, electroplating, metal cladding, organic coating.

(b) Passivity : Definition, Theories of passivity - (i) oxide film theory (ii) Gaseous film theory

(iii) Physical film theory, valence theory, catalytic theory, Allotropic theory, electrochemical passivity.

Reference :

- 1.Introduction to electrochemistry by S. Glasstone 2nd Ed.
- 2.Advanced Inorganic chemistry, Satyaprakash, Tuli, Basu
- 3.Text book of Inorganic chemistry, P.L. Soni
- 4.Concise, Inorganic chemistry by J.D. Lee
- 5.General Chemistry-Raymond Chang
- 6.Fundamental chemistry A. K. Dee. (3rdEd)
7. Basic Inorganic chemistry by F. A. Cotton,

SECTION-II

Analytical Chemistry (CH-222)

1. Introduction to Analytical Chemistry (Lectures 03)

Importance, the analytical process, sampling (solid liquid and gases), Hazards in sampling, sample treatment (aqueous acid, fluxes, ashing)

2) Inorganic Qualitative Analysis (Lectures 07)

Basic principles, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals. Removal of interfering anions (phosphate and borate) Detection of acidic radicals.

3) Analysis of organic compounds (Lectures 08)

- a) Types of organic compounds. Character tests and reactions of different functional groups.
- b) Analysis - Estimation of C, H(O) by combustion tube, Detection of nitrogen, sulphur, halogen and phosphorus by Lassaigne's test.
- c) Estimation of nitrogen by Duma's Kjeldahl's method. Estimation of Halogen, Sulphur and phosphorus by Carious method.
- d) Determination of empirical and molecular formula, Numerical problems.

4. Errors in Quantitative Analysis (Lectures 05)

Accuracy and precision, methods of expressing accuracy, methods of expressing precision, classification of errors, minimization of errors, significant figures and computations, Numerical problems.

5. Volumetric Analysis (Lectures 18)

Introduction to volumetric analysis, calibration of apparatus (burette, pipette and volumetric flask) standard solution and their preparation. Various methods of expressing the concentration of solutions. Equivalent weight in different types of reactions, primary and secondary standard solutions, Numerical problems.

Classification of volumetric analysis

5. a) Acid base (neutralisation) titrations : Theory of indicators, theory of acid base indicators, mixed and universal indicators, neutralisation curves for strong acid - strong base, weak acid - strong base, weak base - strong acid, weak acid - weak base, polybasic acid with strong base. Displacement titrations, choice of indicators, numerical problems.

5. b) Oxidation-Reduction Titration :

Principle, titration curves with reference to Fe (II) and Ce(IV) reactions, detection of end points, Numerical problems.

5. c) Complexometric Titration:- Principal, Mg- EDTA complex, Standardisation,

5. d) Iodometry and Iodimetry

General discussion, detection of end point, difference between iodometry and iodimetry. Standardisation of sodium thiosulphate solution with potassium dichromate and iodine method.

Applications – Estimation of copper in crystalline copper sulphate, Estimation of available chlorine in bleaching powder.

5. e) Argentimetry

Standardisation of silver nitrate solution by Mohr's method and by Fajan's method, determination of chloride, bromide and iodide individually and in a mixture.

6. Solvent Extraction (Lectures 07)

Introduction, Principle of solvent extraction, Distribution coefficient, distribution ratio, relation between Distribution coefficient and distribution ratio, factors affecting solvent extraction, percentage extracted, solvent extraction method, separation factor, batch extraction, counter current extraction, application of solvent extraction, numerical problems.

Reference Books

- 1) Analytical chemistry by G. D. Christain, John Wiley and sons, 5th Edition.
- 2) Fundamentals of Analytical chemistry by D. A. Skoog, D. M. West and F. J. Holler, 6th Edn.
- 3) A text book of macro and semi micro Qualitative analysis by A. I. Vogel, 5th Edition

- 4) Vogel's text book of Quantitative Inorganic Analysis revised Edn. J. Barret, R. C. Danney, G.H. Jeffery and J. Mendham ELBS.
- 5) Quantitative organic Analysis 4th Ed. A. I. Vogel ELBS
- 6) Quantitative Inorganic Analysis 4th Ed A. I. Vogel ELBS
- 7) Instrumental methods of chemical Analysis by Chatwal and Anand 6th Edition
- 8) A text book of Quantitative Inorganic Analysis A. I. Vogel 3rd Edition.
- 9) Basic concept of analytical chemistry- S. M. Khopkar.
- 10) Instrumental methods of chemical analysis-Willard, Deen & Merrit-6th Edition.
- 11) Analytical chemistry by Skoog.

Chemistry Practical II

Physical Chemistry Practical (Any Five)

1. To determine the critical solution temperature of phenol – water system
2. To determine molecular weight of given organic liquid by steam distillation.
3. To determine molecular weight of given electrolyte (KCl) and non electrolyte (Urea) by Landberger's method and to study abnormal molecular weight of electrolyte.
4. To determine the degree of dissociation of potassium chloride by Landberger's method.
5. To determine molecular weight of solute by depression in freezing point method.
A. Naphthalene – Sulphur B. Naphthalene – acetanilide
C. Naphthalene – m-dinitrobenzene.
6. To study association of benzoic acid in benzene by Beckmans method (Freezing point depression)
7. To determine the distribution coefficient of iodine between water and carbon tetrachloride and hence to determine the molecular condition of iodine in both solvent.
8. Determination of solubility of benzoic acid at different temperature and to determine ΔH of dissolution process.
9. To study neutralization of acid (HCl) by base (NaOH) & CH₃COOH by NaOH and H₂SO₄ by NaOH.

References:

1. Systematic experiment physical chemistry by Rajbhoj and Chondekar, Anjali publication
2. Experiment in Physical Chemistry by R. C. Das and Behere Tata Mc. Graw Hi

Organic Chemistry Practicals (Any 5)

1) Organic Qualitative Analysis (6 compounds, two compounds per day) Identification of organic compounds through –

- a) Type determination of organic compound b) preliminary tests c) detection of elements (Sodium fusion tests)
- d) Detection of functional groups e) melting point / Boiling point
 - i) Acids (Any two) : benzoic, salicylic, phthalic, cinnamic, oxalic and salicylic acid
 - ii) Phenols (Any two) : α -naphthol, β -naphthol, resorcinol, o-nitrophenol, p-nitrophenol
 - iii) Base (Any two) : Aniline, p-toluidine, diphenylamine, N, N-dimethylaniline, o-nitroaniline m-nitroaniline, p-nitroaniline
 - iv) Neutral (Any two) : Benzaldehyde, glucose, fructose, acetone, ethylmethyl ketone, acetophenone, methyl acetate, ethyl acetate, naphthalene, Anthracene, Nitrobenzene, mdinitrobenzene, Acetamide, Urea, Acetanilide, Chloroform, Carbon tetrachloride, Thiourea.

2) Organic Preparation (Any two)

(With crystallisation, m. p. and TLC)

3) Aspirin from salicylic acid

- ii) Benzoic acid from toluene
- iii) Phthalimide from phthalic anhydride
- iv) Osazone form glucose and mannose

3) Purification of organic liquids by distillation (any two mixtures) one volatile and one non volatile

Ref. 1 Organic Qualitative Analysis – A. I. Vogel

Inorganic Chemistry Practicals(Any 5)

Inorganic Qualitative Analysis of Binary Mixtures (including phosphates and borates). Sodium carbonate extract is to be used wherever necessary for detecting acidic radicals. (Minimum five Mixtures)

Ref. Inorganic Qualitative Analysis by Vogel

Analytical Chemical Practicals (Any Five)

1. a) Preparation of standard 0.05 N oxalic acid solution and standardisation of approx. 0.05N KMnO_4 solution.
b) Determination of the strength of given H_2O_2 solution with standard 0.05 N KMnO_4 solution.
2. Estimation of Aspirin from a given tablet and find errors in quantitative analysis
 - a) Find absolute and relative error with reference to the mean of the analysis
 - b) Find standard deviation and relative standard deviation with reference to the mean of the analysis
3. a) A choice of best indicator for titrating between approx. 0.05 N NaOH and standard 0.05N oxalic acid solution and standardisation of NaOH by using best indicator.
b) Determination of acetic acid in commercial vinegar by titrating with standard NaOH using selected best indicator.
4. Determination of the percentage available chlorine from bleaching powder
5. Determination of the percentage of dissolved oxygen by Winkler's method
6. Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black-T indicator (Back titration method)
7. Estimation of copper iodometrically.
8. Estimation of Fe^{+2} using external indicator.
9. Report on one day industrial educational visit.

Note:- All volumetric experiments should be performed by using two burette method.

Ref. 1 Quantitative Inorganic Analysis by A. I. Vogel 4th Ed.

Ref. 2 Qualitative Inorganic Analysis by A. I. Vogel 4th Ed.

PHYSICS

Paper III

MATHEMATICAL METHODS IN PHYSICS (PH211)& ELECTRONICS(PH-212)

SECTION-I

MATHEMATICAL METHODS IN PHYSICS (PH211)

1. Complex Numbers (12 Periods)

- 1.1 Introduction to complex numbers.
- 1.2 Algebra of complex numbers
- 1.3 Argand diagram, algebra of complex numbers using Argand diagram
- 1.4 Rectangular, polar and exponential forms of complex numbers.
- 1.5 De-Moivre's Theorem (statement only)
- 1.6 Trigonometric, hyperbolic and exponential functions.
- 1.7 Powers, roots and log of complex numbers.
- 1.8 Applications of complex numbers to determine velocity and acceleration in curved motion
- 1.9 Problems

2. Vector Algebra (04 Periods)

- 2.1 Introduction to scalars, vectors: dot product and cross product.
- 2.2 Scalar triple product and its geometrical interpretation.
- 2.3 Vector triple product and its proof.
- 2.4 Problems.

3. Vector Analysis (16 Periods)

- 3.1 Differentiation of vectors with respect to scalar.
- 3.2 Scalar and vector fields.
- 3.3 Vector differential operator.
- 3.4 Gradient of scalar field and its physical significance.
- 3.5 Divergence of scalar field and its physical significance

- 3.6 Curl of vector field and its physical significance
- 3.7 Vector integrals: line, surface and volume integral with their examples.
- 3.8 Statements of Gauss-Divergence theorem and Stoke's theorem.
- 3.9 Vector identities
- 3.10 Problems.

4. Partial Differentiation (12 periods)

- 4.1 Definition of partial differentiation
- 4.2 Successive differentiation
- 4.3 Total differentiation
- 4.4 Exact differential
- 4.5 Chain rule
- 4.6 Theorems of differentiation
- 4.7 Change of variables from Cartesian to polar co-ordinates.
- 4.8 Implicit and explicit functions
- 4.9 Conditions for maxima and minima (without proof)
- 4.10 Problems.

5. Differential Equation (04 Periods)

- 5.1 Frequently occurring partial differential equations (Cartesian coordinates)
- 5.2 Degree, order, linearity and homogeneity of differential equation.
- 5.3 Singular points ($x = 0$, $x = x_0$) of differential equation.
- 5.4 Problems.

Reference Books:

- 1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
- 2. Mathematical Physics by B. D. Gupta
- 3. Mathematical Physics by Rajput and Gupta
- 4. Mathematical Methods in Physical Science by Mary and Boas
- 5. Vector analysis by Spiegel and Murrey
- 6. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.

SECTION-II

ELECTRONICS (PH-212)

(For students Not opting Electronics at F.Y.B.Sc.)

1. Basic Electronic Components (03 Lectures)

- 1.1 Definitions of resistance, capacitance and inductance
- 1.2 Equations defining resistance, capacitance and inductance
- 1.3 Concept of reactance and impedance
- 1.4 Transformers: Centre tapped, Step-up, Step-down, Various energy losses in transformer.

2. Network Theorems (07 Lectures)

- 2.1 Kirchhoff's laws (revision)
- 2.2 Voltage and current divider circuits
- 2.3 Thevenin's theorem
- 2.4 Norton's theorem
- 2.5 Super-position theorem
- 2.6 Maximum power transfer theorem (All theorems 2.3 to 2.6 without proof)
- 2.7 Problems.

3. Semiconductor Devices (12 Lectures)

- 3.1 Revision of bipolar junction transistor, types, symbols and basic action
- 3.2 Configurations (Common Base, Common Emitter & Common Collector)
- 3.3 Definition of alpha, beta and their relations.
- 3.4 Input, output and transfer characteristics of CE and CB configurations.
- 3.5 Biasing methods
- 3.6 AC and DC load lines, Operating point (Q point)

3.7 Transistor as a switch, Transistor as an amplifier (only concept)

3.8 Frequency response of CE transistor amplifier

3.9 Unijunction transistor: principle, construction and operation

3.10 Problems.

4. Operational Amplifiers and Oscillators(12 Lectures)

4.1 Operational amplifier: IC 741- Block diagram, Characteristics: ideal and practical

4.2 Concept of virtual ground

4.3 Inverting and non-inverting operational amplifiers with concept of gain.

4.4 Operational amplifier as an adder and subtractor.

4.5 Oscillators: concept of positive and negative feedback

4.6 Barkhausen criteria for an oscillator

4.7 Phase shift oscillator and Wien bridge oscillator (Derivation for frequency and feedback factor for both oscillators expected)

4.8 Problems.

5. Power Supplies(06 Lectures)

5.1 Half wave, Full wave and Bridge rectifier, ripple factor, capacitor filter

5.2 Difference between regulated and unregulated power supply

5.3 Definition of Line and Load regulation

5.4 Series and Shunt regulators- Block diagram and circuit of regulated power supply using discrete components, Simple current limiting circuit

5.5 Problems.

6. Digital Electronics (08 Lectures)

6.1 Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal

6.2 Addition and subtraction of binary numbers and binary fractions using one's and two's complement.

6.3 Basic logic gates: OR, AND, NOT, Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables

6.4 Boolean Algebra, Boolean Equations

6.5 De Morgan's theorems and its verification

6.6 Problems.

Reference Books:

1 Electronics Principles, Malvino, 7th Edition TaTa Mc-Graw Hills.

2 Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.

3 Op Amp and Linear integrated circuits, Ramakant Gaikwad, Prentice Hall of India Pub.

4 Integrated Circuits, Botkar, Khanna Publications, New Delhi

5 Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub.

PHYSICS

Paper IV

OSCILLATIONS, WAVES AND SOUND(PH-221) & OPTICS (PH-222)

SECTION-I

OSCILLATIONS, WAVES AND SOUND(PH-221)

1. Undamped Free Oscillations (09 periods)

1.1 Different types of equilibria (stable, unstable, and neutral equilibrium)

1.2 Potential well and periodic oscillations, Approximation of a general potential well $V(x)$ to a parabola for small oscillations

1.3 Definition of linear and angular S.H.M.

1.4 Differential equation of S.H.M. and its solution (exponential form)

1.5 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method)

1.6 Lissajous's figures and its uses, Applications (mechanical, electrical and optical)

1.7 Problems.

2. Damped Oscillations (09 periods)

2.1 Introduction

- 2.2 Differential equation of damped harmonic oscillator and its solution, discussion of different cases.
- 2.3 Logarithmic decrement
- 2.4 Energy equation of damped oscillations
- 2.5 Power dissipation
- 2.6 Quality factor
- 2.7 Application: LCR series circuit
- 2.8 Problems.

3. Forced Oscillations (10 periods)

- 3.1 Forced oscillation with one degree of freedom
- 3.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation
- 3.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapor lamp), electrical (LCR Circuit)
- 3.4 Velocity and Amplitude resonance
- 3.5 Sharpness of resonance
- 3.6 Energy of forced oscillations
- 3.7 Power dissipation
- 3.8 Quality factor and Bandwidth
- 3.9 Application of forced oscillations (LCR circuit)
- 3.10 Equation of coupled oscillations, electrically coupled oscillations
- 3.11 Problems

4. Wave Motion (08 periods)

- 4.1 Differential equations of wave motion in continuous media
- 4.2 Equations for longitudinal waves and its solution (one dimension only)
- 4.3 Equation for transverse waves and its solution (one dimension only)
- 4.4 Energy density and intensity of a wave
- 4.5 Discussion of seismic waves
- 4.6 Problems

5. Doppler Effect (06 periods)

- 5.1 Explanation of Doppler effect in sound
- 5.2 Expression for apparent frequency in different cases.
- 5.3 Asymmetric nature of Doppler effect in sound
- 5.4 Doppler effect in light, symmetric nature of Doppler effect in light.
- 5.5 Applications: Red shift, Violet shift, Radar, Speed trap, Width of a spectral line.
- 5.6 Problems

6 .Sound (06 periods)

- 6.1 Definition of sound intensity, loudness, pitch, quality and timber
- 6.2 Acoustic intensity level measurement
- 6.3 Acoustic pressure and its measurement
- 6.4 Reverberation time and Reverberation of a hall
- 6.5 Sabine's formula (without derivation)
- 6.6 Stroboscope
- 6.7 Problems

Reference Books:

1. Waves and Oscillations, Stephenson
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, S. P. Puri, Tata McGraw- Hill, Publishing co. ltd.
4. A text book of sound, Subramanyam and Brijlal, Vikas Prakashan
5. Sound, Mee, Heinmann, Edition - London
6. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd.

SECTION-II OPTICS (PH-222)

1 .Geometrical Optics (Lectures 08)

- 1.1 Introduction to development of Optics
- 1.2 Lenses: thin and thick lenses
- 1.3 Lens equation
- 1.4 Lens maker's formula
- 1.5 Cardinal points of an optical system
- 1.6 Combination of two thin lenses (equivalent lenses) (including derivation for focal length and cardinal points).
- 1.7 Problems.

2. Lens Aberrations (Lectures 08)

- 2.1 Introduction
- 2.2 Types of aberrations: monochromatic and chromatic aberration
- 2.3 Types of monochromatic aberration and their reduction
 - 2.3.1 Spherical aberration
 - 2.3.2 Coma
 - 2.3.3 Astigmatism
 - 2.3.4 Curvature of field
 - 2.3.5 Distortion
- 2.4 Types of chromatic aberration: Achromatism (lenses in contact and separated by finite distance)
- 2.5 Problems.

3. Optical Instruments (Lectures 10)

- 3.1 Simple microscope and Compound microscope
- 3.2 Telescopes, Reflection and transmission type of telescope
- 3.3 Eyepieces: Huygen's eyepiece, Ramsden's eyepiece, Gauss's eyepiece
- 3.4 Constant deviation spectrometer
- 3.5 Problems

4. Interference and Diffraction (Lectures 12)

- 4.1 Classification of interference of thin films, Interference by division of amplitude
- 4.2 Interference by wedge shaped film: Interference due to reflected light and transmitted light.
- 4.3 Fringes of equal inclination, equal thickness, equal chromatic order (FECO fringes), colors of thin films
- 4.4 Interferometry: Michelson's interferometer and Fabry-Perot interferometer
- 4.5 Types of diffraction: Fresnel's diffraction and Fraunhofer's diffraction
- 4.6 Fraunhofer's diffraction at double slit and its analytical treatment, Fraunhofer's diffraction at N slits
- 4.7 Plane diffraction grating
- 4.8 Rayleigh's criterion for resolution
- 4.9 Resolving power of a grating
- 4.7 Problems

5 .Polarization (Lectures 10)

- 5.1 Introduction to polarization
- 5.2 Types of polarization- plane, circular, elliptical
- 5.3 Polarization by reflection of light
- 5.4 Brewster's law
- 5.5 Law of Malus
- 5.6 Polarisation by double refracting uniaxial crystals
- 5.7 Linear polarizer (Polaroid)
- 5.8 Fabrication of linear polarizer by Nicol prism
- 5.9 Problems.

Reference Books:

- 1. Optics, fourth edition, Pearson education, E. Hetch, A. R. Genesan
- 2. A Text book of Optics, N.Subhramanyam, Brijlal, M. N. Avadhanulu, S. Chand publication.

3. Introduction to Optics, Third Edition, F.L. Pedrotti, Pearson Education
4. Physical Optics by A.K.Ghatak, McMillan, New Delhi
5. Fundamental of Optics, F.A.Jenkins, H.E.White, McGraw-Hill international Edition.
6. Principles of optics, D.S. Mathur, Gopal Press, Kanpur
7. Optics and Atomic physics, D.P.Khandhelwal, Himalaya Publication Bombay.
8. Fundamentals of optics- Francies A Jenking, Harvey E.White, Tata McGraw Hill

PHYSICS

PH-223: PRACTICAL COURSE II

Oscillations, Waves and Sound (Any 4 experiments)

1. Resonance Pendulum: Determination of acceleration due to gravity (g)
2. Logarithmic decrement (in air and water)
3. Study of coupled oscillators comprising two simple pendulum (Mechanical)
4. Study of oscillations under gravitational and magnetic field.
5. Velocity of sound by Ruben's flame method
6. Stroboscope: Determination of frequency of AC mains or tuning fork.
7. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
8. Velocity of sound by phase shift method.
9. Audibility of human ear.
10. Directional characteristics of Microphone.

Optics (Any 4 experiments)

1. Newton's Ring: Determination of wavelength of monochromatic light source (λ)
2. Dispersive power of glass prism
3. Total internal reflection (using spectrometer, Na/Hg Source, glass prism) and determination of refractive index of a liquid.
4. Diffraction at straight edge/cylindrical obstacle
5. Optical activity of sugar solution (polarimeter)
6. Goniometer to determine cardinal points and focal length.
7. To determine temperature of sodium flame.
8. Double refracting prism.

Electronics (Any 6 experiments)

1. Circuit Theorems. (Thevenin's, Norton's and Maximum power transfer theorem)
2. Transistor characteristics (CE configuration)
3. RC coupled transistor amplifier (single stage)
4. Study of rectifiers (half wave and full wave), line and load regulations
5. I-V characteristics of UJT
6. Zener as a regulator.
7. Study of Wein bridge/Phase shift oscillator (using IC 741)
8. OPAMP as inverting and non inverting amplifier
9. OPAMP as an adder/subtractor.
10. Study of logic gates (using IC) and verification of De Morgan's theorem.
11. Use of CRO (AC/DC voltage measurement, frequency measurement).
12. To measure displacement (linear and angular) using potentiometer/variable inductor/variable capacitor.
13. To measure force using load cell.
14. To measure pressure using elastic diaphragm (in variable Capacitor/Bourden Tube)
15. To measure magnetic field using Hall Probe.

Computer (2 experiments)

1. Plotting of given data with Excel software.
2. Plotting various trigonometric functions using Excel/origin/graph softwares.

Ex: $x \sin x$ and $\sin x$

e^x and $\log x$

e^{-x} and $\cos x$

$\log_{10}x$ and $\tan x$

Additional Activities (Any Two)

- 1) Demonstrations- Any 4 demonstrations equivalent to 2 experiments
- 2) Study tour with report equivalent to 2 experiments
- 3) Mini project equivalent to 2 experiments
- 4) Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities should be equivalent to twenty experiments.

MATHEMATICS

PaperIII

Calculus of Several Variables (MT:211), Differential Equations & MT:212(A)/ Numerical Analysis MT:212(B)

SECTION-I

Calculus of Several Variables (MT:211)

1. Limits and Continuity : [6 lectures]

- (1) Functions of two and three variables.
- (2) Notions of limits and continuity.
- (3) Examples.

2. Partial Derivatives : [4 lectures]

- (1) Definition and examples.
- (2) Chain Rules.

3. Differentiability : [14 lectures]

- (1) Differential and differentiability and necessary and sufficient conditions for differentiability.
- (2) Higher ordered partial derivatives.
- (3) Schwartz's theorem, Young's theorem with proof.
- (4) Euler's theorem for homogeneous functions.
- (5) Mean Value theorem, Taylor's theorem for functions of two variables

4. Extreme Values : [8 lectures]

- (1) Extreme values of functions of two variables.
- (2) Necessary conditions for extreme values.
- (3) Sufficient conditions for extreme values.
- (4) Lagrange's method of undetermined coefficients.

5. Multiple Integrals : [16 lectures]

- (1) Double integrals, evaluation of double integrals.
- (2) Change of order of integration for two variables.
- (3) Double integration in Polar co-ordinates.
- (4) Triple integrals.
- (5) Evaluation of triple integrals.
- (6) Jacobians, Change of variables. (Results without proofs)
- (7) Applications to Area and Volumes.

Text book:

Shanti Narayan and P.K. Mittal, A Course of Mathematical Analysis (12th Edition, 1979), S. Chand and Co..

References:

- (1) M.R. Spiegel, Advanced Calculus: Schaum Series.
- (2) D.V. Widder, Advanced Calculus (IInd Edition), Prentice Hall of India, New Delhi, (1944).
- (3) T.M. Apostol, Calculus Vol. II (IInd Edition), John Willey, New York, (1967).

SECTION-II

Differential Equations & Numerical Analysis(MT:212AMT:212B)

1. Differential Equations of first order and first degree: [20 lectures]

- (1) Variables separable form.
- (2) Homogeneous Differential Equations and Exact Differential Equations. Examples of Non- Homogeneous equations.
- (3) Condition for exactness. (Necessary and sufficient condition)
- (4) Integrating factor, Rules of finding integrating factors (Statements only).
- (5) Linear Differential Equations, Bernoulli's equation.

2. Application of Differential Equations : [8 lectures]

- (6) Orthogonal trajectories.
- (7) Growth and decay.

3. Linear Differential Equations with constant coefficients: [20 lectures]

- (8) The auxiliary equations.
- (9) Distinct roots, repeated roots, Complex roots, particular solution.
- (10) The operator $1/f(D)$ and its evaluation for the functions $xm, eax, eaxv, xv$ and the operator $1/(D^2+a^2)$ acting on $\sin ax$ and $\cos ax$ with proofs.
- (11) Method of undetermined coefficients, Method of variation of parameters, Method of reduction of order.

Text Book:

- (1) Rainville and Bedient, Elementary Differential Equations, Macmillan Publication .
- (2) Daniel Murray, Introductory Course in Differential Equations, Orient Longman

Reference books:

- (1) Shanti Narayan, Integral Calculus, S. Chand and Company.
- (2) G.F. Simmons and S. Krantz, Differential Equations with Applications and Historical notes, Tata Mc-Graw Hill.

Numerical AnalysisMT:212(B)

1. Errors: [4 lectures]

- (1) Rounding off numbers to n significant digits, to n decimal places.
- (2) Absolute, relative and percentage errors.

2. Solution of Equations: [12 lectures]

- (1) Location of roots.
- (2) Descartes' Rules.
- (3) Sturm's theorem (without proof).
- (4) Regula Falsi theorem.
- (5) Newton- Raphson Method.
- (6) Gauss-Seidel Method.

3. Fitting of Polynomials: [6 lectures]

- (1) Least Square Method.
- (2) Fitting of
 - (i) Straight Line.
 - (ii) Second Degree Curve.
 - (iii) Power Function axb
 - (iv) Exponential Function $aebx$

4. Interpolation: [12 lectures]

- (1) Operators Δ, ∇, E and their relations.
- (2) Fundamental theorem of difference calculus.

- (3) Newton's Interpolation Formulae (Forward and Backward with proofs).
- (4) Lagrange's Interpolation Formula with proof.
- (5) Divided difference formula and Newton's divided difference formula.

5. Numerical Integration: [8 lectures]

- (1) General quadrature formula.
- (2) Trapezoidal rule.
- (3) Simpsons's $1/3^{rd}$ rule.
- (4) Simpsons's $3/8^{th}$ rule.

6. Numerical solution of first order ordinary differential equations: [6 lectures]

- (1) Euler's method.
- (2) Modified Euler's methods.
- (3) Runge - Kutta Methods 1st and 2nd order.

Text Books :

- (1) H.C. Saxena; Finite differences and Numerical Analysis, S. Chand and Company.
- (2) S.S. Sastry; Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India, 1999.

Note: Refer to S.S. Sastry for Chapter 1. Remaining Chapters from H.C.Saxena.

Reference Book:

- (1) K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.

MATHEMATICS
Paper IV
Linear Algebra (MT:221)&
Vector Calculus MT:222(A)/ Discrete Mathematics MT:222(B)
SECTION-I
Linear Algebra (MT:221)

1. Vector Spaces : [14 lectures]

- (1) Definitions and Examples.
 - (2) Vector Subspaces.
 - (3) Linear Independence.
 - (4) Basis and Dimensions of a Vector Space.
 - (5) Row and Column Spaces of a matrix.
- Row rank and Column rank.

2. Linear Transformations: [12 lectures]

- (1) Linear Transformation, representation by a matrix.
- (2) Kernel and Image of a Linear Transformation.
- (3) Rank-Nullity theorem.
- (4) Linear Isomorphism.
- (5) $L(V, W)$ is a vector space. Dimension of $L(V, W)$ (Statement only)

3. Inner Product spaces: [16 lectures]

- (1) The Euclidean space and dot product.
- (2) General inner product spaces.

(3) Orthogonality, Orthogonal projection onto a line, Orthogonal basis.

(4) Gram-Schmidt Orthogonalization.

(5) Orthogonal Transformation.

4. Eigen values and Eigen vectors: [6 lectures]

(1) Rotation of axes of conics.

(2) Eigenvalues and eigenvectors.

Text Books:

S. Kumaresan , Linear Algebra: A Geometric Approach, Prentice Hall of India, New Delhi, Chapters: 2, 4, 5 (excluding Arts 4.4.10 -4.4.12, 5.3. 5.6, 5.7, 5.9), 7.1, 7.2. 1999.

Reference Books:

(1) M. Artin, Algebra, Prentice Hall of India , New Delhi, (1994).

(2) K. Hoffmann and R. Kunze Linear Algebra, Second Ed. Prentice Hall of India New Delhi, (1998).

(3) S. Lang, Introduction to Linear Algebra, Second Ed. Springer-Verlag, New York, (1986).

(4) A. Ramchandra Rao and P. Bhimasankaran, Linear Algebra, Tata McGraw Hill, New Delhi (1994).

(5) G. Schay, Introduction to Linear Algebra, Narosa, New Delhi, (1998).

(6) L. Smith, Linear Algebra, Springer –Verlag, New York, (1978).

(7) G. Strang, Linear Algebra and its Applications. Third Ed. Harcourt Brace Jovanovich, Orlando, (1988).

(8) T. Banchoff and J. Werner, Linear Algebra through Geometry. Springer-Verlag, New York, (1984).

(9) H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed., Wiley, (1994).

SECTION-II

Vector Calculus MT:222(A) & Discrete Mathematics MT:222(B)

1. Vector functions of one variable: [10 lectures]

1) Limit and continuity.

2) Derivatives.

3) Derivability in relation to algebraic operations: constant vector functions.

4) Limits, continuity and partial derivatives of vector function of two and three variables.

5) Total differentials

2. Curves in three dimensional spaces: [6 lectures]

1) Curves in three dimensional spaces.

2) Tangent vector.

3) Normal plane and osculating plane.

4) Normal plane at a point and fundamental planes.

5) Orthonormal triad of unit vectors

3. Differential operators: [18 lectures]

1) The operator del, scalar and vector fields.

Gradient of a scalar point function, properties and its geometrical interpretation.

2) Directional derivatives of a scalar point function.

3) Divergence and curl of a vector point function and its properties.

4) Physical interpretation of Divergence and Curl , Solenoidal and Irrotational vector field.

4. Vector Integration : [14 lectures]

1) Line Integral.

2) Surface Integral.

3) Volume Integral.

4) Green's theorem with proof.

5) Gauss's Divergence Theorem(statement only).

6) Stokes's Theorem(Statement only), Examples on sphere, cube, cylinder.

Text book:

1) Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S.Chand and Company,(2005).
Articles:1.1 to 1.13, 2.1 to 2.5, 6.1 to 6.17, 7.1 to 7.11.

Reference books:

- (1) M.R. Spiegel, Advanced Calculus : Schaum Series.
- (2) D.V. Widder, Advanced Calculus (IInd Edition), Prentice Hall of India , New Delhi,(1944).
- (3) John M. H. Olmsted, Advanced Calculus, Eurasia Publishing House, New Delhi(1970)
- (4) T.M. Apostol , Calculus Vol. II (IInd Edition), John Wiley, New York, (1967).

Discrete Mathematics MT:222(B)

1. Mathematical Induction: [4 lectures]

- 1) Introduction.
- 2) Strong Induction.
(Section 2.4 of [1])

2. Counting: [14 lectures]

- 1) Permutations.
- 2) Combinations.
- 3) The Pigeonhole principle excluding Extended Pigeonhole principle
- 4) Recurrence relations.

3. Order Relations and Structures: [12lectures]

- 1) Relations and Digraphs.
- 2) Partially Ordered Sets.
- 3) External elements of Partially Ordered Sets.
- 4) Lattices.
- 5) Finite Boolean Algebras.
- 6) Functions on Boolean Algebras.
- 7) Circuit Design

4. Topics in Graph Theory: [10 lectures]

- 1) Graphs (including Subgraphs)
- 2) Euler Paths and Circuits.
- 3) Hamiltonian Paths and Circuits.
- 4) Transport networks.
- 5) Matching problems.

6. Trees: [4 lectures]

- 1) Definitions.
- 2) Spanning Trees
- 3) Minimal Spanning Trees.
- 4) Kruskal's Algorithm.

Text Books:

- (1) Bernard Kolman, Robert C. Busby, Sharon Cutler Ross and Nadeem-ur-Rehman: Discrete Mathematical Structures, Fifth Edition, Pearson Education, Inc., 2004.
- (2) Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall of India Pvt Ltd, 1974.

Reference Book:

- (1). Kenneth H. Rosen, Discrete Mathematics and its Applications, Fifth Edition, Tata McGraw-Hill Publishing Company Ltd., 2003.

MathematicsPractical II

***Practical Based on PaperI&PaperII**

Botany

PaperIII

Fundamentals of Plant Systematics and Plant Ecology & Fundamentals of Plant Physiology

SECTION-I

Fundamentals of Plant Systematics and Plant Ecology

1. Introduction to Plant Systematics (3Lecturers)

- 1.1 Definition, need, objectives and importance, scope of taxonomy and systematics.
- 1.2 Systematics- Principles, Concepts ,Different aspects of taxonomy- Identification, Nomenclature, Classification, Kinds of systems- Artificial, Natural and Phylogenetic
- 1.3 Taxonomic Literature- Flora, Monographs, Revisions, Reference books.

2. Aspects of Taxonomy (4L Lecturers)

- 2.1 Phases of Taxonomy – pioneer, consolidation, experimental, encyclopedic.
- 2.2 Broad outline classification of Bentham & Hooker’s system of classification of seed plants up to series,
- 2.3 Merits and limitations of Bentham & Hooker’s system.

3. Sources of data for Systematics (5 Lectures)

Enlisting gross features of Morphology, Anatomy, Cytology, Embryology, Phytochemistry, Micromorphology and Molecular biology, (one example from each major group of plants.)

4. Botanical Nomenclature (4 Lecturers)

- 4.1 ICBN, History, principles and some important rules of nomenclature,
- 4.2 Binomial nomenclature, coining of generic names and specific epithets.
- 4.3 Ranks & endings of taxa names.
- 4.4 Principles of priority, effective and valid publication,
- 4.5 Single and double authority citation, *Nomina conservanda*.

5. Study of Plant Families (8L Lecturers)

Study of following families with reference to systematic position, salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Meliaceae, Myrtaceae, Rubiaceae, Solanaceae, Asclepiadaceae, Euphorbiaceae and Liliaceae

Plant Ecology

1. Introduction to plant ecology. (3 Lecturers)

- 1.1 Introduction, concept, definition, Autecology and Synecology,
- 1.2 Plant ecology in relation to environmental biology and disaster management.
- 1.3 Importance of ecology,

2 .Ecosystem Ecology: (11 Lecturers)

- 2.1 Introduction, ecological organization – species population, community ecosystem and biosphere.
- 2.2 Kinds of ecosystem, structure and function of ecosystem, abiotic components, biotic components and their role, ecosystem dynamics.
- 2.3 Ecosystem energetics – energy flow, processes within ecosystem, nutrient cycling, food chain, food web, ecological pyramids – pyramids of number, biomass, energy and homeostasis.
- 2.4 Bio-geo-chemical cycles-concept, enlisting, details of water and carbon cycle.
- 2.5 Composition and functioning of ecosystem: i) Simple – pond ecosystem, ii) Complex – forest ecosystem iii) Artificial – cropland ecosystem.

3. Ecological grouping of plants: (5 Lectures)

Ecological grouping of plants with reference to their significance of adaptive external and internal features: Hydrophytes, Mesophytes, Xerophytes

4. Community dynamics (Ecological Succession): (5 L)

- 4.1 Introduction, causes - physiographic, climatic and biotic.
- 4.2 Succession – a) Principles b) Types – primary and secondary c) Succession on land, rock and in water
- 4.3 Stages – Nudation, Migration. Competition, Ecesis and Climax.

SECTION-II

Fundamentals of plant physiology

1. Introduction to plant physiology (2 Lectures)

- 1.1 Why to study plant physiology?

- 1.2 Brief History of plant physiology,
- 1.3 Plants as organic laboratories,
- 1.4 Applications of plant physiology.
- 2. Biophysical phenomenon in plant cell (9 Lectures)**
 - 2.1 Energy transduction in cell – Bioenergetics, Laws of thermodynamics, ATP as biological energy transfer molecule.
 - 2.2 Solutions, suspensions and colloids – True solutions, percentage, molarity, molar, buffer, molal solutions, normal solutions, pH, acids, bases, salts, colloids, emulsions, hydrophilic and hydrophobic systems, gels, colloidal system – properties, Plant cell as colloidal system.
 - 2.3 Permeability – Theories of cell permeability.
 - 2.4 Diffusion – Definition, mechanism, laws of diffusion, factors affecting diffusion, diffusion pressure deficit (DPD), significance of diffusion in plants.
 - 2.5 Osmosis – Introduction, definition, types of membranes, mechanism, osmotic pressure (OP), types of osmosis – endosmosis, exosmosis, turgor pressure (TP) and wall pressure (WP), relation between OP, DPD (Suction pressure) and TP, significance of osmosis.
 - 2.6 Plasmolysis – Definition, mechanism, deplasmolysis, significance of Plasmolysis.
 - 2.7 Imbibition – Introduction, definition, mechanism, imbibition pressure, significance.
- 3. Absorption of water - (5 Lectures)**
 - 3.1 Water, “the elixir of life” - Role of water in plant life.
 - 3.2 Structure of water molecule, physico-chemical properties of water.
 - 3.3 Sources of water - soil water, gravitational, hygroscopic and capillary.
 - 3.4 Types of soil – sand, clay and loam; Water holding capacity of soil.
 - 3.5 Root hair as water absorbing part of the plant.
 - 3.6 Mechanism of water absorption - i) Active absorption.
ii) Passive absorption.
 - 3.7 Factors affecting rate of water absorption.
- 4. Ascent of sap - (4 Lectures)**

Introduction, Mechanism of ascent of sap – i) Root pressure theory, ii) Physical force theories: Capillarity, Imbibition, Atmospheric pressure and Cohesion-tension Factors affecting ascent of sap.
- 5. Transpiration - (5 L)**

Introduction, Definition, Transpiration, guttation, exudation and evaporation, Significance of transpiration, Types of transpiration – Cuticular, Lenticular and Stomatal; Pathway of stomatal transpiration; Stomata – Structure, number, distribution and mechanism of opening and closing of stomata. K⁺ - Pump theory explaining stomatal opening and closing. Factors affecting transpiration. Atitranspirants.
- 6. Mineral nutrition - (6 Lectures)**

Introduction. Essential elements, criteria of essentiality and methods of assessment of essentiality – sand culture, solution culture (hydroponics) and aeroponics. Enlisting of major and minor elements. Role and deficiency symptoms of N, P and K, Role of micronutrients in agriculture and horticulture. Role of mycorrhiza in agriculture. Liquid fertilizers, foliar nutrition and ion antagonism. Plants as mineral indicators.
- 7. Mineral salt absorption - (4 Lectures)**

Introduction, soil solution, soil pH and availability of nutrients. Regions of root involved in absorption. Mechanism of salt absorption – i) Passive absorption : Ion exchange. Donnan’s equilibrium, ii) active absorption : Lundegearth’s theory. Factors affecting salt absorption.
- 8. Plant growth - (3 Lectures)**

Introduction, Definition, Growth and development. Kinetics (phases) of growth, Regions of growth and Measurement of growth. Factors affecting growth – External and Internal.
- 9. Plant growth regulators - (4 Lectures)**

Introduction and definition Discovery, site of synthesis and practical applications of – i) Auxins, ii) Gibberellins, iii) Cytokinins, iv) Ethylene, v) Absciscic acid.
- 10. Physiology of flowering - (6 Lectures)**

Introduction.

Regulation of sexuality. Phytohormones and flower initiation.

Photoperiodism – Concept, definition, Short Day Plants, Long Day Plants and Day Neutral Plants, Photoperiodic induction, phytochromes and flowering. Endogenous rhythms. Flowering hormone.

Photoperiodism and C/N ratio. Vernalization – Concept, mechanism and site of vernalization, cold induction technique and applications of vernalization.

Botany

Paper IV

Structural Botany (Anatomy, Embryology and Palynology)/ Fundamentals of Plant Biotechnology

SECTION-I

Structural Botany (Anatomy, Embryology and Palynology)

Anatomy: (20 Lectures)

1. Introduction. (1 Lectures)

2. Plant Tissues: (4 Lectures)

2.1 Ground tissues: parenchyma, chlorenchyma, collenchyma, and sclerenchyma.

2.2 Vascular tissues: xylem, phloem.

2.3 Secretory tissues: laticiferous, glandular.

3. Epidermal tissue system: (3 Lectures)

3.1 Structure and function: uniseriate epidermis, multiple epidermis,

3.2 Stomata – structure and function.

3.3 Epidermal outgrowths- nonglandular, glandular.

4. Mechanical tissue system: (4 Lectures)

4.1 Principles involved in distribution of mechanical tissues – Inflexibility, Incompressibility, Inextensibility and Shearing stress.

4.2 Tissues providing mechanical support, their distribution in leaf, stem and root of dicots and monocots.

5. Normal secondary growth. (4 Lectures)

5.1 Introduction and need.

5.2 Process in annual and perennial stem.

5.3 Structure and function of periderm, bark, tyloses, growth rings and lenticels.

6. Anomalous secondary growth. (4 Lectures)

6.1 Definition, causes.

6.2 Growth in *Bignonia* (dicot stem) and *Raphanus* (dicot root).

6.3 Growth in *Dracaena* (monocot stem).

Embryology (20 Lectures)

1. Definition and scope. (1 L)

2. Microsporangium: structure of tetrasporangiate anther, tapetum types, sporogenous tissue. (3 L)

3. Microsporogenesis: process cytokinesis and its types Types of microspore tetrad (2 L)

4. Male gametophyte: structure of pollen grain, development of male gametophyte. (2 L)

5. Megasporangium: structure and types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous. (2 L)

6. Megasporeogenesis: tenuinucellate and crassinucellate ovules, types of megaspore tetrads. (2 L)

7. Female gametophyte: structure of typical 8-nucleate embryo sac, types and development of embryo sacs – monosporic, bisporic and tetrasporic. (3 L)

8. Fertilization: entry of pollen tube, discharge of pollen tube content, fusion of gametes, syngamy, triple fusion, significance of double fertilization. (2 L)

9. Endosperm types: nuclear, helobial, cellular. (1 L)

10. Embryo - structure of dicot and monocot embryo (development not expected) (1 L)

Palynology (8 Lectures)

1. Definition, applications and importance. (3 L)

2. Pollen structure - Polarity, symmetry, size and shape, apertures, exine stratification.(4 L)
3. NPC system. Principles and general outline 1 L

SECTION-II

Fundamentals of Plant Biotechnology

1. An Introduction to plant Biotechnology. (6Lecture)

- 1.1 What is biotechnology?
- 1.2 Biotechnology - an interdisciplinary subject.
- 1.3 Biotechnology and the developing world. (Role)
- 1.4 Substrates for biotechnology –
 - i) A biomass strategy.
 - ii) Natural raw materials.
 - iii) Availability of byproducts.
 - iv) Chemical and petrochemical feed stocks.
 - v) Raw materials for future of biotechnology.

2. Plant Genome (6Lectures)

- 2.1 Nuclear Genome – Genetic materials, DNA replication, mechanism of DNA amplification, plant gene structure.
- 2.2 Chloroplast genome – Structure and organization.
- 2.3 Mitochondrial genome – size, structure and mitochondrial plasmids.
- 2.4 Cytoplasmic male sterility.

3. Genetic Engineering - (4Lectures)

- 3.1 Introduction, genetic engineering - safety, social, moral and ethical aspects.
- 3.2 Release of genetically manipulated organisms to the environment.
- 3.3 Genetic modification and food uses.

4. Bioprocess Technology. (6lecturesL)

- 4.1 Introduction.
- 4.2 Principles of microbial growth.
- 4.3 Bioreactor.
- 4.4 Scale up.
- 4.5 Media design for fermentation process.
- 4.6 Solid substrate fermentation.
- 4.7 Downstream processing.

5. Enzyme Technology - (4Lectures)

- 5.1 The nature of enzyme.
- 5.2 The applications of enzymes.
- 5.3 Technology of enzyme production.
- 5.4 Immobilized enzymes.

6. Biomass Technology for energy (4Lectures)

- 6.1 Photosynthesis – the ultimate energy source.
- 6.2 Sources of Biomass.
- 6.3 Ethanol from biomass.
- 6.4 Methane from biomass
- 6.5 Biodisel from plants.

7. Biomass Technology for food (Single cell protein) (4Lectures)

- 7.1 The need for proteins.
- 7.2 Acceptability and toxicology of SCP.
- 7.3 SCP from wastes.
- 7.4 SCP from agricultural crops and residues
- 7.5 SCP from algae.
- 7.6 The economic implications of SCP.

8. Tissue culture Technology - (10Lectures)

- 8.1 Introduction, totipotency.

8.2 Media composition and preparation.

8.3 Culture technique –

i) Sterilization and aseptic culture technique.

ii) Organogenesis and Embryogenesis.

iii) Single cell culture.

iv) Haploid production.

v) Somatic hybridization and cybridization, artificial / synthetic seeds.

vi) Applications of PTC.

vii) Design and economics of PTC Laboratory.

9. Environmental Biotechnology - (4 Lectures)

9.1 Introduction

9.2 Waste water treatment

9.3 Landfill technology.

9.4 Environmental sustainability.

Botany Practical II

Fundamentals of Plant Systematics and plant ecology (any six)

1. Study of Tools of Taxonomy – field, library and laboratory (01 P)

2. How to study plant family? (Description of plant in botanical terms) (01 P)

3. Study of plant families (any four and at least one from monocot) (02 P)

4. Botanical excursion and submission of photographs of wild plants. (01 P)

5. Study of ecological adaptations. (02 P)

A) Hydrophytes

B) Xerophytes

6. Study of vegetation by list count quadrat method. (01 P)

7. Study of Ecological instruments. (any four) (01 P)

8. Study of forest / grassland ecosystem. (01 P)

Fundamentals of Plant Biotechnology (any six)

9. Demonstration of DNA Model. (01 P)

10. Demonstration of comparison of GM Plants with Non-GM Plants. (01 P) (BT cotton, BT Tomato)

11. Estimation of citric acid by assay method. (01 P)

12. Cultivation of *Spirulina* and Study of its commercial products. (01 P)

13. Plant tissue culture technique. (02 P)

A) Instrumentation, Sterilization, Media preparation.

B) Inoculation of Explants / Meristem / Nodal sector / Embryo.

14. Visit to biotechnology institute and submission of visit report with respect to design of PTC lab. (01 P)

15. Demonstration of synthetic seeds (01 P)

16. Visit to waste water treatment plant and submission of its report. (01 P)

Anatomy, Embryology and Palynology (any six)

17. Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (dicot and monocot). (01 P)

18. Study of mechanical tissues. (01 P)

19. Study of normal secondary growth in dicot stem – *Annona* and *Moringa*. (01 P) (Double stained temporary preparation).

20. Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem. (01 P) (Double stained temporary preparation).

21. Study of tetrasporangiate anther – T.S. of young and mature anther. (01 P)

22. A) Study of types of ovules. (01 P)

B) Study of germination of pollen grain on stigma (in vivo).

23. Study of dicot and monocot embryo. (01 P)

24. A) Study of pollen grains by acetolysis method. (02 P)

B) Study of pollen grains by NPC observation.

25. Observation of exine ornamentation (any five) (01 P)

Plant physiology (any six)

26. Determine water holding capacity (WHC), pH and moisture content of soil (01 P)

27. Determine Diffusion Pressure Deficit by using potato tubers. (01 P)

28. Determine rate of transpiration under different conditions of shade, wind and light. (01 P)

29. Demonstration Experiments. (Suction due to transpiration, Curling Experiment, Imbibition Pressure, Effect of root promoting hormone, Arc Indicator) (01 P) 30. To study the process of plasmolysis. (01 P)

31. Preparation of phosphate buffer. (01 P)

32. Isolation of mycorrhizal fungi of any crop plant with the help of soil dilution technique and Identification of any two fungal forms. (02 P)

N.B. Botanical excursion tours and visits are compulsory to all the students.

ZOOLOGY

General Zoology and Biological Techniques Part-I(ZY-211)& Applied Zoology-part-I(212)

SECTION-I

General Zoology and Biological Techniques Part-I(ZY-211)

Unit 1. General Topics(Lectuers 10)

1.1 Locomotion in Protista (Amoeboid, Ciliary and Flagellar). 2

1.2 Economic importance of Protista 1

1.3 Patterns of coelom and segmentation in animals:

a) Acoelomate, Pseudocoelomate and coelomate animals. 3

b) Pseudosegmentation, Metamerism, Cephalothorax abdomen and Cephalothorax specialization.

1.4 Diversity of mouth parts in Insects (Biting and chewing, piercing and sucking , siphoning , sponging , chewing and lapping types). 2

1.5 Shell and foot diversity in Mollusca: Representative examples from each class. 3

Unit 2) Developmental Biology(Lectuers 12)

2.1 Introduction and theories of Developmental Biology (Epigenesis, Pangenesis and Germ plasm). 2

2.2 Gametogenesis in animals in brief and gross structure of gametes. 2

2.3 Types of eggs: on the basis of distribution of yolk . 1

2.4 Concept and significance of Fertilization : process and significance 2

2.5 Cleavage and blastulation : Definition, pattern, structure of blastula and its types 2

2.6 Gastrulation and Morphogenetic movements in early development (invagination, epiboly, emboly, involution, ingression and delamination). 2

2.7 Test Tube Baby : Technique , Advantages and Disadvantages . 1

Unit3) Animal Type: (Lectuers 08)

3.1 **Starfish**—External characters, Digestive system, food and feeding, Water vascular system, Reproductive system and development. 8

Unit 4) Biological Techniques: (Lectuers 15)

4.1 Concept of sterilization: Filtration, Dry heat sterilization, Wet sterilization, Radiation. 2

4.2 Separation of Biomolecules: **a)** Centrifugation (sedimentation, density gradient).

b) Chromatography: Principle and applications i) Thin layer ii) Gel filtration iii) Ion exchange,

c) Electrophoresis: Paper and gel (agarose) 3

4.3 Cell counting techniques: using haemocytometer (by using suitable stain) 1

4.4 Quantification techniques: **a)** Measuring of pH using paper strips , pH meter.

b) Principle of colorimeter and spectrophotometer.

c) Measurement of blood pressure. 3

4.5 Introduction to microtechnique: Fixation- fixatives, their types, merits and demerits dehydration, clearing, cold and hot impregnation, block preparation, sectioning and staining for tissue sections (nuclear and cytoplasm) 4

4.6 Microscopic measurements: i) micrometry (using the ocular and stage micrometer)

ii) using Camera Lucida: construction and working. 2

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37. Tools and Techniques in Microbiology, Nath & Upadhyay.
38. Practical Pharmacognosy, Khandelwal K.R., Nirali Prakashan.

SECTION-II

General Zoology and Biological Techniques Part-II(221)

Unit 1) General Topics: (Lecturers 10)

- 1.1 Types of scales and fins in fishes. 2
1.2 Parental care in Amphibia. 1
1.3 Aquatic and desert (Extreme hot and cold) adaptations in vertebrates. 2
1.4 Beak and feet modifications in Birds. 2
1.5 Migration in Birds. 1
1.6 Fossils, fossilization, types, Dating of fossils and examples of fossils. 2

Unit2) Animal Type: (Lecturers 20)

2.1 Study of *Scoliodon*—External characters, Digestive system, Respiratory system, Blood vascular system, Nervous system, sense organs, Male urinogenital and Female reproductive system 20

Unit 3) Biological techniques: (Lecturers 15)

- 3.1 a) Preparation of solutions: Molar, Normal, Percent solutions, PPM, PPB,
b) Dilutions—serial dilutions
c) Preparation of different stains: Methylene blue, Eosin, Haematoxylin, Janus green- B, Acetocarmine, Aceto-orcein
3.2 Principles of different types of microscopes: a) Simple b) Compound c) Phase contrast
d) Electron e) Fluorescence f) Confocal. 4
3.3 Haematology: Blood cell count, Hb %, Lipid (HDL and LDL), Glucose Tolerance Test (GTT) Thyroid hormones (T1, T2, T3, T4) and significance of each 5
3.4 Applications of computers for Zoological Sciences. 2
3.5 Maintenance of following laboratory equipments: compound/dissecting microscopes, Refrigerator, oven, pH meter and centrifuge machine and safety measures in laboratory.

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Applied Zoology

SECTION-I

Fisheries and Agricultural Pests and their control

Unit 1) Fisheries: (Lecturers 23)

- 1.1 Types of Fisheries (in brief): a) Inland (freshwater) fisheries b) Marine fisheries: Coastal, Offshore and deep sea fisheries, c) Brackish water fisheries. 2
1.2 Habit, habitat and culture methods of following freshwater forms: Rohu (*Labeo rohita*) b) Catla (*Catla catla*) c) Mrigal (*Cirrihinus mrigala*)
d) Giant prawn (*Macrobrachium rosenbergi*). 6
1.3 Harvesting methods of following marine forms: a) Harpadon b) Mackerel c) Lobsters d) Pearl oysters. 4
1.4 Crafts and gears in Indian Fishery: a) Crafts—Catamaran, Machwa, Dinghy,

Dug out canoe, Built- up. b) Gears---- Gill net, Dol net, Purse, Rampani, Cast net. 5

1.5 Fishery byproducts: a) Fish meal b) Fish flour c) Liver Oil d) Ising glass e) Fish glue

f) Fish manure.g) Fish fin soup h) Ladies Purse 3

1.6 Fish preservation techniques: a) Chilling b) Freezing c) Salting d) Drying e) Canning. 3

Unit 2) Agricultural Pests and their control: (Lectuers 22)

2.1 Introduction to Pests, Concept of Pest and Types of pests (agricultural, household, stored grains, structural, veterinary, forestry and nursery). 2

2.2 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures).

a) Jowar stem borer b) Blister beetle c) Red cotton bug d) Castor Semilooper

e) Brinjal fruit borer f) Aphids g) Mango stem borer h) Lemon butterfly

i) Pulse beetle j) Rice weevil. 7

2.3 Non insect pests: Rats and Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels. 2

2.4 Pest control practices: Cultural control, Physical control, Mechanical control, Chemical

2.5 control, Biological control, Herbal control, Pheromonal and autocidal control. And concept of IPM. 8

2.6 Plant protection appliances: Rotary duster, knapsack sprayer and cynogas pump , hazards of pesticides and antidotes. 3

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Applied Zoology-part-II(222)

SECTION-II

Apiculture and Sericulture

Unit 1) Apiculture: (Lectuers 23)

1.1 Introduction to Apiculture and study of habit, habitat and nesting behaviour of

Apis dorsata, *Apis indica*, *Apis floera*, *Apis mellifera*. 3

1.2 Life cycle, Colony organization and division of labour. 3

1.3 Bee behaviour and communication. 3

1.4 Bee keeping equipments: a) Bee box (Langstroth type) b) Honey extractor c) Smoker

d) Bee-veil e) Gloves f) Hive tool g) Brush h) queen excluder. 3

1.5 Bee keeping and seasonal management. **2**

1.6 Bee products (collection methods, composition and uses): **a)** Honey **b)** Wax **c)** Venom
d) Propolis **e)** Royal jelly **f)** Pollen. **2**

1.7 Diseases and enemies of Bees: **a)** Bee diseases- Protozoan, Bacterial,
viral, Fungal. **3**

b) Bee pests- Wax moth (Greater and Lesser), wax beetle. **1**

c) Bee predators- Bee eater, King crow, Wasp, Lizard, Bear, Man. **1**

1.8 Bee pollination and management of bee colonies for pollination . **2**

Unit 2) Sericulture: (Lecturers 22)

2.1 Study of different types silk moths, their distribution and varieties of silk produced by Mulberry, Tassar, Eri and Muga silk worms in India . **3**

2.2 External morphology and life cycle of *Bombyx mori*. **2**

2.3 Cultivation of mulberry: **a)** Varieties for cultivation **b)** Rainfed and irrigated mulberry cultivation- Fertilize schedule, Pruning methods and leaf yield **3**

2.4 Harvesting of mulberry: **a)** Leaf plucking **b)** Branch cutting **c)** Whole shoot cutting **1**

2.5 Silk worm rearing: **a)** Varieties for rearing **b)** Rearing house **c)** Rearing techniques

d) Important diseases and pests **6**

2.6 Preparation of cocoons for marketing. **1**

2.7 Post harvest processing of cocoons: **a)** Stiffling, sorting, storage, deflossing and riddling, **b)** cocoon cooking, reeling equipment and rereeling, washing and polishing. **2**

2.8 Sericulture as labour intensive Agro- industry.

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Zoology Practical Course-II

Practical No.1:a) Study of permanent slides of mouth parts of the following Insects:

Mosquito, Plant bug/ Bed bug, Butterfly and House fly, cockroach **(D)**

b) Whole mount preparation of any suitable material **(E)**

Practical No. 2: Study of shell and foot of the following Molluscs:(any five) Chiton, Patella, Solen, Dentalium, Sepia, Mytilus, Cypraea (Cowrie), Aplysia, Nautilus. **(D)**

Practical No. 3: a) Study of external characters and digestive system of starfish. **(E)**

b) Temporary preparation of gonads from starfish. **(E)**

Practical No. 4: a) Study of water vascular system of starfish. **(E)**

b) T.S. of arm of starfish, Bipinnaria larva and types of pedicellariae
(Permanent slides) **(D)**

Practical No. 5: a) Study of permanent slides: Amphioxus , Insect ,Frog ,Hen Eggs **(D)**

b) Study of Blastulae and Gastrulae of amphioxus, Frog and chick. **(D)**

Practical No. 6: a) Preparation of standard acid (succinic acid) and alkali and their standardization.

b) Preparation of various solutions (normal, molar, and percent) and ppm/ppb by serial dilutions **(E)**

Practical No.7 a) Limits of cleanliness **(E)**

b) Study of use of oven, autoclave and filter for sterilization of Glass ware, Medium and Serum. **(D)**

Practical No. 8: a) Study of principles of Colorimetry and Electrophoresis. **(D)**

- b) Study of principle and working of pH meter and Measurement of pH of Milk, Pepsi, Lemon juice etc. using pH paper and pH meter. **(E)**
- Practical No. 9** a) Study of principle of Chromatography and separation of amino acids mixture by ascending Paper Chromatography. b) Study of centrifugation technique **(D)**
- Practical No.10:** a) Measurement of blood pressure.and Estimation of haemoglobin percentage **(E)**
- Practical No. 11:** b) Differential count of W. B. Cs.
- Practical No.12:** Total count of R. B. Cs.
- Practical No 13:** Total count of W.B.C.
- Practical No. 14:** Identification, Classification and study of habit, habitat and economic importance of the following: a) Rohu, Catla, Mrigal, Mackerel, Bombay duck, Eel, Pomphret. b) Prawn, Crab, Lobster, Oyster, Sepia. **(D)**
- Practical No. 15:** a) Study of maintenance of Aquarium. b) Types of scales and tail fins in fishes. c) Different types of crafts and gears in fishing (models/charts/ Photographs/line drawings etc). **(D)**
- Practical No. 16:** a) Study of any five insect pests and any five non-insect pests, corresponding to theory course. b) Study of any one plant protection appliance (sprayers / duster). **(D)**
- Practical No. 17:** Study of modifications of beaks and feet in birds. a) **Beaks:** water and mud probing, tearing and piercing, fruit eating and mud straining. b) **Feet:** Perching, Raptorial, Cursorial and Swimming (museum specimens/ photographs/ models/line drawings). **(D)**
- Practical No. 18:** Study of fossils: Trilobite, Fossil snail, Fossil fish, Archaeopteryx, Stegosaurus and Iguanodon (Museum specimens/ photographs/ models/ line drawings) **(D)**
- Practical No. 19:** a) Study of external characters,sexual dimorphism and digestive system of *Scoliodon*. and mounting of placoid scales **(E)**
- b) Study of Male and Female reproductive systems of *Scoliodon*. **(D)**
- Practical No. 20:** Study of heart and arterial system of *Scoliodon*. **(E)**
- Practical No. 21:** a) Study of brain of *Scoliodon*. **(E)**
- b) Study of temporary preparations of ampullae of Lorenzini from *Scoliodon*. **(E)**
- c) Study of cranial nerves, eye ball muscles and membranous labyrinth of *Scoliodon*. **(D)**
- Practical No. 22:** a) External morphology and life-cycle of *Bombyx mori*. b) Any five equipments in Sericulture. **(D)**
- Practical No. 23:** a) Study of life cycle of Honey Bee. b) Caste system in Honey Bee. **(D)**
- c) Study of mouth parts, appendages, pollen basket and sting apparatus of worker bee. **(E)**
- Practical No. 24:** Study of a) Bee keeping equipments b) Bee products c) Bee pests, parasites and enemies. **(D)**
- Practical No. 25:** Compulsory study tour/Visit to following Institutes:
a) Fishery b) Sericulture c) Apiculture d) Agriculture University/College/ any agricultural farm./sea shore.
- Practical No. 26:** Preparation of temporary and permanent whole mount of small animals or their parts. and measurement under microscope. **(E)**

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11. Hand Book of Practical Sericulture, 1987. S. R. Uttal and M. N. Narasimhana, Central Silk Board, Bangalore.

Psychology of Development and Learning.

Section I

1. Educational Psychology (4hrs)
 - 1.1 Meaning & nature of educational psychology
 - 1.2 Methods of studies of Human behaviour:
 - a) Introspection b) Observation
 - c) Experimental d) Case study
 - 1.3 Use of psychology to the teacher.
2. Growth & development of the learner. (12hrs)
 - 2.1 Nature & importance of heredity and environment, social heredity.
 - 2.2 Stages of growth & development: later childhood & adolescence (physical, mental, emotional, social).
 - 2.3 Role of school in growth & development of the learner.
3. Individual differences related to academic achievement (16 hrs)
 - 3.1 Nature of individual differences: inter and intra
 - 3.2 Causes of Individual differences:-
 - (a) Personal: Readiness to learn, abilities, aptitude, motivation, age, gender & maturity, interest, attention & attitude.
 - (b) Environmental: socio-economic status, rural-urban home environment, 'e' environment.
 - 3.3 Individual differences w.r.t.: personality, self concept, achievement motivation, study habits, emotions.
- 4 . Special Education (8 hrs)
 - 4.1 Identification of children with special needs.
 - 4.2 Need of special education.
 - 4.3 Catering for their special education needs.
 - 4.4 Concept of integrated & inclusive education.
 - 4.5 Adjustment- causes of maladjustment dealing with Child abuse & Child exploitation.

Section II

- 5 .Learning. (11hrs)
 - 5.1 Nature of learning process.
 - 5.2 Theories of learning & their educational importance: Trial & Error, introduction to cognitivism, Behaviourism, & constructivism and learning application of Behaviourism and constructivism.
 - 5.3 Transfer of Learning: Concept & types.
6. Role of Teacher in school. (8hrs)
 - 6.1 Teacher effectiveness.
 - 6.2 Teacher-student, student-student interaction. (cooperative
 - 6.3 Teacher behaviour & classroom achievement, effects of teachers
 - 6.4 Organization of favorable school climate.
7. Higher Mental Processes. (10hrs)
 - 7.1 Sensation, Perception, Imagination, Concept formation, mind mapping.
 - 7.2 Sense training programme
 - 7.3 Thinking: types & tools of thinking
 - 7.4 Developing thinking, reasoning, problem solving & creativity
8. Intelligence. (11hrs)
 - 8.1 Brain: Structure & function.
 - 8.2 Brain-based learning.

8.3 Concept of intelligence: definition, concept of M.A. and C.A, (Types Intelligence- Artificial Intelligence Emotional Intelligence Multiple intelligence)

8.4 Memory: Process (registration & retention) & types, ways of Enhancing memory, recall & recognition.

Practical Work

1) Each student will perform at least 5 experiments from the list of Psychology experiments given below. (15 marks).

Psychology Test

Scoring Key of Practical : Total marks = 15

1. Initial information : (Marks 3)

Details of the student teacher/Purpose of choosing the test. (1 Marks)

Details of the test : Name, Objectives, description (reliability, validity, no. of items, type- verbal/ non verbal, scoring method). (2 marks)

2. Administration of the test : (Marks 4)

Date, time (1 Mark)

Age group, number of students, schools, instructions (3Marks)

3. Analysis of Data: (Marks 8)

Statistical tools used (2 Marks)

Tabular/ graphical presentation (2 Marks)

Interpretation (2 Marks)

Conclusion (2 Marks)

Total Marks :

1. Initial Information: 3 Marks

2. Administration of the test: 4 Marks

3. Analysis of Data: 8 Marks

Total Marks 15 Marks

2) Each student will administer any 1 of the psychological group test given below & interpret the results. Intelligence, Attitude, Aptitude, Personality, Self concept, Interest, Adjustment, Creativity. (15marks).

List of Experiments

Topic	Title	Apparatus
1. Learning	To study the process of learning with the help of learning curve.	i. Letter-digit substitute sheet. ii. Stop watch
2. Learning	(a) To study the process of learning by Trial & Error (b) To study the process of transfer of learning	i. Mirror, star pattern ii. Stop watch
3. Memory	To study the process of recall and recognition	i. A list of 20 words. ii. A recognition list of 80 words
4. Memory	To determine & compare the immediate memory span of an individual for visual & auditory presentation	A list of numbers containing 3 to 12 digits
5. Fatigue	To study the different stages of learning in a continuous mental work	i. Multiple Test sheet/letter cancellation sheet. ii. Stop watch
6. Image Sense	To study & compare the vividness of the audio-visual imagery of the individual (Galton's method)	List of stimulus words with audio & visual

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