B.SC. B.ED.
(4 YEARS INTEGRATED COURSE)

UNIVERSITY OF PUNE

SYLLABUS OF T.Y.B.SC.B.ED.

Chemistry
Paper V
Physical Chemistry(CH-331)
Section I

1. Kinetics of Homogeneous Reactions (Lectures 14)

molecularity and order,
First order reactions and its characteristics,
Second order reactions (with equal and unequal initial concentrations) and its characteristics,
Third order reactions (with equal initial concentrations) and its characteristics,
Pseudomolecular reactions,
Effect of temperature on rate of reaction,
The energy of activation.

2. Adsorption (Lectures 08)

Adsorption phenomenon
Adsorption of gases by solids,
Types of adsorption,
Adsorption isotherm - Freundlich and Langmuir ,
Adsorption of solute by solids,
Applications of adsorption,
Catalysis of gaseous reactions by solid surfaces,
One reactant gas slightly, moderately and strongly adsorbed
Retarded reactions
The order of heterogeneous reactions.

3. Crystal Structure (Lectures 10)

Crystallization and fusion process,
Crystallography, Crystal systems,
Properties of crystals,
Crystal lattice and unit cell,
Crystal structure analysis by X ray - The Laue method and Braggs method,
X-ray analysis of NaCl crystal system,
Calculation of d and λ for a crystal system.

4. Investigations of molecular structure (Lectures 16)

Molar refraction,
Electrical polarization of molecules,
Permanent dipole moment,
Determination of dipole moment,
Molecular spectra - Rotational, vibrational and Raman spectra

Physical Chemistry(CH-341)
Section II

1. Electrolytic conductance (12Lectures)

Recapitulation of Electrolytic conductance,
Specific and equivalent conductance,
Variation of equivalent conductance with concentration,
Kohlrausch's law and its applications to determine

i) Equivalent conductance at infinite dilution of a weak electrolyte,
ii) The ionic product of water,
iii) Solubility of sparingly soluble salts,

Migration of ions and ionic mobilities, absolute velocity of ions
Transport number determination by Hittorf;s method and moving boundary method,
Relation between ionic mobility, ionic conductance and transport number,

Ionic theory of conductance,
Debye-Huckel –Onsager equation and its validity,
Activity in solution, fugacity and activity coefficient of strong electrolyte,

2. Electrochemical cells (14 Lectures)

Reversible and irreversible cells,
Emf and its measurements,
Standard cells, cell reaction and Emf,
Single electrode potential and its calculation,
Calculation of cell Emf,
Thermodynamics of cell Emf,
Types of electrodes,
Classification of electrochemical cells with and without transference,
Applications of Emf measurmenti)
Solubility product of sparingly soluble salt,
ii) Determination of pH,
iii) Potentiometric titration

3. Nuclear Chemistry (12 Lectures)

The atom, nucleus and outer sphere, classification of nuclides, nuclear stability and binding energy.
Discovery of radioactivity, types of radioactivity, general characteristics of radioactive decay and decay kinetics,
Measurements radioactivity, gaseous ion collection method, proportional and G.M.Counter,
Applications of radioactivity-
Radiochemical principles in the use of tracers,
Typical applications of radioisotopes as a tracer
i)Chemical investigations- reaction mechanism ,
ii) Sructure determination- phosphorus pentachloride and thiosulphate ion
iii) Age determination- dating by 3H and 14C content,
iv) Medical applications

4. Elements of Quantum Chemistry: (10 Lectures)

concept of quantization, atomic spectra (no derivation), wave particle duality, uncertainty principle, wavefunction and its interpretation, well-behaved function, Hamiltonian (energy) operator, formulation of Schrodinger equation, particle in box (1D, 2D and 3D box) (no derivations), sketching of wavefunction and probability densities for 1D box, correspondence principle, degeneracy, applications to conjugated systems, Jahn teller effect and energies of 3 D box (lifting of degeneracy), harmonic oscillator, wavefunction and probability densities (no derivation), zero point energy and quantum tunneling.

References:

1. Principles of Physical Chemistry,Fourth Edition by S.H. Marron and C. F. Pruton
2. Essentials of Nuclear Chemistry,H.J.Arnikar Second edition
3. Nuclear and radiation Chemistry, Third edition
4. Quantum Chemistry second editionby Manas Chandra
5. Physical Chemistry a molecular approachby Donald A. McQuarrie , John D. Simon
6. Molecular Spectroscopy C. N. Banwell, 3rd edition
7. University general Chemistry,C.N.R.Rao, Mc Millan
8. Elements of Physical Chemistry,G.M. Barrow, Mc Graw Hill Public

Paper VI
Inorganic Chemistry(CH-332)
Section I

1. M.O. Method(15 Lectures)

- LCAO principle & Rules of LCAO.
- Combination of Atomic orbital: S-S, S-P, P-P and d-d
- Non-bonding combination orbitals.
- M.O. Energy leveldaigram for homonuclear diatomic molecules.
- Explaining existence by calculating bond order, energy and magnetic behavior for following molecules or ions H2, H2+, He2+, Li2, Be2, B2, C2, N2, O2, O2+, O2-, O2- -, F2, Ne2
- M.O. energy level diagram for heteronuclear diatomic molecule like CO, NO, HCl, HF.

2. Coordination Chemistry(33 Lectures)

2.1 Introduction to coordination chemistry

- - General account and meaning of the terms involved in coordination chemistry (central metal atom or ions, complex compound , complex ion calculation of oxidation number of metal, coordination number etc)

Ligands: Definition, Classification, Chelates and chelating agents.
Formation Constant, inert and labile complexes.
IUPAC nomenclature
Application of complexes in different fields.

2.2 Werner theory of coordination copmopounds

- Assumptions
- - Stereochemistry of Complexes

2.3 Isomerism in coordination complexes

Structural isomerism (ionization, hydrated, linkage ligand, coordination position, polymerization isomers)
Geometrical isomerism and optical isomerism.

2.4 Sidwick model, ean rule limitations

2.r Paulings valence bond theory

-Introduction
- Assumptions

Concept of hybridization

Bonding in tetrahedral, square planer, trigonal bipyramidal and octahedral complexeswith examples.

- Inner and outer orbital complexes.
- Electro neutrality principle
- Multiple bonding
- Limitations

2.6 Crystal field theory

- Introduction
- Assumptions
- Degeneracy of d orbital.
- Application of CFT to octahedral, tetrahedral, square planer complexes
- CFSE, calculation of CFSE in weak field and strong field complexes.
- Evidences of CFSE.
- Factors affecting 10 Dq

CFT and magnetic properties :- Spin only magnetic moments equation, electron occupancy in CFT. Problems related to calculation of spin only magnetic moment for octahedral, tetrahedral & square plannar complexes. (i.e. for high spin & low spin omplexes)

- Spectrochemical series.
- Nephelauxatic effect
- John teller distortion, limitations.

2.7 Molecular orbital theory of coordination complex

- Introduction
- Assumptions
- MO treatment to octahedral complexes with □ and □ bonding, effect of □-bonding.
- Charge transfer spectra.
- Comparison of VBT, CFT, & MOT.

Reference Books:

1 Introduction to electrochemistry by Glasstone - 2nd edition.
2 Concise inorganic chemistry by J.D. Lee - 5th edition.
3 Inorganic Chemistry- D.F. Shiver & P.W. Atkins- C.H.Largeford ELBS - 2nd edition.
4 Basic Inorganic Chemistry- F.A. Cotton and Wilkinson, Wiely Eastern Ltd 1992.
5 Concept and model of inorganic chemistry by Douglas – Mc Daniels - 3rd edition.
6 Chemistry by Raymond Chang - 5th edition
7 New guide to modern valence theory by G.I. Brown - 3rd edition
8 Co-ordination Compounds by Baselo and Pearson.
9 Theoretical Inorganic Chemistry by day and Selbin.
10 Inorganic Chemistry by Sharpe - 3rd Editionation

INORGANIC CHEMISTRY(CH-342)
Section II

1. Chemistry of f- block elements

1.1. Lanthanides

- Position in periodic Table

Name electronic Configuration
Oxidation States
Occurrence and separation (Group/ Individual) by ion exchange and solvent extraction method.

- Lanthanide contraction & its effect on chemistry of Lanthanides and post lanthanide element.
- Applications.

1.2. Actinides

Position in periodic Table
Name electronic Configuration
Oxidation States
Occurrence and general methods of preparation of transition element
Neutron Bombardment
Accelerated projectile bombardment.
Heavy ion bombardment.
Nuclear Fuels:
Nuclear Fusion fuels & nuclear fission fuels
IUPAC nomenclature system for super heavy elements with atomic no. (z) greater than100.
Comparison between Lanthanides and Actinides.

2. Bioinorganic Chemistry

Introduction
Role of metal in bioinorganic chemistry.
Compounds of Ca, Mg, Fe and Co

- Bioinorganic Chemistry of Iron: Heam proteins – hemoglobin and myglobein, Functions of Oxygen transfer, Fe (II) complex of porphyrin, oxygen binding O2 transfer, partial pressure, pH dependence

Nature of oxyheamoglobein & deoxyheamoglobein, geometry of Complex.
Vitamin B12 Structure and Applications.

3. Organometalic Chemistry

- Introduction
- General principle
- Carbonyl complexes
- CO most important ligand
- Binary carbonyl complexes

Synthesis

18 electron rule

- Solid state structure of some neutral binary metal carbonyl

Homogeneous catalysis by soluble transition metal complex

- Feed stock for chemical industry
- Hydroxylation (oxoreaction)
- Wacker process

Monsanto acetic acid synthesis

4. Metal semiconductor and Super conductors

- Introduction
- Band theory with respect to Na along with n (E) and N(E) diagrams
- Electrical conductance of metal (Na, Mg, Al)
- Semiconductors – types of Semiconductors: I. Intrinsic II. Extrinsic
- N & P type semiconductors ZnO and NiO
- Super conductivity
- Discovery
- Property
- Models structure and superconductivity
- Applications

5. Ionic Solids

Crystal structure simple cubic

- Voids in crystal structure
- Ionic radius
- Palings univalent and crystal radii (Problems)

Radius ratio effect, lattice energy, Born-lande equation Born Haber cycle and its applications

- Scotty and Frankel's defect .

6. Thermodynamic properties of Coordination Complexes

- CFSE: High spins octahedral complexes.
- CFSE: Tetrahedral complexes of site preferences
- CFSE: Low spin octahedral complexes
- Oxidation states of transition metal complexes in aqueous media.

Ionization potential of transition complexes

- Qualitative survey of the substitution of co-ordination complexes

Reference Books:

1 Introduction to electrochemistry by Glasstone - 2nd edition.

2 Concise inorganic chemistry by J.D. Lee - 5th edition.

3 Inorganic Chemistry- D.F. Shiver & P.W. Atkins - C.H.Largeford ELBS - 2nd edition.

4 Basic Inorganic Chemistry- F.A. Cotton and Wilkinson, Wiely Eastern Ltd 1992.

5 Concept and model of inorganic chemistry by Douglas – Mc Daniels - 3rd edition.

6 Chemistry by Raymond Chang - 5th edition

. 7 New guide to modern valence theory by G.I. Brown - 3rd edition

. 8 Co-ordination Compounds by Baselo and Pearson.

9 Theoretical Inorganic Chemistry by day and Selbin.

.10 Inorganic Chemistry by Sharpe - 3rd Edition

Paper VII
Analytical Chemistry (CH-334)
Section I

1. Gravimetric Analysis (14 lectures)

Common ion effect and solubility product principles
Conditions for good precipitation,
Factors affecting precipitation like acid, temperature, nature of solvent,
Super saturation and precipitation formation,
Precipitation from homogeneous solution and examples
Co-precipitation, post-precipitation and remedies for their minimization
Washing of precipitate and ignition of precipitate,
Brief idea about method of filtration and drying of precipitate,
Use of organic reagents in gravimetric analysis such as 8-hydroxy quinoline, □-nitroso-□-napthol, DMG, cupferron and oxime
Introduction to thermal methods of analysis,
Classification and different parameters measured in TGA
Factors affecting thermo gravimetric analysis

2. Electro-gravimetric Analysis (06 lectures)

Introduction,
Theory of electro gravimetric analysis
Faradays Laws of electrolysis
Electrolytic Cell and Electrolysis Process
Use and care of the electrodes
Terminology used in electro gravimetric analysis
Decomposition potential
Electrode Reactions
Over potential
Completeness of deposition
Applications of Electrogravimetry
Electrolytic separation of copper and nickel
Numerical Problems

3.Spectrophotometry (12 lectures)

Introduction
Electromagnetic spectrum
Interaction of electromagnetic radiations with the matter
Mathematical Statement and derivation of Lambert's Law and Beer's Law
Terminology involved in spectrophotometric analysis
Instrumentation of single beam colorimeter
Instrumentation of single and double beam spectrophotometer
Principle of additivity of absorbance and simultaneous determination
Qualitative analysis- chromophore, auxochrome, bathochromic and hypsochromic shift, hyper and hypochomic shift
Spectrophotometric Titrations
Experimental Applications-
Structure of organic compounds
Structure of complexes
Quantitative analysis using Beer's law
Equilibrium constant of acid base indicator
Numerical Problems

4. Atomic Absorption Spectroscopy (06 lectures)

Introduction and theory of atomic absorption spectroscopy
Instrumentation of single beam atomic absorption Spectrophotometer

Measurement of absorbance of atomic species by AAS
Spectral and Chemical Interferences
Qualitative and Quantitative Applications of AAS
Numerical Problems

5. Flame Emission Spectroscopy (06 lectures)

Introduction and theory of atomic emission spectroscopy
Instrumentation of single beam flame emission spectrophotometer
Measurement of emission of atomic species
Interferences in emission spectroscopy
Methods of analysis- calibration curve method, Standard addition method, and internal standard method
Qualitative and Quantitative Applications of FES
Numerical Problems

5. Nephelometry and Turbidimetry (04 lectures)

Introduction
Principles and instrumentation of Nephelometric and Turbidimetric analysis
Difference between Nephelometric and Turbidimetric measurements
Choice between Nephelometry and Turbidimetry
Factors affecting Nephelometric and Turbidimetric measurements
Quantitative Applications
Numerical Problems

Analytical Chemistry (CH-344)
Section II

1. Polarography (08 lectures)

Introduction to voltammetric methods of analysis
Principles of polarographic analysis
Dropping Mercury Electrode
Instrument and working of polarographic apparatus
Ilkovic equation and quantitative analysis
Polarogarm and chemical analysis,
Analysis of mixture of cations
Factors affecting polarographic wave
Quantitative Applications
Numerical Problems

2. PH-metry (05 lectures)

Introduction, Potentiometric method of determination of pH
Comparison between pH-meter and Potentiometer
Electrode System- Construction and working of glass and calomel electrodes
Brief instrumentation of pH-meter and measurement of pH
Application-pH-metric titrations

3. Chromatographic Analysis (08 lectures)

Introduction and classification of chromatographic methods
Principle of chromatographic analysis with match box model
Theoretical plates and column efficiency
Theory, Principle, technique and applications of-
Column Chromatography,
Ion exchange Chromatography
Thin layer Chromatography
Paper Chromatography
Numerical Problems

4. Electrophoresis (04 lectures)
Introduction
Principle and theory of electrophoresis
Different types of electrophoresis techniques
Moving Boundary Electrophoresis
Zone electrophoresis- Paper, Cellulose acetate and Gel electrophoresis
Applications of electrophoresis
5. Gas Chromatography (07 lectures)
Introduction, Theory, Principle, GSC and GLC
Separation mechanism involved in GSC and GLC
Instrumentation of Gas chromatography
Working of gas chromatography,
Gas chromatogram and qualitative-quantitative analysis
Applications of gas chromatography
Numerical Problems

7. Mass Spectrometry (08 lectures)
Introduction,
Instrumentation- electron impact ionization and chemical ionization,
Mass analyzers- Magnetic, double focusing and time of flight
Detectors- faraday's cup, dynode strip electron multiplier
Mass spectrum – terminology involved and chemical analysis,
Applications of mass spectrometry
Numerical Problems

References:

1. Textbook of Quantitative Chemical Analysis- 3rd Edition, A. I. Vogel.
2. Principles of Physical Chemistry 4th edition – Prutton and Marron
3. Instrumental Methods of chemical analysis- Chatwal and Anand
4. Basic Concept of Analytical Chemistry-2nd edition S.M. Khopkar
5. Vogel's textbook of Quantitative Inorganic Analysis-4th edition Besset Denney, Jaffrey, Mendham
6. Instrumental Methods of chemical analysis- 6th edition Willard, Merritt, Dean and Settle
7. Analytical Chemistry by Skoog
8. Analytical Chemistry – Narkhede
9. Introduction to instrumental analysis- R.D. Braun

PaperVIII
Industrial Chemistry(CH-335)
Section I

1 General Aspects of Chemical Industry(Lectures 08)
Introduction, basic requirements of chemical industries, chemical production, raw materials, unit process and unit operations, Quality control, quality assurance, process control, research and development, process control, pollution control, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity and yield, copy right act, patent act, trade marks

2 Manufactue of basic chemicals(Lectures 08)
a. Ammonia: Physico-chemical principles involved, manufacture of NH_3 by modified Haber–Bosch process, uses of NH_3
b. Sulphuric acid: physico-chemical principles involved, manufacture of H_2SO_4 by contact process, uses of H_2SO_4
c. Nitric acid: physico-chemical principles involved, Manufacture of

HNO3 by Ostwald`s process, , uses of HNO3

3. Fertilizer Industry (Lectures 08)

Introduction, importance of fertilizers, N,P,K ratio, micronutrients, organic manure, Vermi-compost,

a. Nitrogenous fertilizers: Manufacture of urea,

b. Phosphatic fertilizers: Manufacture of triple super phosphate

c. Mixed fertilizers: Manufacture of mixed fertilizer

4 .Sugar Industry (Lectures 08)

Introduction, importance of sugar industry,

Manufacture of cane sugar: raw material, extraction, clarification and concentration of cane juice, crystallization of sucrose, centrifugation, Utilization of by-products of sugar industries , testing and estimation cane sugar, estimation of reducing sugars and their significance (Munson-Walker method, Lene-Eynon method)

5. Fermentation Industry (Lectures 08)

Introduction, importance, Basic requirement of fermentation process, Factors favoring fermentation, fermentation operations.

Manufacture of industrial alcohol:(Ethyl alcohol) from

a) Molasses b) Food grains, c) from hydrocarbons d) manufacture of alcohol from fruits (wine)

Grades of alcohols: Silence spirit, rectified spirit, absolute alcohol, proof spirit, denatured spirit, duty and duty free alcohol.

Importance of power alcohol as fuel.

6 .Pollution prevention and waste management(Lectures 08)

Introduction, importance of waste management, concept of atom economy, Terms involved in waste minimization: source reduction, recycling, product changes, source control, use and reuse, reclamation, assessment procedures, types of wastes, treatment and disposal of industrial waste. Treatment of wastes or effluents with organic impurities, Treatment of wastes or effluents with inorganic impurities.

The nature, effect and treatment of some important chemical wastes-(Pulp and paper industries, soap and detergent industries and food processing industries).

Industrial Chemistry (CH-345)

Section II

1. Cement and ceramic industry (Lectures 08)

a. Cement industry: Introduction, Importance, composition of portland cement, raw materials, proportioning of raw materials, manufacture of Portland cement by using modern vertical shaft kiln, rotary kiln verses modern vertical shaft kiln setting and Hardening of cement, reinforced concrete.

Ref.1: *P.No*. 313-333 Ref. 2: *P.No173-176*

Ref. 4: *P.No*.188-192

b) Ceramic industry : Introduction, Importance, types, properties, raw material, manufacture of ceramics, grinding of raw materials , mixing, body preparation using dry clay, clay slip, throwing, slip casting, pressing, extrusion, drying, firing, glazing and decoration. Special ceramic wares like porcelain and bon china, new ceramics

Ref.1: *P.No*.270-289

2 .Glass industry (Lectures 08)

Introduction, importance, physical and chemical properties of glass,

chemical reaction, manufacture of glass using tank furnace.
Forming of glass :pressing, blowing, drawing, rolling, annealing, finishing, grading and gauging of glass articles
Special glasses: coloured, safety, hard, borosilicate, optical, photosensitive, conducting, glass laminates.

3. Dyes(Lectures 08)

Introduction, importance, qualities of good dye, color, color and chemical constitution, , Otto-Witt`s theory of color, resonance theory, molecular approach to color. Classification of dyes according their applications.
Meaning of terms: chromophore, auxochrome, bathochromic (red) and hypsochromic (blue) shifts.
Synthesis and uses of following dyes: Methyl orange, Rosaniline, crystal violet, phenolphthalein, Florescence, Alizarin, Indigo, pigments

4 .Soaps and detergents: (Lectures 08)

a) Soap industry: Introduction, importance, raw materials for soaps, manufacture soap, special soap products, toilet soap, super fatted soap, transparent soap, medicated soap, shaving soap and shaving cream, floating soap, cleansing powders, shampoos.
b) Detergent industry: Meaning of the terms detergent and surfactants, emulsion and emulsifying agents, wetting and non-wetting, hydrophobic and hydrophilic nature, amphipathic structures, types of surfactants, raw materials for detergents, manufacture of detergents, washing action of soaps and detergents, detergent builders, additives.

5. Pharmaceutical Industry(Lectures 08)

Introduction, importance, qualities of good drug, functional and chemotherapeutic drugs.
Meaning of the terms: Prescriptions, doses, analgesic, antipyretic, diuretic, anesthetics, antibiotics, anti-inflammatory, anti-viral, tranquilizer, antiulser, antialargic and bronchodilators, cardiovascular, cold preparations, anti-hypertensive, cough preparation, anti-neoplastics, sedative and hypnotics, steroidal, contraceptive, histamine and antihistamine
Synthesis and uses: paracetamol, sulphanilamide, benzocaine, aspirin, chloramphenicol.

6 .Fuels(Lectures 08)

Introduction, importance, calorific value, determination of calorific value, criterion of selection of fuel, properties of liquid fuels-ignition temperature, flash point, fire point coak number, knocking and anti knocking, octen number, cetane number
a. Solid fuels: coal, cocking of coal, high and low temperature carbonization of coal, distillation of coal tar coal chemicals
b. Gaseous fuels: Advantages of gaseous fuels, artificial gaseous fuels- water gas and produce gas, LPG and bio-gas.
Liquid fuels: Common liquid fuels, distillation of crude petroleum, Bio-diesel
c) Fuel cell: Methanol and H2-O2 fuel cell

References:

1. Essentials of Nuclear Chemistry:Prof.H.J.Arnikar, 4TH Edition,Wiley Estern
2. Source book of Atomic energy :Samuel Glasstone ,3rd edition,East -West press

Physical Chemistry Practical III (CH- 347)

Group A

1. Chemical Kinetics (any five)
   1. To study the effect of concentration of the reactants on the rate of hydrolysis of an ester.
   2. To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.
   3. To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of Inversion of cane sugar using Polarometer.
   4. To study the kinetics of iodination of acetone
   5. To determine the first order velocity constant of the decomposition of hydrogen peroxide by volume determination of oxygen.
   6. To determine the energy of activation of the reaction between potassium iodide and potassium persulphate.
   7. To determine the order of reaction between $K_2S_2O_8$ and KI by equivalent method.
2. Viscosity
   To determine the molecular weight of a high polymer by using solutions of different concentrations.
3 Adsorption
   To investigate the adsorption of oxalic acid /acetic acid by by activated charcoal and test the validity of Freundlich / Langmuir isotherm
4. Phenol-water system
   To study the effect of addition of salt on critical solution temperature of phenol water System
5. Transport number
   To determine the transport number of cation by moving boundry method .
6. Refractometry (any two)
   i) To determine the specific refractivities of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C.
   ii) To determine the molecular refractivity of the given liquids A,B,C and D.
   iii) To determine the molar refraction of homolouges methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by $-CH_2$ group.

Group B

1. Colorimetry (any two)
   i) Determination of λmax and concentration of unknown solution of $KMnO_4$ in 2 N H_2SO_4
   ii) Determination of λmax and concentration of unknown solution of $CuSO_4$.
   iii) To titrate Cu^{2+} ions with EDTA photometrically ,
   iv) To determine the indicator constant of methyl red indicator
2. Potentiometry (any three)
   i) To prepare standard 0.2 M Na_2HPO_4 and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the Pk value of these and unknown solutions.
   ii) To determine Pka value of given monobasic acid by potentiometric titration.
   iii) To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
   iv) To determine the formal redox potential of Fe^{2+}/ Fe^{3+} system potentriometrically
   v) To determine the amount of Cl^- and Br^- from the given halide mixture by titrating with silver nitrate solution
3. pH metry. (Any two)

i) To determine the degree of hydrolysis of aniline hydrochloride
   ii) To determine Pka value of given weak acid by pH-metric titration with strong base.

iii) To determine the dissociation constant of oxalic acid by pH-metric titration with strong base

iv) To determine pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence to find the dissociation of acetic acid.

4. Radioactivity. (any one)

i) To determine plateau voltage of the given G M counter.

ii) To determine the resolving time of GM counter

iii) To determine Emax of beta particle

5. Conductrometry (any two)

i) To determine the cell constant of the given cell using 0.01 M KCl solution and hence determine dissociation constant of a given monobasic weak acid.

ii) To estimate the amount of lead present in given solution of lead nitrate by conductometric titration with sodium sulphate.

iii) To investigate the conductometric titration of any one of the following

a) Strong acid against strong base

b) Strong acid against weak base

c) Strong base against weak acid

d) Weak acid against weak base

Reference books

1. Practical Physical Chemistry 3rd edition
A.M.James and F.E. Prichard , Longman publication
2. Experiments in Physical Chemistry
R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry
J.B.Yadav, Goel Publishing House5. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor,S.Chand and Co.

Inorganic Chemistry Practicals IV (CH-348)

A) Gravimetric estimations (Any 3)

1. Fe as Fe_2O_3
2. Nickel as Ni – DMG
3. Al as Aluminum oxide
4. Gravimetric estimation of Ba as $BaSO_4$ using homogeneous precipitation method.

B) Volumetric Estimations (Any 3)

1. Mn by volhard method
2. Analysis of Alkali mixture by Volumetric method
3. Estimation of % purity of given sample of Sodium Chloride
4. Analysis of Brass

C) Inorganic preparations (Any 3)

1. Preparation of $[Ni(NH_3)_6]^{2+}$
2. Preparation of Trioxalatoferrate and estimation of oxalate using permagnometry.
3. Preparation of $[Cu(NH_3)_4]SO_4$ and estimation of Copper Idometrically.
4. Preparation of Crystals of Potash alum and estimation of aluminum volumetrically.

D) Colorimetric Estimations (Any 2)

1. Iron
2. Cobalt
3. Titanium
4. Separation of Iron from aqueous solution by solvent extraction using 8-hydroxyquinoline in Chloroform and its colorimetric titration's

E) Separation of binary mixture of cations by Column Chromatography (2 mixtures)

F) Qualitative Analysis (6 mixtures including Borates and Phosphates)

Reference Books :

1 General Chemistry experiment – Anil J Elias (University press).
2 Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
3 Quantitative chemical analysis S. Sahay (S. Chand & Co.).
4 Quantitative analysis R.A. Day, Underwood (prentice Hall).
5 Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
6 Vogel textbook of quantitative chemical analysis.

Physics
PaperV
Mathematical Methods in Physics (PH-331) & Quantum Mechanics (PH-342)
Section I
Mathematical Methods in Physics (PH-331)

1) Introduction to partial differential equations: (13 Lectures)

Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Singular points, Fuch's theorem (Statement only), Frobenius method for power series solution of Legendre, Hermite and Bessel differential equation.

Problems based on unit I.1

2) Special functions: (11 Lectures)

Generating function for Legendre, Hermite, Recurrence relation, their differential equations and orthogonality properties. Bessel function of first kind and their properties.

Problems based on unit I.2

3) Curvilinear co-ordinate system: (12 Lectures)

Introduction to Cartesian, Spherical polar and Cylindrical coordinate systems, transformation equations.

General curvilinear coordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.Orthogonal Curvilinear coordinate system, Expressions for gradient, divergence, Laplacian and Curl , special case for gradient, divergence, Laplacian, and curl in Cartesian, spherical polar and cylindrical co-ordinateSystem

Problems based on unit I.3

4) The Special Theory of Relativity: (12 Lectures)

Concept of space, time and mas (absolute and invariant nature according to Newtonian Mechanics), frames of reference, Newtonian relativity, Galilean transformation and its inverse.

The need for ether hypothesis, Michelson-Morley Experiment and its result along with explanation provided by MM, Fitzgerald and Einstein.

Einstein's Postulates, Lorentz transformation and its inverse, geometry of relativity (relativity of simultaneity, lorentz contraction, time dilation, twin paradox, barn and ladder paradox, structure of space-time.

Additon of velocities, concept of expanding universe

Relativistic mass (rest mass is least), mass and evergy ($E=mc^2$), relativistic momentum and energy (massless particle, Compton scattering)

Problems based on unit I.4

Reference Books:

1. Mathematical Physics – P. K. Chattopadhyay New Age International Publishers.
2. Mathematical methods in the Physical Sciences (Second Edition) – Marry L. Boas John Willy and Sons Publication.

3. Fourier series – Seymour Lipschutz, Schaum outlines series.
4. Laplace transform : Seymour Lipschutz, Schaum outlines series.
5. Mathematical methods for Physicists : Weber and Arfken. (6th edition) Academic press – N. Y.
6. Introduction to Special Relativity – Robert Resnick Wiley Eastern Ltd.
7. Physics, 4th Edition, volume I, Resnik, Halliday, Krane, John Wiley and Sons

Section II
Quantum Mechanics (PH-342)

1. Origin of Quantum Mechanics: (10 Lectures)

- Historical Background
- Review of Black body radiation
- Review of photoelectric effects.
- Wave particle duality
- Matter waves
  - De Broglie hypothesis.
  - Davisson and Germer experiment.
- Concept of wave packet, phase velocity, group velocity and relation between them
- Heisenberg's uncertainty principle with thought experiment. - Electron diffraction experiment, different forms of uncertainty.
- Problems based on unit II.1

2. The Schrodinger equation: (15 Lectures)

- Wave function and its physical interpretation.
- Schrodinger time dependent equation.
- Schrodinger time independent equation.(Steady state equation).
- Requirements of wave function.
- Probability current density, equation of continuity, and its physical significance.
- Definition of an operator in Quantum mechanics.
  - Eigen function and Eigen values.
- Expectation value – Ehrenfest's theorem
- Problems based on unit II.2

3. Applications of Schrodinger Steady state equation: (12 Lectures)

- Free particle.
- Particle in infinitely deep potential well (one - dimension).
- Particle in three dimension rigid box.
- Step potential.
- Potential barrier. (Qualitative discussion). Barrier penetration and tunneling effect.
- Harmonic oscillator (one-dimension), correspondence principle.
- Problems based on unit II.3

4. Spherically symmetric potentials: (06 Lectures)

- Schrodinger's equation in spherical polar co-ordinate system.
- Rigid rotator (free and fixed axis).
- Hydrogen atom: Qualitative discussion on the radial and angular parts of the bound state energy, energy state functions, Quantum numbers n, l, m_l, m_s – Degeneracy.
- Problems based on unit II.4

5. Operators in Quantum Mechanics: (05 Lectures)

- Hermitian operator.
- Position, Momentum operator, angular momentum operator, and total energyoperator (Hamiltonian).
- Commutator brackets- Simultaneous Eigen functions.

- Commutator algebra.
- Commutator brackets using position, momentum and angular momentumoperator.
- Raising and lowering angular momentum operator.
- Concept of parity, parity operator and its Eigen values.
- Problems based on unit II. 5

Reference Books:

1. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles.
   - By R. Eisberg and R. Resnik Published by Wiley.
2. Quantum Mechanics.- By Gupta, Kumar and Sharma Published by J. Prakash Nath and Co. Meeral.
3. Concepts of Modern physics.- By A. Beiser Published by Mc. Grawthill. Chapter 2,3,5,6.
4. Introduction to Quantum Mechanics.- By D. Griffiths Published by Prentice Hall.
5. Quantum Mechanics.- By Ghatak and Lokanathan Published by Mc. Millan.
6. Quantum Mechanics.- By L. I. Schiff.
7. Quantum Mechanics.- By Powell and Crasemann, Addison-Wesley Pub. Co.
8. Quantum Mechanics an accessible introduction- Robert ScherrerPearson - Addison Wesley

PaperVI
Classical Electrodynamics(PH-332)&Solid State Physics (PH-341)
Section I
Classical Electrodynamics(PH-332)

1. Electrostatics: (16 Lectures)

- Coulomb's law, Gauss law, Electric field, Electrostatic Potential.
- Potential energy of system of charges.
- Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system.
- Method of image charge.Examples of a) point charge near an infinite grounded conducting plane.
  b) Point charge near grounded conducting sphere.
- Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric
- constant, bound volume and surface charge densities.
- Electric field at an exterior and interior point of dielectric.
- Problems based on unit I.I

2. Magnetostatics: (16 L Lectures)

Biot-savart law, Ampere's law for force between two current carrying loops,Ampere's circuital law, Equation of continuity, Magnetic vector potential **A**. Energy density in magnetic field, magnetization of matter (**B,H,M**) Magnetic susceptibility and permeability. Hysteresis loss, B-H curve. Diamagnetic, paramagnetic and ferromagnetic substances.

3. Electrodynamics: (16 Lectures)

- Time varying fields: Faradays law of induction, generalization of Amperes' law, Maxwell's equation (Differential and Integral form)
- Wave equation and plane waves in free space.
- Poynting theorem, Polarizations of plane wave.
- Microscopic form of ohm's law (**J**=σ.**E**)
- Problems based on unit I.3

Reference Books:

1) Introduction to Electrodynamics - By D. J. Griffith
2) Classical Electrodynamics – By J. D. Jackson.
3) Introduction to Electrodynamics - By A. Z. Capri, Panat
4) Electricity and magnetism – By Reitz and Milford

Section II
Solid State Physics(PH-341)

1. The Crystalline State: (11 Lectures)

Lattice, Basis, Translational vectors, Primitive unit cell, Symmetry operations, Different types of lattices-2D and 3D (Bravais lattices) ,Miller indices, Inter-planer distances, SC, BCC and FCC structures, Packing fraction, Crystal structures- NaCl, diamond, CsCl, ZnS, HCP, Concept of reciprocal lattice and its properties with proof.

Problems based on unit II.1

2. X-ray Diffraction and Other Characterization Techniques: (11 Lectures)

Introduction, Crystal as a grating, Bragg's law and Bragg's Diffraction condition in direct and reciprocal lattice- Ewald's construction, Debye Schrrerer method, Analysis of cubic structure by powder methodCharacterization Techniques: Principle, Working and ApplicationsThermal Technique: Thermo Gravimetric Analysis (TGA) Spectroscopy: Ultra-Violet (UV) Electron Spectroscopy : Scanning Electron Microscopy (SEM)

Problems based on unit II.2

3. Free Electron and Band Theory of Metals: (13 Lectures)

Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch function (statement only), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Origin of energy gap, Energy bands in Solids, Effective mass of electron (with derivation), Distinction between metal, semiconductor and insulator

Problems based on unit II 3

4. Magnetism: (13 Lectures)

Diamagnetism, Langevin theory of Diamagnetism, Application of diamagnetic material (Superconductor)- Occurrence of Superconductivity, Critical magnetic field and Meissner effect, Paramagnetism, Langevin theory of Para magnetism, Ferromagnetism, Ferromagnetic domains, Hysteresis, Curie temperature, Ferrimagnetism, Ferrites and its applications, Antiferromagnetism, Neel temperature.

Problems based on unit II.4

Reference Books:

1. Solid State Physics, S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999).
2. Solid State Physics – By Kakani and Hemrajani, S. Chand Publication.
3. Solid State Physics - By Saxena, Gupta and Saxena, Pragati Prakation.
4. Introduction to Solid State Physics, Charles Kittel, John Wiley and Sons, 7Edition.
5. Solid State Physics, A.J.Dekker, Macmillan India Ltd, (1998).
6. Solid State Physics, R.K. Puri, V.K. Babbar, S. Chand Publication.
7. Problems in Solid State Physics, S.O. Pillai, New Age International (P) Ltd.
8. Solid State Physics, Palanyswamy.
9. Solid State Physics, David, Snoke, Pearson Publication.

Paper VII
Classical Mechanics (PH 333)& Thermodynamics and Statistical Physics (Ph-343)
Section I
Classical Mechanics (PH 333)

1. Mechanics of system of particles: (10 Lectures)

1. Introduction (review of classical mechanics)
2. Applications of Newton's laws of motion-Projectile motion in resistive medium, Rocket Motion of a charged particle in constant electric, magnetic and electromagnetic field.
3. System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles (statements only)

Problems based on unit I.1

2. Motion in Central Force Field: (10 Lectures)

- Central force, equivalent one body problem
- Motion in central force field

- General features of motion, equation of orbit
- Deduction of Kepler's laws of planetary motion
- Orbits of artificial satellite
- Problems based on unit I.2

3. Scattering of particles: (10 Lectures)

- Elastic and inelastic scattering
- Elastic scattering-Laboratory and centre of mass system
- Relation between scattering angles in laboratory and centre of mass system
- Inelastic scattering-cross section, differential cross section, total cross section,
- impact Parameter.
- Problems based on unit 1.3

4. Langrangian and Hamiltonian formulation: (10 Lectures)

- Limitations of Newtonian formulation
- Types of constraints, degrees of freedom, generalized co-ordinates, configuration space
- D' Alembert's principle of virtual work
- Langrangian equation from D' Alembert's principle, cyclic co-ordinates
- Phase space, Hamiltonian's equations
- Problems based on unit 1.4

5. Moving coordinate system: (08 Lectures)

- Inertial and Non-inertial frames of references, Galilean invariance
- Rotating co-ordinate system
- Corioli's force
- Effect of Corioli's force on cyclone formation, river flow, flight of missiles and freely falling body on Earth's surface
- Problems based on unit 1.5

Reference Books:

1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata Mc Graw Hill publishing Company Ltd.
2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata Mc Graw Hill Publishing company Ltd.
3. Principles of mechanics, J. L. Synge, B. A. Griffith, Tata Mc Graw Hill Publishing company Ltd.
4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House

Section II

Thermodynamics and Statistical Physics (Ph-343)

1. Kinetic Theory of Gases: (08Lectures)

Assumptions of Kinetic theory of gases, Mean free path, Transport phenomenon, Viscosity, Thermal ,conductivity and diffusion

Problems based on II.1

2. Maxwell Relations and Application: (10 Lectures)

Thermodynamical functions, Derivation of Maxwell Relations, First and Second Tds Equations, Specific heat and latent heat equations, Joule Thomson effect (Throttling Process)

3. Elementary Concepts of Statistics: (10 Lectures)

Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Probability distribution for large-scale N, Guassian probability distributions.

4. Statistical Distribution of System of Particles: (08 Lectures)

Specification of state of system, Statistical ensembles, Basic Postulates, Probability calculations, Behaviors of density of states, Thermal, Mechanical and general interactions

5. Statistical Ensembles: (08 Lectures)

Micro canonical Ensemble (Isolated System), Canonical ensembles, simple application of canonical ensemble, Molecules in Ideal gas, Calculation of mean values in canonical ensemble

6. Quantum Statistics: (06Lectures)

Quantum distribution function, Maxwell-Boltzmann's statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics,

Comparision.

References:

1. Statistical and Thermal physics- By Lokanathan, R.S. Gambhir,
2. Fundamentals of statistical and thermal physics- By F.Reif
3. Perspectives of modern physics- By A. Beiser
4. Fundamental of Statistical Mechanics- By B.B. Laud
5. A primer of Statistical Mechanics- By R.B. Singh
6. Statistical Mechanics- By Gupta, Kumar

Paper VIII
Atomic and Molecular Physics (PH-334)& Nuclear Physics(PH 344)
Section I
Atomic and Molecular Physics (PH-334)

1. **Atomic structure (6 Lectures)**

- Rutherford model of atom
- Electron orbits
- Bohr atom
- Energy levels and spectra
- Vector atom model (Concepts of space and quantization and electron spin)
- Atomic excitation and atomic spectra
- Problems based on I.1

2. One and two valence electron systems (**14 Lectures)**

- Pauli Exclusing principle and electron configuration, quantum states, Spectral notations of quantum states.
- Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na atom, selection rules, spectra of
- sodium atom, sodium Doublet.
- Spectral terms of two electron atoms, terms for equivalent electrons, L-S and JJ
- coupling schemes.
- Singlet-Triplet separation for interaction energy of L-S coupling. Lande Inteval
- rule, spectra of Helium atom
- Problems based on I.2

3. Zeeman Effect (4 Lectures)

- Early discoveries and developments
- Experimental arrangement
- Normal and anomalous Zeeman Effect
- Problems based on I.3

4. X-ray spectroscopy (6 Lectures)

- Nature of X-rays
- Discrete and continuous X-ray spectra, Daune and Hunt's Rule
- X-ray emission spectra
- Mosley's law and its applications
- Auger effect
- Problems based on I.4

5. Molecular spectroscopy (**10 Lectures)**

- Rotational energy levels
- Vibrational energy levels
- Rotational and Vibrational spectra
- Electronic spectra of molecules
- Problems based on I.5

6. Raman spectroscopy (8 Lectures)

- Classical theory of Raman Effect. Molecular polarizability
- Quantum theory of Raman Effect
- Experimental set up for Raman Effect

- Applications of Raman spectroscopy

Reference Books:

1. Concepts of Modern Physics 4th edition- Arthur Baiser (Mc-Graw Hill International edition)
2. Introduction to Atomic spectra-White.H.E (Mc-Graw Hill International edition)
3. Fundamentals of Molecular spectroscopy-C.N Banwell and E.M McCash (Mc-Graw Hill International edition)
4. Modern Physics-J.B.Rajam

Section II
Nuclear Physics(PH 344)

1. Basic Properties of Nucleus: (06 Lectures)

Composition, charge, size, density of nucleus, Nuclear Angular momentum,Nuclear magnetic dipole moment, Electric quadrupole moment, parity and symmetry, Mass defect and Binding energy, packing fraction, Classification of nuclei, stability of nuclei (N Vs Z Curve) and problems. Problems: Ref: 4 -, ch (26)

2. Radioactivity: (09 Lectures)

Radioactivity disintegration (concept of natural and artificial radioactivity, Properties of α, β, γ-rays, laws of radioactive decay, half-life, mean life, specific activity and its units, successive disintegration and equilibriumsand radioisotopes).Application of radioactivity (Agricultural, Medical, Industrial, Archiological).
Problems:Ref: 1 - ch (8), Ref: 2 – ch (15)
Problems: Ref: 4 - ch (27, 29)

3. Nuclear forces: (07 Lectures)

Meson theory of nuclear forces, Properties Of nuclear forces, properties of deuteron system, Elementary particles, Quarks model for elementary particles.
Ref:1- ch (2, 3), Ref: 2 - ch (10), Ref: 3 - ch (3)
Problems: Ref: 4 - ch (26)

4. Nuclear Models: (08 Lectures)

Introduction to various nuclear Models,
a). Liquid drop model: Assumptions, semi-empirical mass formula,
limitations.
b). Shell Model: Assumptions, Evidences, Spin and Parity limitations.
Ref: 1- ch (6), Ref: 2 (11), Ref: 3 ch (4, 5)
Problems: Ref: 4 - ch (28)

5. Particle Accelerator and Detectors: (05 Lectures)

Introduction to particle Accelerators,
a). Linear (electron/proton Linac)
b). Cyclic (Cyclotron)
Classification of Nuclear Detector
a). Gas filled Detectors (G. M. counter)
b). Solid state detectors (scintillation counter)
Problems: Ref: 1- ch(7,12)

6. Nuclear Reactions: (05 Lectures)

Introduction to Nuclear reactions, compound nuclear Q-value equation, Exothermic and Endothermic, reaction Threshold energy, Conservation laws, nuclear cross-section.
ProblemsRef: 1- ch(13), Ref: 2- ch(12)
Problems: Ref: 4- ch (30)

7. Nuclear Energy: (07 Lectures)

Nuclear fission, chain reaction and critical mass, nuclear reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, nuclear fusion, stellar energy.
Problems.Ref: 2- ch(14),
Problems: Ref: 4- ch (31)

Reference Books:

1. Introduction to Nuclear Physics- H.A.Enge (Addition Wesley co.)
2. The Atomic Nucleus- R.D.Evans (Tata McGraw Hill co.)
3. Concepts of Nuclear Physics – B.L.Cohen (Tata McGraw Hill co.)

4. Schaum's Outline Series: Modern Physics- R.Gautrearu (McGraw Hill co.)

Additional References:

1. Atomic and Nuclear Physics- Shatendra Sharma (Pearson Education,1st Edition)
2. Nuclear Physics- Kaplan (Narosa Publishing House)
3. Introduction to Nuclear Physics- Y.R. Waghmare (Oxford IBH.)

Practical / Laboratory Course III (PH-347)

GROUP I

GENERAL PHYSICS (ANY EIGHT)

1. Viscosity by Rotating cylinder method
2. Moment of Inertia by Bifilar suspension
3. Y by Newton's rings
4. Y by koeing method
5. Michelson's interferometer
6. Surface tension by Fergusson method
7. Surface tension by Quincke's method
8. Hall Effect
9. Energy gap of a semiconductor
10. Study of XRD spectra of any matter
11. Four probe method
12. Platinum resistance thermometer

GROUP II

ATOMIC AND MOLECULAR PHYSICS AND OPTICS (ANY TWO)

1. Rydberg's constant
2. Zeeman Effect
3. Llyod's mirror
4. R.P. of grating
5. Constant deviation spectrometer

STATISTICAL PHYSICS AND THERMODYNAMICS (ANY TWO)

1. Verification of Stefan's law
2. Forbes Method.
3. Thermal conductivity of rubber tubing

NUCLEAR AND QUANTUM MECHANICS (ANY TWO)

1. Characteristics of G.M. tube
2. Inverse square law (γ-rays)
3. e/m by Thomson method
4. Planck's constant

ELECTROMAGNETISM (ANY TWO)

1. Self Inductance by Anderson's bridge
2. Core losses in transformers
3. Electromagnetic pendulum
4. Inductance by Maxwell's bridge

Additional Activities (Any Two)

a. Demonstrations- Any 4 demonstrations equivalent to 2 experiments
b. Study tour with report equivalent to 2 experiments
c. Mini project equivalent to 2 experiments
d. 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.

Practical / Laboratory Course IV: PROJECT (PH 349)

It is expected that

1. The student does work equivalent to about twenty laboratory experiments through out both the semesters in the third year.
2. One bears in mind that the project work is a practical course and it is intended to develop a set of skills pertaining to the laboratory work apart from the cognition of students. Therefore, the guides should not permit projects that involve no contribution on part of student.
3. The project must have a clear and strong link with the principles of basic physics and/or their applications.
4. The theme chosen should be such that it promotes better understanding of physics concepts and brings out the creativity in the students.
5. The evaluation of the project work must give due credit to the amount of the project work actually done by a student, skills shown by the student, understanding of the physics concepts involved and the presentation of the final report at the time of viva voce.
6. The viva voce should be conducted at least for thirty minutes per student. Extra care must be taken in the evaluation of projects done in a pair or group. Delegation of the work done by individuals must be sought from the students in such cases.
7. Any ready-made material used in the report (such as downloaded pages from the web) must be clearly referred to and acknowledged. Any non-adherence to this norm should attract a penalty by way of deduction in the marks awarded to a student. It is recommended that the College will provide consumables/contingencies for every project, to the tune of Rs. 500/- each. It is also recommended that a teacher will look after 4 projects at one time.

THE ART AND SCIENCE OF WRITING PROJECT REPORTS:

Introduction: Writing project reports is considered an artistic as well as a scientific activity because it must satisfy the authorities about the utility of the work carried out in a convincing manner. Authorities, being humans, cannot be one hundred percent objective while assessing the work. They too have their likes and dislikes which is why it is necessary to create a report that reflects the truth but avoids negative impressions, if any, that might be generated. This demands the development of certain skills in communications (presentation) as well as data analysis from the report writer. This paper aims to give the participants some insight in this direction. Title: Writing the title of a project is not a trivial task. It requires serious deliberation on not only the contents but also the priorities of various factorson part of the researcher. The title should give the correct idea as to what the authorities could expect the report to contain. It should neither be too short nor too lengthy. The words used in the title would depend upon the nature of work carried out but highly technical jargon should be avoided, wherever possible. Purpose of producing report: Different reports have different purposes- e.g. writing a report after completing a research scheme is different than writing a report for a progressing Ph.D. work to the University. In any case it is essential to state clearly what is the purpose of writing the report for the knowledge of its reader – whosoever it might be. The writer must also have sufficient understanding about the expectations from the authorities. Many times, they provide a format for your guidance. It is often very useful in developing a complete report. If no format is recommended, the writer should seek clarification from them in person. If this is not feasible, he can contact someone who has submitted a similar report to the authorities earlier before he undertakes the task to avoid wastage of time and energy later. Acknowledgement: No project can be completed without timely support from a number of individuals or institutions. Their contributions may not always be direct. It is essential to acknowledge all of them. If your project is a sponsored one, this is most important. In such a case, it is worth a mention even on the front cover or immediately thereafter. Raw data, diagrams, references to quotations and such other material what helps you in developing a good report but which has been borrowed, must be duly referred to. If this is not done, it reflects negatively on the researcher's honesty. Organization of contents of the report: There are many ways to organize the contents of a report. For example, it might be according to chronology of the main events. It might be according to the scientific method used for testing a system or constructing a system of several modules. It could be based on classification of the data collected, say, through a number of surveys conducted at different places and so on. Thus, a universal style of writing a project report is a myth. However, this is not to suggest that the report writer should write it like his personal diary. Perhaps the HCF (highest common factor) of all reports is that all styles must possess a common feature. The author must select a style that permits him to provide a sufficiently comprehensive view of his philosophy, problem/task, procedure, data, the product (if any), its characterization, data analysis and the logical conclusions that follow naturally. No report can be complete without justifying the course of action taken by

the author of the report. If the course of action is presented properly (and proved the best under the given constraints), the authorities might even accept the failure of the report writer to achieve his goals completely or in time. A standard format is enclosed herewith for bringing some uniformity in the T.Y. B.Sc B.Ed project reports. Data presentation and analysis: Most of the times, the authorities are not interested in the raw data. They are interested in it only to the extent of ensuring that the report is founded on methodical hard work done with all sincerity. In such cases, the author should not waste time in discussing the efforts he took in collecting the raw data. Rather he should skip it and provide only samples and the method used for analysis leading to inferences. Many authors (particularly students) have the notion that their proper evaluation essentially demands a thick report from them. This belief is ill founded. Another common dilemma a reporter suffers from is about honesty. There are instances in all types of projects where everything does not happen as expected and the observations are disturbing in some cases. This is perfectly natural and the writer should not have any guilt feeling in either reporting it or not reporting it. The decision to report or otherwise should be based on the frequency of recurrence of the 'failure' rather than anything else. It must also be remembered that a researcher is always free to check and recheck the conditions under which an observation is made and to decide whether to accept the observed data or to reject it. There is nothing unethical or dishonest about it.

Schedule for project work:

1. Allotment of Internal Guide by 30th July.
2. Submission of Synopsis by 14th August.
4. Project Work Review- Every Week.
5. First Draft of Report by 15th February.
6. Final Report Submission by 5th March.

Format for preparation of project report for B.sc.B.Ed

Arrangement of contents:

The material in the project report should be arranged and bound as per the following order:
Cover Page and Title Page
Bonafide Certificate
Acknowledgement
Abstract
Table of Contents
List of Tables
List of Figures
List of Symbols, Abbreviations and Nomenclature
Chapters
Appendices
References
The table and figures shall be introduced at appropriate places.

Page dimension and binding specifications:

The dimension of the project report should be in A4 size (210mm X 297 mm) Paper used should be 75 GSM or higher quality. The project report should be spiral bound using flexible cover of the thick white art paper. The cover should be **printed in black letters** and the text should use only one font style viz. Times New Roman.

Preparation format:

1.Page Set-Up : The recommended margins are as follows: top 1", bottom 1.5", left 1.5" and right 0.75". All text pages should be numbered after the page of contents.

2. Cover Page and Title Page – A specimen copy of the Cover page and Title page of the project report are given in **Appendix 1.**

3. Bonafide Certificate – The Bonafide Certificate shall be printed in double line spacing using Font Style Times New Roman and Font Size 14, as per the format in **Appendix 2.**

The certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department, name of the college, city/town and PIN code where the supervisor has guided the student. The term **'SUPERVISOR'** must be typed in capital letters between the supervisor's name and academic designation.

4. Acknowledgement – A student should acknowledge the following authorities:
(i) Principal of the college (ii) Head and the faculty members including non-teaching staff of the Physics department /college (iii) Guide (iv) Sponsoring organization (if any) (v) Funding agency (if any) (vi) Organisation where the work is carried out (if external to the college) (vii) classmates (viii) Others who helped directly/indirectly. The acknowledgement must have the full signature of the student, his/her name, class, academic year and date as shown in the **Appendix 3.**

5 Abstract – Abstract should be one page synopsis of the project report typed in 1.5 line spacing, Font Style Times New Roman and Font Size 12.

6 Table of Contents – The table of contents should list all material following it as well as any material which precedes it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents of the project report is given in **Appendix 4.**

3.7 List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head.

3.8 List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head.

3.9 List of Symbols, Abbreviations and Nomenclature – One and a half spacing should be adopted or typing the matter under this head. Standard symbols, abbreviations etc. should be used.

3.10 Chapters – The chapters may be broadly divided into 3 parts (i) Introductory chapter, (ii) Chapters developing the main theme of the project work (iii) and Conclusion.
The main text will be divided into several chapters and each chapter may be further divided into several divisions and sub-divisions.
Each chapter should be given an appropriate title.
Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
Footnotes should be used sparingly. They should be typed single space and placed directly underneath the very same page, which refers to the material they annotate.

3.11 Appendices – Appendices are provided to give supplementary information, which if included in the main text, may serve as a distraction and cloud the central theme.
Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc. Appendices, Tables and References appearing in appendices should be numbered and referred to at appropriate places just as in the case of chapters.
Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

3.12 List of References –The listing of references should be typed 4 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. The reference material should be listed in the alphabetical order of the first author. The name of the author/authors should be immediately followed by the year and other details.
A typical illustrative list given below relates to the citation example quoted above.

REFERENCES [<Book, journal, Web resources>]

1. William Stallings , Data and Computer Communications, prentice Hall, 2000, pp 203-07
2. Barnard, R.W. and Kellogg, C. (1980) 'Applications of Convolution Operators to Problems in Univalent Function Theory', Michigan Mach, J., Vol.27, pp.81–94.
3. http://www.compadre.org/PSRC/items/Load.cfm?ID=143

Table and figures - By the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non-verbal materials used in the body of the project work and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures.

4.Typing instructions:
The impression on the printed (computer typed) copies should be black in colour.

One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style 'Times New Roman' and Font size 14.

* * * * *

Appendix 1

(A typical Specimen of Cover Page and Title Page)

<Font Style Times New Roman – Bold>

T.Y.B.Sc. B.Ed Physics

TITLE OF PROJECT REPORT

<Font Size 18><1.5 line spacing>

A PROJECT REPORT

<Font Size 14>

Submitted by

<Font Size 14><Italic>

NAME OF THE CANDIDATE(S)

<Font Size 16>

in partial fulfillment for the award of the degree

of

<Font Size 14><1.5 line spacing><Italic>

NAME OF THE DEGREE

<Font Size 16>

IN

BRANCH OF STUDY

<Font Size 14>

NAME OF THE COLLEGE

<Font Size 14>

UNIVERSITY OF PUNE, PUNE 411 007

<Font Size 16><1.5 line spacing>

MONTH and YEAR

<Font Size 14>

SPECIMEN

THE STUDY OF SOME CHARACTERISTICS OF AN ELECTRET MICROPHONE

A PROJECT REPORT

Submitted by

MANGESH PATIL

SHIVANI G.

In partial fulfillment for the award of the degree

Of

BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION

In

PHYSICS and EDUCATION

ABC COLLEGE OF SCIENCE , TIMBAKTOO

UNIVERSITY OF PUNE, PUNE 411 007

MARCH 2011

APPENDIX 2

Examination Seat No:

(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

UNIVERSITY OF PUNE, PUNE 411 007

<Font Style Times New Roman – size -18>

BONAFIDE CERTIFICATE

<Font Style Times New Roman – size -16>
<Font Style Times New Roman – size -14>

Certified that this project report **"…….TITLE OF THE PROJECT……..."**
is the bonafide work of "**……..NAME OF THE CANDIDATE(S).……"**
of T.Y.B.Sc B.Ed (Physics) during the academic year 20<<XX-XX>> who carried out the project work under my supervision.

<<Signature of the Guide >> <<Signature of the Head of the Department >>
SIGNATURE WITH DATE SIGNATURE WITH DATE
<<Name>> <<Name>>
GUIDE HEAD OF THE DEPARTMENT
<<Academic Designation>>
<<Department>> <<Department>>
<< College, city and PIN code >> << College, city and PIN code >>
date: << >>
Internal Examiner External Examiner
<<Signature>> <<Signature>>

APPENDIX 3
(A typical specimen of the acknowledgement)
<< Font Times New Roman, Case UPPER, Bold 16>>

Acknowledgement

I wish to thank the Principal << correct initials and surname >> of my college for permitting me to use all the facilities available in the institution for my project work. I would also like to thank the Head of the Physics department << correct initials and surname>>, the teaching faculty and all the non-teaching staff of my college for their support in completing the work successfully.
I am grateful to my Guide << correct initials and surname>> for his encouragement, guidance and supervision of my project work during the year. I was fortunate to have received sponsorship for my project work from << name of agency>>. I express my thankfulness to them. I must acknowledge the financial support given to this project by << name>> without which it would have been difficult to complete the work in time.
My classmates have been of great help to me during the project work. My ideas were shaped and refined progressively through my discussions with them from time to time. I cannot miss to thank them all. There were some persons like << name(s)>> who were not directly but indirectly involved in my preparatory/practical work. I heartily appreciate their contribution and thank them too.
Date: 12 March 2010 <<Signature of the student>>
<<Full name of the student>>
<<Class:>>
<<Year: >>

APPENDIX 4
(A typical specimen of table of contents)
<Font Style Times New Roman>
TABLE OF CONTENTS
CHAPTER NO. TITLE PAGE NO.

BOOKS ON EXPERIMENTAL PHYSICS

1. Laboratory Physics, Parts A and B – Berkeley Physics Laboratory
2. Laboratory Physics (laser Expt) – Berkeley Physics Laboratory
3. University Practical Physics with Viva Voce – C K Bhattacharya (C B S Publications, Delhi)
4. A Textbook of Practical Physics – Brijlal and Subramanyam
5. Introduction to Experimentation – B J Brinkwork (The English University Press Ltd.)
6. Advanced Practical Physics, Vol I and II – M S Chauhan and S P Sinha
7. Experimental Physics – C Daish (Hodder and Sons, 1970)
8. Practical Physics for B.Sc. Major – A Dhanalaxmi and A Williams (Popular Book Depot, Madras)
9. Experiments in Electronics – Panik S Jabbar
10. Digital Electronics Practice using – Jain and Anand Integrated Circuits (Tata Mc Graw Hill)
11. Radiation Detectorss – S S Kapoor, V S Rama Moorthy
12. A Laboratory Manual of Physics for Undergraduate Classes - D P Khandelwal (Vani Publishing House, New Delhi)
13. Instrumentation - Franklin Kirk, Nicolu Hombai
14. Designing with TTL Integrated Circuits – Robert L Morris, John R Miller (Texas Instruments)
15. Advanced Level Practical Physics – M Nelson and J M Ogborn
16. Experiments in Modern Physics – Olon
17. Understanding Circuits and Opamps – Concepts, experiments and troubleshooting Dale R Patrick, (Prentice Hall, Englewood Cliffs) and Stephen W Faxlo
18. B.Sc. Practical Physics – K Hanumantha Rao (Maruthi Book Dept, Guntur) D P Siva Ramrah and V Krishna Murthy
19. Physics Through Experiments, 1-B L Saraf EMF-Constant and Varying and D P Khandelwal (Vikas Publishing House, New Delhi)
20. Physics Throught Experiments, 22-B L Saraf Mechanical Systems and D P Khandelwal (Vikas Publishing House, New Delhi)
21. Electronic Circuits, II Ed- L Schilling and Velove (Mc Graw Hill)
22. Digital Integrated Circuits – M C Sharma (Business Promotion Bureau, Delhi)
23. Advanced Practical Physics – S S Sharma (Ratan Prakashan Mandir)
24. B.Sc. Practical Physics – Harnam Singh (S Chand and Co)
25. Advanced Practical Physics – S P Singh (Pragati Prakashan, 1985)
26. Experimental Nuclear Physics – R M Singru (Wiley Eastern, 1972)
27. Experiments in Mechanics – R S Sirohi
28. A Course of Experiments with He-Ne Laser – R S Sirohi (I.I.T. Madras)

29. Practical Physics – E M Somekh (Chatto Window Educational Ltd. London) and F C Brown
30. Practical Physics, III Ed. – G L Squires Cambridge University Press, Cambridge)
31. Electronic Devices: Circuits and Application – W D Stanley (Prentice Hall, New Jersey, USA)
32. A Textbook of Practical Physics – M N Srinivasan (Sultan Chand and Sons. New Delhi)
33. Experiments in Electronics – S.V.Subramanyam (Macmillan India Ltd. 1983)
34. Practical Physics for B.Sc. Physics Main – N.Sundaresan Parts I and II (Eswari Publications, Tiruchy)
35. Laboratory Notes on Electrical and Galvanomagnetic Measurements, Materials Science Monographs 2 (Elsevier, 1979) – H H Wieder
36. Advanced Practical Physics for Students – B.L.Worsnop and (Asia Publishing House, 1961) H T Flint
37. Experimental Crystal Physics – W A Wooster (Claredon Press, 1970) A Breton
38. Kaye and Laby Talks of Physics and Chemical Const. (Longman, London)
39. Manual for Practical Physics – I, II and III years prepared by Association of Physics Teachers of Mangalore University
40. Instrumentation – Rangan, Sarma and Mani
41. Instrumentation – Nakra and Choudhari
42. Beyond Agricultural Electronics – American Society of Agri. Engg.
43. Process Control System – F.G.Shinsky (McGraw Hill)
44. The Complete book of the Green House – Ian g Walls (Ward Lock Ltd, London)
45. Treatise on Agrophysics and agroelectronis – G.N.Acharya, D.G. Hapse (Vasantdada Sugar Institute, Manjari, Pune)
46. The Art of Electronics – Paul Horowitz, Winfield Hill (Cambridge Univ. Press)
47. Principles of Electronics – A.P. Malvino
48. Modern Digital Electronics – R.P. Jain (Tata Mc Graw Hill)
49. Electrical and Electronic Instrumentation – A W Sawhney
50. Electronic Instrumentation – Kalsi
51. Microprocessor Programming – Leventhol
52. Microprocessor Principles and Applications – Ajit Pal
53. Programming with C – Schaum Series
54. Let us C – Yashwant Kanitkar
55. Computer Oriented Numerial Methods – V Rajaraman
56. C Programming Language – Keveningham and Ritchie
57. Experiments in Solid Status Physics – Pune University Manual
58. High Vacuum Technology – J Yarwood (Chapman and Hills)
59. Motion Picture Technology – L.B.Happe
60. A Course in regrigeration and air-conditioning – S.Domkundwar (DhanpatRai and Sons)
61. Introduction to biomedical Electronics – Joseph Bovy (Mc Graw Hill)
62. Handbook of biomedical Instrumentation – R.S. Khandpur
63. An Introduction to atmospheric Physics – Fleagle and Businger (International Geophysics series vol iii the upper atmosphere)
64. Radioisotope application engineering – J.Kohl, R.Zenter, H.Lukens (Van Nostrand Co. New York)
65. Martial Science and Engineering – Raghvan
66. Elements of Material Science and Engg. – L.H.Van Vlack
67. Electronic Fundamentals and Application – John Ryder
68. Acoustics – Seto (Schaum series)
69. Acoustic Measurements – L.Beranek
70. Fundamentals of acoustics – Kinsler and Frey
71. Solar Energy – Fundamentals and Engg. Applications – Greg and Prakash (Tata Mc Graw Hill)
72. Solar Cells – M A Green Solar Energy conversion – S.P. Sukhatme
73. Solar Thermal Engineering – J A Duffie (Academic Press)
74. Terrestrial Photovoltaics – T.Bhattacharya
75. Electronic communication – Roddy Coolen

List of major Equipments/Instruments required for undergraduate laboratory:

1. Signal generators
2. Function generators
3. D.C. and A.C. voltmeters
4. D.C. and A.C. ammeters
5. D.C. power supplies – 0-30 V, 1 amp continuously variable
6. D.C. power supplies: 5 V, 1 amp; +/-12 V, 500 mA
7. Single and dual trace oscilloscopes
8. Graphic equalizer
9. Loundspeakers 250 mW, 5 W and 20 W
10. Sound pressure level meter
11. Public address system
12. Microphones (carbon, condenser, dynamic etc,)
13. Loudspeaker horns
14. Spectrometers
15. Gratings – of varying number of lines per unit length
16. Prisms – ordinary glass, double refracting
17. Lasers – pointers, He-Ne > 2 mW power output
18. Small boilers for heat experiments
19. Half degree resolution thermometers
20. Retort stands
21. Metal rods of various compositions
22. Electronic components commonly required such as resistors of different values(quarter/half watt), capacitors of different values and working voltages, transformers (6,9,12 volts 250/500/1000 mA), zener diodes, rectifier diodes, general purpose and power transistors, integrated circuits including logic gates, opamps and timers etc.
23. Made to order apparatus for various experiments such as study of Hall Effect:Electromagnets, Gaussmeter, probes etc.Essential glassware like beakers, measuring cylinders, capillaries etc.
24. A good quality balance (physical or electronic) Pan balance
25. Vernier calipers, micrometer screws gauges etc.
26. Optical benches, sources of light for white light, monochromatic light
along with ballast etc. Discharge tubes (neon/hydrogen etc), luxmeter Radioactive sources for nuclear physics experiments, absorption plates,G.M. tube apparatus.
27. Electronic timers with display or stop watches/stop clocks
28. Complete set of tools including pliers, cutter, soldering iron,screwdrivers of various types
29. Copper clad for making printed circuit boards, chemicals such as HCL,$FeCl_3$ etc.
30. Heating arrangement (electrical or gas burners)
31. Aspirators or similar water reservoirs, pinch cocks, rubber tubing etc.

Mathematics
Paper V
Set Theory and Logic(MT 331) & Real Analysis(MT 332)
Section I
Set Theory and Logic(MT 331)

1.Sets and Relations : [8 Lectures]

Cantor's concept of a set, Intuitive set theory, Inclusion, Operations for sets, Algebraof sets, Equivalence relations, Functions, Composition and Inversion of Functions,Operations for collections of sets, Ordering relations, Power sets, Numerical Equivalenceof sets.

2.Natural Number sequence : [12 Lectures]

Induction and Recursion, Cardinal numbers and Cardinality, Cardinal arithmetic,Countable and Uncountable sets, Schroeder-Bernstein Theorem (without proof),Paradoxes of Intuitive set theory, Russell's Paradox.

3.Logic : [4 Lectures]

Statement calculus (Sentential connectivities, Truth tables, Validity, Consequence, Applications), Predicate Calculus (Symbolizing every day language, Formulation, Validity, Consequence).

4.Basic Logic : [6 Lectures]

(Revision) Introduction, proposition, truth table, negation, conjunction and disjunction, Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

5.Propositional equivalence : [6 Lectures]

Logical equivalences, Predicates and quanti_ers : Introduction, Quanti_ers, Bindingvariables and Negations.

6.Methods of Proof: [12 Lectures]

Rules of inference, valid arguments, methods of proving theorems; direct proof, proof by contradiction, proof by cases, proofs by equivalence, existence proofs, Uniqueness proofs and counter examples.

Reference Books :

1. Symbolic Logic, I.M. Copi, Fifth Edition, Prentice Hall of India, 1995.
2. Naive Set Theory, P.R. Halmos, 1974.
3.. Set Theory and Logic, Robert R. Stoll, Errasia publishers, New Delhi.
4. Discrete Mathematics and its Applications, K.H. Rosen, Tata McGraw, New Delhi.

SectionII
Real Analysis(MT 332)

1. Sequences of real numbers : [10 Lectures]

De_nition of sequence and subsequence, Limit of a sequence, convergent sequences,Limit superior and Limit inferior, Cauchy sequences.

2. Series of Real numbers : [10 Lectures]

Convergence and divergence of series of real numbers, alternating series, Conditional and absolute convergence of series, test of absolute convergence (Ratiotest and Root test), series whose terms form a non-increasing sequence.

3. Riemann integral : [14 Lectures]

Sets of measure zero, De_nition and existence of a Riemann integral, properties of Riemann integral, Fundamental theorem of integral calculus, Mean value theorems of integral calculus.

4. Sequence and series of functions : [14 Lectures]

Pointwise and uniform convergence, sequence of functions, consequences of uniform convergence, convergence and uniform convergence of series of functions, integration and di_erentiation of series of functions.

Reference Books:

1. D. Somasundaram, B. Choudhary - A _rst course in Mathematical Analysis, Narosa Publishing House, 1997.
2. Robert, G. Bartle, Donald Sherbert - Introduction to real analysis, Third edition, John Wiley and Sons.
3. Shantinarayan and Mittal - A course of Mathematical Analysis, Revised edition,
S. Chand and Co.(2002).
4. S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publications,Third Edition,(2008).
5. R.R. Goldberg - Methods of Real Analysis (Oxford and IBH Publications (1970)).

PaperVI
Group Theory (MT 334) & Ordinary Differential Equations(MT 335)
SectionI
Group Theory (MT 334)

1.Groups [12 Lectures]

- Groups : de_nition and examples.
- Abelian group, _nite group, in_nite group.
- Properties of groups.
- Order of an element - de_nition, examples, properties.
- Examples of groups including Z;Q;R;C; Klein 4-group, Group of quaternions, S1(= the unit circle in C);GLn(R); SLn(R);On(=the group of n _ n real orthogonal matrices), Bn(= the group of n _ n nonsingular upper triangular matrices), and groups of symmetries of plane _gures such as D4 and S3.

2.Subgroups [10 Lectures]

- Subgroups : de_nition, necessary and su_cient conditions, examples on _nding subgroups of _nite groups, union and intersection of subgroups.
- Subgroup generated by a subset of the group.
- Cyclic groups : de_nition, examples of cyclic groups such as Z and the group _n of the n-th roots of unity, properties (a) Every cyclic group is abelian.

(b) If G = (a); then G = (a□1):
(c) Every subgroup of a cyclic group is cyclic.
(d) Let G be a cyclic group of order n. Let G = (a): The element as 2 Ggenerates a cyclic group of order n gcd(n; s) :
(e) Let G = (a) and o(G) = n: Then (am) = G if and only if (m; n) = 1:

- Cosets : de_nition and properties.
- Lagrange's theorem and corollaries.

3.Permutation Groups [6 Lectures]

- De_nition of Sn and detail discussion of the group S3:
- Cycles and transpositions, even and odd permutations.
- Order of permutation.
- Properties : (i) o(Sn) = n! (ii) An is a subgroup of Sn:
- Discussion of the group A4 including converse of Lagrange's theorem does nothold in A4:

4.Normal Subgroups [8 Lectures]

- De_nition.
- Properties with examples:
  (a) If G is an abelian group, then every subgroup of G is a normal subgroup.
  (b) N is a normal subgroup of G if and only if gNg□1 = N for every g 2 G:
  (c) The subgroup N of G is a normal subgroup of G if and only if every leftcoset of M in G is a right coset of N in G.
  (d) A subgroup N of G is a normal subgroup of G if and only if the product of two right cosets of N in G is again a right coset of N in G,.
  (e) If H is a subgroup of index 2 in G then H is a normal subgroup of G.
  (f) If H is the only subgroup of G of a _xed _nite order then H is a normal subgroup of G.
- . Quotient groups and examples.

5.Homomorphism and Isomorphism [12 Lectures]

- Homomorphism.
- Isomorphism : de_nition, examples, establish isomorphism of two _nite groups.
- Fundamental Theorem of homomorphisms of groups.
- The group Z=nZ of residue classes (mod n). Characterization of cyclic groups (as being isomorphic to Z or Z=nZ for some n 2 N):
- Cayley's Theorem for _nite groups.
- Classi_cation of groups of order _ 5:
- Cauchy's theorem for Abelian Groups.

Reference Books :

1. M. Artin, Algebra, Prentice Hall of India, New Delhi, 1994.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, Second Ed., Foundation Books, New Delhi, 1995.
3. J.B. Fraleigh, A. First Course in Abstract Algebra, Third Ed., Narosa, New Delhi, 1990.
4. N.S. Gopalakrishnan, University Algebra, Second Ed., New Age International, New Delhi, 1986.
5. D.A.R. Wallace, Groups, Rings and Fields, Springer-Verlag, London, 1998.
6. I.N. Herstein, Abstract Algebra.
7. I. H. Sheth, Abstract Algebra, Second Revised Edition, 2009, PHL,India.
8. I.N. Herstein, Topics in Algebra, Wiley, 1990.

SectionII

Ordinary Differential Equations(MT 335)

1. What is a Differential Equation?: [14 Lectures]

Introductory Remarks, the nature of solutions, separable equations, _rst-orderlinear equations, exact equations, orthogonal trajectories and families of curves,homogeneous equations, integrating factors,reduction of order:(1) dependent variable missing, (2) independent variablemissing, electrical circuits.

2. Second-Order Linear Equations: [12 Lectures]

Second-order linear equations with constant coe_cients, the method of undeterminedcoe_cients, the method of variation of parameters, the use of aknown solution to _nd another, vibrations and oscillations : (1) undampedsimple harmonic motion (2) damped vibrations (3) forced vibrations.

3. Power Series Solutions and Special Functions: [12 Lectures]

Introduction and review of power series, series solutions of _rst-order di_erentialequations, second-order linear equations, ordinary points, regular singularpoints, more on regular singular points.

4. System of First-Order Equations: [10 Lectures]

Introductory remarks, linear systems, homogeneous linear systems with constant coe_cients.

Reference Book:

1. W.R. Derrick and S.I. Grossman, A First Course in Di_erential Equations withApplications. CBS Publishers and distributors, Delhi-110 032. Third Edition.
2. Rainville, Bedient: Di_erential Equations
3. Di_erential Equations by George F. Simmons, Steven G. Krantz, TataMcGraw-Hill.

PaperVII

Metric Spaces(MT 341) & Complex Analysis (MT 342)

Section I

Metric Spaces(MT 341)

1. Basic Notions. [8 Lectures]
2. Convergence. [8 Lectures]
3. Continuity. [8 Lectures]
4. Compactness. [10 Lectures]
5. Connectedness. [6 Lectures]
6. Complete Metric Spaces. [8 Lectures]

Reference books :

1. Real Analysis, Carothers, Cambridge University Press, 2000.
2. Methods of Real Analysis, R.R. Goldberg, Oxford and IBH Publishing Company.
3. Metric Spaces, E.T. Copson, University Press, Cambridge, 2nd edition, Mumbai,1978.
4. Introduction to Topology and Modern Analysis, G.F. Simmons. McGraw HillInternational Book Company, International Student Edition.
5. Topology of Metric Spaces' by S. Kumaresan, Narosa Publishing House, 2005.(Note: All the problems which are based on normed linear spaces and matrices be Dropped)

SectionII

Complex Analysis (MT 342)

1. Analytic function [10 Lectures]

Functions of Complex Variables,Limits, theorems on limits, Limits involvingthe point at in_nity, continuity, derivatives, di_erentiation formulas, Cauchy-Riemann Equations, Su_cient Conditions for di_erentiability, polar coordinates,Harmonic functions.

2. Elementary Functions [8 Lectures]

Elementary Functions, Exponential functions, Logarithmic function and itsbranches and derivatives of logarithms, sum identities involving logarithms,complex exponents,. Trigonometric functions, Hyperbolic functions,inverse trigonometric and hyperbolic functions.

3. De_nite Integrals [12 Lectures]

Derivatives of functions, de_nite integrals of functions, contours, contour integrals,examples, upper bounds for moduli of contour integrals, anti-derivatives,examples, Cauchy-Groursat's Theorem, Simply and multiply connected domains.Cauchy integral formula. Derivatives of analytic functions. Liouville'sTheorem. Fundamental Theorem of Algebra.

4. Series [8 Lectures]

Convergence of sequences, convergence of series, Taylor Series, examples, LaurentSeries, examples. Absolute and uniform convergence of power series, continuityof sums of power series, Integration and Di_erentiation of power series.

5. Residues [6 Lectures]

Residues, Cauchy residue theorem, using a single residue, three typesof isolated singular points, residues at poles, zeros of analytic functions, zerosand poles.

6. Applications of Residues [4 Lectures]

Evaluation of improper integrals, examples.

Reference Books:

1. S. Ponnusamy, Complex Analysis , Second Edition (Narosa).
2. J.M. Howie, Complex Analysis, (Springer, 2003).
3. S. Lang, Complex Analysis, (Springer Verlag).

4. A.R. Shastri, An Introduction to Complex Analysis, (MacMillan).
5.R.V. Churchill and I.W. Brown, Complex Variables and Applications, International Student Edition, 2003. (Seventh Edition).

PaperVIII

Ring Theory (MT 344) & Partial Differential Equations(MT 345)

SectionI

Ring Theory (MT 344)

1. Defition and properties of Ring, Subring. [5 Lectures]

2. Integral Domains[5 Lectures]

Zero devisiors, Cancellation Law, Field, Characteristics of Ring

3. Ideals and Factor Rings [6 Lectures]

Existence of Factor Ring, Prime Ideals, MaximalIdeals.

4. Homomorphism of Rings [8Lectures]

Properties of Ring Homomorphism, Kernel,First isomorphism Theorem for Ring, Prime Fields. The _eld of Quotients.

5. Polynomial Ring [6 Lectures]

De_nition. The division Algorithm, Principle Ideal Domain.

6. Factorization of Polynomial [8 Lectures]

Reducibility and Irreducibility Tests, Eisensteincriterion. Ideals in F[x]: Unique Factorization in Z[x].

7. Divisibility in Integral Domain[10 Lectures]

Associates, Irreducible and Primes, UniqueFactorization Domains, Ascending chain Condition for PID, PID implies UFD,Euclidean Domains. ED Implies PID,D is UFD implies D[x] is UFD

Reference Books:

1. J.B. Fraleigh, First course in Abstract Algebra (4rd Edition). Narosa PublishingHouse.2. I.N. Herstein. Abstract Algebra, (3rd Edition), Prentitice Hall of India, 1996.
3. N.S. Gopalkrishnan, University of Algebra, Wiley Eastern 1986.
4. C. Musili, Rings and Modules, Narosa Publishing House, 1992.
5. Joseph, A. Gallian, Contemporary Abstract Algebra,(4th Edition), Narosa PublishingHouse.

SectionII

Partial Differential Equations(MT 345)

1. Ordinary Di_erential Equations in More Than Two Variables[20 Lectures]

(a) Surface and Curves in Three Dimensions
(b) Simultaneous Di_erential Equations of the First Order and the First Degreein Three Variables.
(c) Methods of solution of $dx/P = dy/Q = dz/R$.
(d) Orhogonal Trajectories of a System of curves on a Surface.
(e) Pfa_an Di_erential Forms and Equations.
(f) Solution of Pfa_an Di_erential Equations in Three Variables.

2.First Order Partial Differential Equations : [28 Lectures]

(a) Curves and surfaces.
(b) Genesis of First Order Partial Di_erential Equations.
(c) Classi_cation of Integrals.
(d) Linear Equations of the First Order.
(e) Pfa_an Di_erential Equations.
(f) Compatible Systems.
(g) Charpit's Method.
(h) Jacobi's Method.
(i) Integral Surfaces through a given curve.
(j) Quasi-Linear Equations.

Reference Books:

1. Frank Ayres Jr., Di_erential Equations, McGraw-Hill Book Company, SI Edition (International Edition, 1972)
2. Ravi P. Agarwal and Donal O'Regan, Ordinary and Partial Di_erential Equations, Springer, First Edition (2009).
3. W.E. Williams, Partial Di_erential Equations, Clarendon Press, Oxford,(1980).
4. Ian Sneddon, Element of Partial Di_erential Equations, McGraw-Hill Book Company, McGraw-Hill Book Company. Chapter 1 x1 to x6.

5. T. Amaranath, An Elementary Course in Partial Di_erential Equations, Narosa Publishing, House 2nd Edition, 2003 (Reprint, 2006). Chapter 1 x1 to x10.

Practical Course III (MT 333 & MT 336)

1.Problem based on Set theory & Logic(MT 331)
2.Problem based on Real Analysis(MT 332)
3.Problem based on Group Theory(MT 334)
4.Problem based on Ordinary Differntial Equation(MT 335)

Practical Course IV (MT 343 & MT 346)

1.Problem based on Metric Spaces(MT 341)
2.Problem based on Complex Analysis (MT 342)
3.Problem based on Ring Theory(MT 344)
4.Problem based on Partial Differntial Equation(MT 345)

Zoology
Paper V
General Zoology(ZY 331) & Biotechnology(ZY-341)
Section I
General Zoology(ZY 331)

1. Study of following following groups with reference to : (5 Lectures)

- Arthropoda : Larval forms in Crustacea
- Mollusca : Torsion
- Hemichordata : Affinities.

2. Study of *Pila* with references to the following: (10 Lectures)

- 2.1 Systematic position, habit and habitat, external characters,
- 2.2 Organs of pallial complex
- 2.3 Functional anatomy: - digestive, circulatory, respiratory, excretory,
- reproductive system, nervous system and sense organs.

3. Comparative study with reference to the following topics in the vertebrates: (10 Lectures)

Heart : Structure of heart of *Scoliodon*, Frog, *Calotes*, Pigeon and Rat
Kidney : Evolution of Archinephros, Pronephros, Mesonephros,
Metanephros .
Evolution of : Aortic Arches
Brain : Morphological variations in the different regions of the brain
of *Scoliodon*, Frog, *Calotes*, Pigeon and Rat

4. Study of following groups with reference to: (8 Lectures)

Pisces : Electric organs, Dipnoi, Accessory respiratory organs.
Amphibia : Neoteny and paedogenesis
Reptilia : General characters of Rhyncocephalia
Mammalia : Dentition in Mammals

5. Study of C*alotes* with references to the following: (12 Lectures)

- 5.1 Systematic position, habit and habitat, external characters,
- 5.2 Functional anatomy: - digestive, circulatory, excretory, reproductive, nervous system and sense organs.

Reference books:

1. Living invrtebrates, 1987: Pearse/ Buchshaum, Blackwell Scientific Publication,California.
2. A text book of zoology Invertebrates, vol. I 1992, 7th edn. Parker and Haswelledited by marshall and William, CBS publishers and distributors , New delhi.
3. Invertebrate zoology, 1992; E.L.Jorden, S. Chand and Co.,New delhi.
4. Life of invertebrate, 1992; S.N.Prasad, Vikas publishing house, New Delhi.
5. Invertebrate zoology, 1992 4th edn. , reprint, P.S.Dhami and J.K.Dhami, R. Chandand Co.,New delhi.
6. Modern text book of zoology, Invertebrates 6th edn.. 1992, R.L.Kotpal, Rastogipubl.,Meerut.
7. Invertebrates structure and function, 2nd edn. 1992, R.L.Kotpal, Rastogipublication,Meerut.
8. Invertebrate zoology, 1982, R.D.Barnes; Saunder college, Philadalphia.
9. The protochordata, 1972, K.Bhatia, Central Book Depot, Allahabad.
10. Invertebrate zoology , 1991, Meglitsch P.A. and Ssharm F.R. Oxford UniversityPress; U.K.

11. Invertebrata : New synthesis , 1988, Barnes R.S.K.Calow P. and Olive
P.J.W..,Blackwell Scientific , U.K.
12. Invertebrate zoology 1987, 5th edn. Barnes R.D.Saunders College PublishingU.S.A.
13. Introduction to protochordata, 1990, S.H.Bharmrah and Kavita Juneja, Anmolpublication, New Delhi.
14. The Invertebrates : Protozoa through Ctenophora Vol.I, 1959,McGraw – Hill Book Co., Inc. New York.
15. A text book of Zoology, Vol. II, 1990,T.J. Parker and W.A.haswell, Low pricepublication, Delhi.
16. Chordata zoology, 1982, P.S.Dhami and J.K.Dhami, R.chand and Co.,New Delhi.
17. Modern text book of zoology, 1992, R.L.Kotpal,Rastogi publication meerut.
18. Text book of zoology, vertebrates , Vol.II, T.J.Parker and W.A.Haswell, Edited
by Marshall and Williams,CBS publications, New Delhi.
19. The life of vertebrates, 3rd edn.1993, J.Z.Young, E.L.B.S.,Oxford.
20. The phylum chordate, 1987, H.H.Newman, Distributor Satish book enterprise, Agra,
21. A text book of zoology, 1984, R.D.Vidyarthi, S. Chand and Co., New Delhi.
22. Chordate zoology, E.L.Jorden, S,Chand and Co., New Delhi.
23. The anatomy of Garden Lizard, S.Y.Paranjape, Pune University Publication, Pune.
24. Comparitive anatomy of the vertebrates, G.C.Kent.
25. Invertebrate Practical Zoology; S.S. Lal,
26. Vertebrate Practical Zoology; S.S.Lal.
27. A text book of Invertebrate Practical Zoology by R.L.Kotpal.
28. A text book of Vertebrate Practical Zoology by R.L. Kotpal.
29. Practical Zoology: Non chordate and Chordate by Sharma.

Section II

Biotechnology(ZY-341)

1. Introduction & Scope of biotechnology. (2 Lectures)

2. Recombinant DNA technology. (3 Lectures)

Introduction, Restriction enzymes, cloning vectors (plasmids, bacteriophages, cosmids), PCR technique, Blotting techniques,(Southern blotting, Northern blotting and Western blotting), ELISA, Application towards living systems.

3. Animal cell and tissue culture. (10 Lectures)

Introduction, advantages and disadvantages, laboratory facility for tissueculture, culture media, culture procedure, cell culture and cell lines, somatic cell fusion , organ culture, pharmaceutical applications of animal cell culture.

4. Hybridoma technology. (10 Lectures)

Production of Monoclonal & Polyclonal antibodies.Transgenic animals : - Value of transgenic animals, method of creation of transgenic animals (physical, chemical, virus and bacteria mediated) and its applications.

Stem cell bioengineering/technology : - Division of stem cells, biological role and properties of stem cells, types of stem cells and applications (cell replacement therapy, cardio-vascular therapy, haemopoisis, diabetes and liver therapy)

5**. Advance biotechnology . (6 Lectures)**

Aquaporin structure, artificial intelligence, biosensors, hydroponics, nanotechnology.

6. Biopesticides. (8 Lectures)

Advantage of biopesticides,
Microbial and antimicrobial pesticides (Bacteria / Virus/ Fungi as pesticides)
Natural pesticides, Nematode biopesticides.

7.Industrial fermentation. (6 Lectures)

Introduction, fermentation technology, (fermenters, selection of microbes, fermentation medium), Penicillin production, Riboflavin, Amylase production (bacterial alpha amylase)

Reference Books:

1. Biotechnology by Trehan.
2. Comprehensive Biotechnology 4th edn.,2009, K.J.Ramawat and Shaily Goyal,S.Chand & company.
3. Principles of biochemistry 3rd and 4th edn., Lehninger.
4. Genetic Engineering University press, Science source books.

5. Experimental biotechnology,P.M. Philopose, Dominant publishers and distributors, New Delhi.
6. Culture of animal cells,R.I.Freshney 4th edn.
7. Pharmaceutical microbiology, Experiments and techniques,2nd edn. C.R.Kokare.

PaperVI

Mammalian Histology (ZO-332) & Mammalian Physiology and Endocrinology(ZO-342)

Section I

Mammalian Histology (ZO-332)

1. Introduction. (2 Lectures)

· Definition and scope.

2. Tissues: (3 Lectures)

Definitions and review of different types.

3. Histological study of following organs. (31 Lectures)

· Skin (V.S.)
· Tooth (V.S.)
· Tongue (C.S.) with reference to mucosa papillae and taste bud.
· Alimentary canal: Basic histological organization with reference to : oesophagus(T.S.), stomach(T.S.), duodenum (T.S.) Ileum (T.S.) and rectum (T.S.)
· Glands associated with digestive system : Salivary glands – parotid (C.S.), submandibular (C.S.) sublingual (C.S.), liver (C.S.) and pancreas (C.S.) including both exocrinal and endocrinal components.
· Respiratory organs: Trachea (T.S.) and lung.(C.S.)
· Blood vessels: Artery(T.S.), vein(T.S.) and capillaries.(T.S.)
· Kidney (L.S.) ,structure of nephron and juxta glomerular complex.
· Reproductive organs: a)Testis (T.S.) with reference to seminiferous Tubules and cells of
· Leydig. b) Ovary (C.S.) - primary, secondary and

matured(Graffian)follicle corpus luteum and corpus albicans.

4. Histology of endocrine glands: (5 Lectures)

1)Pituitary. 2) Thyroid 3)Adrenal.

5.Microtechnique: (5 Lectures)

· Histological localization of lipids, carbohydrates and proteins in different tissues.
· Histochemical staining for carbohydrates (PAS), protein(Millon's staining method) and lipids (Sudan black-B method) and Fulgen nuclear staining for DNA.

Reference Books

1. Bailey Text boof of Histology, 1971, 16th edn. Wilfred M.Copenhaver Richord P.Bung & Mary bartell Bunge,
. The William & Wilkings compay Baltimore
2. Histology 979, 8th edn. Arthur W.Ham. David H. Cormark. J.B. Lippincott. Co.Philadelphia.
3. A text book of Histology , 1991 2nd edn. Krishan Garg. Indira Bahl & Mohini Kaul CBS publication & Distributors Delhi.
4. Histology, 1973 3rd edn,. R.D.Greep & L.Weill, McGraw Hill Int. Book C. New York.
5. Histology of Mammals 183 Athawale & Latey, Narendra Prakashan, Pune.
6. Hand book of Basic Mictotechnique, 1964, 3rd edn. Peter Gray McGraw Hill Book Co. New York.
7. Hand Book of Histological & Histochemistry Technique, 1991, 1st edn. S.K.David, CBS publisher & Distributors, Delhi.

Section II

Mammalian Physiology and Endocrinology (ZO-342)

1. Definition and scope. (1 Lectures)

2. Nutrition: (8 Lectures)

- . Physiology of digestion: Names of digestive enzymes and their actions— salivary, gastric and intestinal
- digestion .Role of liver and pancreas.
- Metabolic pathway:
- Carbohydrates - glycogenesis, glycogenolysis, gluconeogenesis, glycolysis, Kreb's cycle, ETS.
- Lipids - Fatty acid beta oxidation.
- Proteins - Deamination, transamination, decarboxylation, transmethylation.
- Integration of carbohydrate, lipid and protein metabolism.

3. Circulation: (4 Lectures)

- 3.1. Cardiac cycle – systole, diastole, pacemakers
- 3.2. Definitions and clinical significance of- ECG, Eco-cardiograph, color Doppler, angiography, angioplasty, angina pectoris, heart attacks, coronary bypass.

4. Respiration: (3 Lectures)

- Mechanism of transport of gases
- Transport of oxygen—oxyhaemoglobin formation.
- Transport of carbondioxide in the form of --- physical solution of carbonic acid, carbamino compounds and bicarbonate ions or chloride shift.
- Respiratory quotient and BMR.
- Respiratory disturbances –Definitions - Apnoea, dyspnoea, arterial hypoxia,
- hypo- and hypercapnia, asphyxia.

5. Excretion: (4 Lectures)

- 5.1. Physiology of urine formation—ultrafiltration, selective reabsorption, tubular secretion.
- 5.2. Counter current multiplier theory for urine concentration.
- 5.3. Definitions and clinical significance —renal failure, renal calculi, dialysis.

6. Muscle physiology: (5 Lectures)

- 6.1. a) Ultra structure of striated muscle (structure of sarcomere).
  b) Chemical composition of striated muscle.
- 6.2. Sliding filament theory of muscle contraction.
- 6.3. Physical and chemical changes during muscle contraction.
- 6.4. Response of muscle to stimulation – simple muscle twitch, tetany, muscle fatigue, rigor mortis.

7) Nervous Excitation: (5 Lectures)

- Definitions- Impulse, stimulation, conduction, response, EEG and epilepsy.
- Origin and conduction of nerve impulse, salutatory conduction.
- Synapse – Ultra structure and transmission of nerve impulse.
- Neurotransmitters- definition, properties and types- serotonin, dopamine,histamine, acetylcholine, GABA.

8. Reproduction: (8 Lectures)

- Reproductive cycle with hormonal control-oestrous & menstrual.
- Pregnancy, parturation, lactation and their hormonal control.
- Hormonal control of male reproduction.

9. Endocrinology: (7 Lectures)

- Introduction.
- Concept of positive and negative feed back mechanism of hormone action.
- . Physiology of— pituitary, thyroid, pancreas and adrenal.

Reference Books:

1.Animal Physiology, 1990 4th edn. Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
2.Physiology of Mammals & other vertebrates, 1980, 2nd edn. Marshall & Hughes. Cambridge Univrsit5y Press Cam,bridge.
3.Animal Physiology, 1987, Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
4.Text of Anbimal Physiology, 1976, Hurt & Mathur, S.Chand & Co. New Delhi.

5.General & Comparative Physiology, 1991. 3rd edn. William S Hoar, Prentice hall, India, New Delhi.
6.Text of Animal Physiology, 1991, 2nd edn,N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
7.Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) 4th edn. 1991, CLadd Prosser, Wiley-Liss, Publication, New York
8.Comparative Animal Physiology (Neural & Integrative Animal Physiology), 1991, 4th edn. C. Ladd Prosser, Wiley-Liss, Publication New York.
9.Human Physiology, Vol.I & II 1980.12th edn.Dr.C.C.Chatterjee, Medical applied Agency, Calcutta.
10.Comparative Vertebrate Endocrinology, 1982, 2nd ed, P.J.Bently, Cambridge Univesity Press, London.
11.Handbook of Experimental Physioology & Biochemistry, 1993, Dr.P.V.C0Chandha Jaypee Brothers Medical Publishers, New Delhi.
12.General Endocrinology, 1976, 6th . edn.Turner C.D. & Baganara J.T. W.B.Saunders Co., Philadelphia.
13.Biochemistry, 1993, 3rd edn. Zubay G.Wm.C.Brown Communications Inc.U.S.A.
14.Text book of Medical Physiollgy, 1991, 8th edn. Guyton. A.C. W.NB.Saunders com., Philadelphia (Indian edn. Prism Book Banglore

Paper VII
Biological Chemistry (ZY- 333) & Molecular Biology(ZY-343)
Section I
Biological Chemistry (ZY- 333)

1 Basic biochemistry : (8 Lectures)

- Chemical bond: Types of bonds, covalent bonds (peptide and disulphide bonds),noncovalent bonds (hydrogen bonds ,hydrophobic bonds, electrostatic bonds,Vander wals forces),their functions in biomolecules.
- Water : Structure of water molecule, physico-chemical properties
- Colloids : definition, properties, types, uses.
- Concept of Bronsted acid and base, Concept of pH, Sorensen scale, Henderson – Hasselbalch equation ,
- Measurement of pH (indicator, pH paper, pH meter)
- Buffer: Types of buffers, buffering capacity, Biological buffer systems: Phosphate and bicarbonate (acidosis,
- alkalosis), and Hb

2 .Biomolecules : (19 Lectures)

Concept of Micromolecules, Macromolecules.

- Carbohydrates: Definition, classification, stereochemical properties, physical and chemical properties, structure of common monosaccharide, disaccharides, polysaccharides (homo & heteropolysaccharides), their biological importance.
- Amino Acids and Proteins: Basic structure of amino acid, essential and nonessential amino acids, classification of amino acids Properties related to functional group (NH2,COOH,R group): solubility, acidbase behaviour, titration of amino acids, optical properties NH2 group : salt formation, Sorenson's formal titration, methylation, reaction with HNO2, Sanger's reagent, PITC, Ninhydrin COOH group : ester formation, decarboxylation, amide formation, R group Peptides ,their importance. Protein structure : primary, secondary, tertiary, quarternary,Types of proteins
- Lipids -Definition, classification of lipids with examples, physical and chemical properties of lipids: saponification,hydrogenation, oxidative rancidity. Fatty acids : saturated and unsaturated, essential fatty acids biological and clinical significance of lipids(obesity, arthrosclerosis, myocardial infarction).

3. Enzymes : (8 Lectures)

- Classification and properties, regulatory and nonregulatory enzymes
- Enzyme kinetics and its importance (MM equation, LB equation) Enzyme inhibition – reversible and irreversible and their types.
- Factors affecting enzyme activity –enzyme concentration, substrate concentration pH, temp., activators and inhibitors, Allosteric enzymes and their co-operative behaviour, holoenzyme, apoenzyme, prosthetic group, coenzyme, Immobilize enzyme Isoenzymes, clinical significance of enzymes

4 Vitamins: (8 Lectures)

- Introduction, study with reference to occurrence, biochemical function and deficiency, water soluble vitamins –B1, B2, B6, B12,nicotinic acid, folic acid, lipoic acid ,biotin, pantothenic acid, ascorbic acid Fat soluble vitamins – A, D, E, K; Hypervitaminosis

· Minerals: with reference to sources, biological functions and (2) deficiency: Na, K, Ca, Mg, Fe

Reference books :

1. Principles of Biochemistry, 1993, 2nd & 3rd edn. Lehninger A.L. Nelson D. L. and Cox. M.M. CBH publisher and distributors, Delhi.
2. Biochemistry, 1995, 5th edn. Zubay G. Wm. C.Brown communication U.S.A. 3. Harper's Biochemistry 1996, 26th edn. Murray R.K. Granner D.K. Mayes P.A. and Rodwell V.W. prentice. Hall international U.S.A.
4. Outlines of Biochemistry 1955, 5th edn. Conn E.E. stumph P.K. Bruening G. and Doi R.H. John Wiley and Sons U.S.A.
5. Principles of Biochemistry 1993, 1st edn. Pattabiraman T.N. Gajanan Book publishers and Distributors Banglore.
6. Clinical Biochemistry, 1994, B.P.Godkar, Bhalani Publishing house, Bombay.
7. Biochemistry 1990, 8th edn. D. Voet and J.Voet Willey, New York.
8. Biochemistry 1994, 5th edn. Stryer, sanfrancisco W.H.Freeman and co.
9. Fundamentals of Bio chemistry- Jain, Jain, Jain – S. Chand and Co.

Section II
Molecular Biology(ZY-343)

1. Nucleic Acids : (5 Lectures)

· Structure of DNA and RNA
· Types of DNA – A,B,Z, & H forms
· Types of RNA
· Physico-chemical properties of DNA
· DNA as a genetic material –Evidences
· RNA as a genetic material in viruses

2. Bacterial Genetics / Recombination in Bacteria: (6 Lectures)

· Bacterial transformation – Griffith's expt., process of transformation
· Bacterial conjugation – Lederberg and Tatum expt,Hfr cells, plasmids
· Transduction by Bacteriophage – Zinder and Lederberg expt.,specilised and generalized transduction

3. Chromatin Structure : (4 Lectures)

· Prokaryotic chromosome structure
· Eukaryotic chromatin structure
· Ultrastructure of nucleosome
· Higher order structure

4. Central Dogma of Molecular Biology: (18 Lectures)

· 4.1 DNA Replication: DNA replication in prokaryotes, eukaryotes Types of DNA replication, experimental
· proof that DNA replication is semi conservative type
· 4.2 Transcription: Transcription in prokaryotes and eukaryotes, processing of RNA, SnRNPs and ScRNPs
· 4.3 Translation: Components : Genetic code, deciphening of genetic code,
Transfer RNA – Structure , activation of amino acid,
Ribosome – Molecular structure , active sites, function
Mechanism of protein biosynthesis – Initiation, elongation, termination,
detail mechanism in both pro- & eukaryotes. regulation of protein synthesis,
inhibitors of protein synthesis

5. Regulation of Gene Activity: (7 Lectures)

· Gene regulation in prokaryotes – Lac operon
· Trp operon – organization, regulation
· Gene regulation in eukaryotes

6. DNA Damage and Repair: (5 Lectures)

· DNA damage due to ionizing radiations,chemicals and other substances.
· DNA repair mechanism : photorepair, dark repair, base excision repair, SOS repair

Reference Books:

1. Molecular biology of cell, 3rd and 4th edition, Alberts B. D. Lewis J. Raff M. Roberts K. and Watson.
2. Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.

3. Molecular biology of the Gene, 1993, Watson J. Hopkins, Roberts Steitz &Weiner, Benjamin Cummings.
4. Text Book of Molecular Biology, 19994, K. Sivrama Sastry G. Padmanabhan and
C. Subramanyam: MacMillan, India.
5. Cell and Molecular biology, 1996, G. Karp, John Willey & Sons, U.S.A.
6. Principles of Genetics, 1997, P.D. Snustad, M.L.Smmons, J.B. & Jenkins, John Willey & Sons, U.S.A.
7. Cell and Molecular biology, De Robertis and De Robertis, 8th & 9th Edition, Saunders Publications.

Paper VIII
Environmental Biology and Toxicology (ZY-334) & Organic Evolution (ZY-344)
Section I
Environmental Biology and Toxicology (ZY-334)

1. Environmental Biology (2Lectures)

- Introduction
- Definition, basic concepts and scope.

2. The Ecosystem (8 Lectures)

- Definition, abiotic and biotic components and their interrelationship.
- Nutrient cycles in ecosystem. atmospheric cycles & edaphic nutrient cycles.
- Energy flow in ecosystem and flow models.
- Major Ecosystems
- a) Natural ecosystem: fresh water eg. pond water, Forest.
- b)Artificial ecosystem: crop land.
- Food chain in ecosystem and food web.
- Ecological pyramids.

3. Environmental Pollution: (8 Lectures)

- Definition and types of pollution.
- Pollutants, types of pollutants. (metallic, gaseous, acids, alkalis, biocides)
- Air pollution: Definition, sources of air pollutants, their effects.(biodegradable,
- non biodegradable)
- Air pollution and its relation with the following.
  a)Acid rain
  b)Green house effect
  c)Ozone layer.
- Water pollution: definition, sources of water pollutants, their effects on ecosystem
- Community waste with reference to following.
  a)Sewage.
  b)Industrial wastes.
  c) Agricultural waste
- Land / Soil pollution: definition, sources of land / soil pollutants, their effects.
- Noise pollution: definition, sources of noise pollutants, their effects and control measures.

4. Environment and Development. (4 Lectures)

- Bioindicators and environmental monitoring.
- Environmental challenges in India: land degradation, population explosion, urbanization and industrialization
- Efforts to meet the environmental challenges.

5. Natural Resources and Conservation: (4Lectures)

- Renewable and non-renewable resources.
- Soil conservation
- Forest conservation.
- Energy sources: conventional and non-conventional.

6. Wildlife Management: (5 Lectures)

- Definition, causes of wildlife depletion.
- Importance of wildlife, management in India.
- Endangered species, vulnerable species, rare species , threatened species.
- Wild life conservation

7. Environmental Education: (3 Lectures)

- Goals and objectives.
- Role of environmental organizations & agencies.

8. Toxicology of pollutants: (3 Lectures)

- Introduction ,definition and scope.
- Basic tests for
  a) Air pollutants.
  b) Water pollutants.
  c) Soil pollutants.

9. Toxicants and Toxicity: (5Lectures)

- Definition and types.
- Factors influencing toxicity (pH, temperature, reproductive status, ages, physiological state).
- Dose, LD50, LC50, effects & types of effects, response.

10. Toxicants of Public Health and Hazards: (3 Lectures)

- Pesticides, heavy metals, fertilizers, food additives and radioactive substances.

Reference Books:

1. Ecology and environment, 1996, P. D. Sharma, Rastogi Publ. Meerat.
2. Environmental Biology, 1996, P. S. Sharma and V.K.Agrawal, S.Chand and Co. New Delhi.
3. Ecology, 1995 Mohan P Arora Himalaya Publ. House Delhi.
4. Fundamentals of ecology, 1993 M.C. Dash, Tata Megrew Hill, New Delhi.
5. Elements of ecology, George L. Clarke, John Wiley and Sons, New York.
6. Ecology of Natural resources, 1995 John Wiley and Sons, New York.
7. Concepts of Ecology, 1996, E.J. Koprmondy, Pentice Hall of India.New Delhi.
8. Modern concepts of Ecology , H. D. Kumar, vikas Publi. House, New Delhi
9. Ecology, E. P. Odum, Oxford & IBM Publi.Co. New Delhi.
10 Environmental problems and Solution, D. K. Asthna, Meera Asthana, S.Chand Publi. Ramnagar, New Delhi.
11. P.D. Sharma Toxicology, Rastogi Publi. Meerut.
12 R. Kumar, Pollution and Health hazards in India. Ashish Publi. House, Panjab Bagl, New Delhi-110026.
13. M. A. Subramanian, Toxicology – Principals and Methods, MJP Publishers, Chennai.
14. A. Albert, Selective Toxicity, Rastogi Publi. Meerut.
15. M.Satake, Y. Mide, Environmental Toxicology, M.S. Sethi, S.A. Iqbal Discovery Publi. House, New Delhi.
16. E.J. Ariece, Simonis, Introduction to General Toxicology, Academic Press,London.

Section II

Organic Evolution (ZY-344)

1. Introduction. (5Lectures)

- Origin of life
- Origin of eukaryotic cell (origin of mitochondria , plastids & symbionts.).

2. Evidences in favour of organic evolution: (8Lectures)

Evidences from: anatomy, embryology, geographical distribution, palaentology, physiology, biochemistry, genetics, and molecular biology.

3.Theories of organic evolution: (8 Lectures)

- Lamarckism.
- Darwinism and Neo Darwinism.
- Mutation Theory
- Modern Synthetic theory.

4. Isolation: (3 Lectures)

- Isolating mechanism.
- Classification of isolating mechanism

· Pre-zygotic and post-zygotic isolating mechanism.

5. Speciation: (4 Lectures)

· Types of speciation.(Allopatric & Sympatrise)
· Mechanism of speciation.
· Patterns of speciation
· Factors influencing speciation.

6. Geological Time Scale. (2 Lectures)

7. Animal Distribution: (4 Lectures)

· Methods of distribution.
· Classification of animal distribution.
· Patterns of animal distribution.
· . Factors affecting distribution

8. Antiquity of Man: (7 Lectures)

Evolution of anthropoids including man *(Kenyamapithecus, Australopithecus, Homo habilis, Homo erectus, Homo sapiens, including Neanderthals and Cro-Magnons)*

9. Zoogeographical Realms: (4 Lectures)

With reference to geographical regions. fauna

Reference Books:

1. Organic Evolution, Richard Swann Lull, Light & Life Publishers.
2 Introduction to Evolution, Paul Amos Moody, Kalyani Publishers, New Delhi.
3. Organic Evolution, 1991 T.S. Gopalkrishanan, Itta Sambashivarab Publ. House
4. Evolution, 1996 P.K. Gupta Rastogi Publ., Meerut.
5. Evolutionary Biology, 1990, Mohan P.Arora, Himalaya Publi.House,Delhi.
6. Evolution, 1968, E. O. Dodson, Reinhold Publ. Crop., New York.
7. The major features of evolution, 1953, Simpson G.G. Columbia, New York.
8. The origin of species,1959, Charles Darwin, New American Library, New York.

Zoology Practicals Course III (ZY 347)

1.General: Zoology

Pract 1- Study of external characters , T. S. through proboscis collar and trunk of *Balanoglossus*. (D)
Pract 2- Study of larval forms of crustacean. (D)
Pract. 3 a) Study of digestive system of *Pila* (E) b) Temporary mounting of osphradium (E)
Pract 4 – a) Study of nervous system of *Pila* (E) b) Temporary mountings of radula, and statocyst of *Pila* (E)
Pract 5 – Study of digestive system of *Calotes* (E) Temporary mountings of Scales of *Calotes* (E)
Pract 6 – Study of venous system and arterial system of *Calotes* (E)
Pract 7 – a) Nervous system of calotes (E) b) Temporary mountings of pectin and Hyoid apparatus of *Calotes*
Pract 8 – Comparative study of :
a) Heart : *Scoliodon*, Frog, *Calotes*, Gallus and Rat. (D)
b) Brain : *Scoliodon*, Frog, *Calotes*, Gallus and Rat (D)
Pract.9- Study of accessory respiratory organs in fishes: Anabas, *Labeo*, *Clarius* (D)
Pract 10- Study of Dipnoi fishes and Axolotl larva (D)

2.Histology of Mammals:

Pract: 1: Principle & use of camera lucida. (E)
Pract 2: Tissue collection & fixation. Block making (E)
Pract 3: Sectioning. Staining & mounting. Permanent slides preparation (E)
Pract: 4: (a) Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum, liver, pancreas and any one salivary gland. (D)
(b) Study of permanent histological slides of trachea, lung kidney testis, ovary, thyroid and adrenal. (D)
Pract: 5: Temporary mounting of tissues: (E)
a) Medullated nerve fiber.
b) Striated muscle fiber

3.Biotechnology

Pract 1 . Study of various instruments, their principal and working. (D)

i. CO_2 incubator
ii. Fermentor
iii. Inverted microscope
iv. Laminar Hood / Laminar Air flow

Pract 2. Establishment of primary cell culture- (D)
Pract 3 Bacteria as bio pesticides – B. Thuringensis (D)
Pract 4 Cell viability assay by trypanblue exclusion method. (E)
Pract 5 Positive & Negative selection (blue-white Selection).
Pract 6 Culture of Bacteria in liquid medium and agar plates. (E)
Pract 7 Antibiotic sensitivity/ resistance (E)
Pract 8 Visit to biotechnology Institute

4.Mammalian Physiology and Endocrinology

Pract 1 Effect of hypo, iso and hypertonic solutions on RBCs. (E)
Pract 2 A] Clotting time of blood. (E)
B] Preparation of haemin crystals. (E)
C] Study of ECG using recorded graph. (D)
Pract 3 Diffusion of glucose through intestine. (E)
Pract 4 Estimation of blood glucose. (E)
Pract 5 Identification of food constituents— (E)
a) Carbohydrates—Glucose, Starch.
b) Protein- Albumin-Biuret test, Ninhydrin test, Millon's test, Xanthoproteic test.
c) Fats—Olive oil/ Groundnut oil—Emulsion test, Solubility test, Saponification test (Rastogi page-75-77)
Pract 6 Study of any five clinical conditions associated with hypo/hyper active (D)
endocrine glands with the help of photographs—Gigantism, Dwarfism, Acromegaly, Cretinism, Myxodema, Grave's disease, Cushing's disease.

Practicals Course IV(ZY 348)

1.Biological Chemistry

Pract 1 :Carbohydrate tests:Identification of carbohydrate by performing
suitable tests(Monosaccharides, Disaccharides, Polysaccharides) (E)
Pract 2: Isolation of starch from potato and digestion of starch by salivary amylase (E)
Pract 3: Isolation of protein by isoelectric precipitation and its quantification (E)
Pract 4: Study of enzyme urease/ invertase, extraction, activeness, effect of temperature,
pH, activator and inhibitor. (E)
Pract 5: Preparation of buffer of desired pH and molarity (E)
Pract 6: Isolation of hemoglobin (E)
Pract 7: Estimation of vitamin by titration method (E)

2.Environmental Biology and Toxicology

Practical 1: Study of fresh water plankton.(field collection, preservation and gross identification) (E)
Practical 2: A visit to water body to study physiochemical properties of water (Temperature, pH, turbidity, hardness, acidity and alkalinity) using analysis kit. (E)
Practical 3: Study of physicochemical properties of soil sample. (Using analysis kit). (E)
Practical 4: To determine LC50, 96 hours value of pollutant by using aquatic (E)
organism as test animals.
Practical 5: Effect of the effect of EDTA on the toxicity of a copper (E)
Practical 6: Estimation of dissolve Oxygen in water by Winkler's method. (E)
Practical 7 : Estimation of dissolve CO_2 inwater
Practical 8: A compulsory visit to costal area/ National park/ Forest etc (E)

3.Molecular Biology

Pract 1: Preparation of DNA paper model and study its characteristics. (E)
Pract 2: Staining of DNA and RNA by methyl green – pyronin. (E)
Pract 3: Estimation of DNA by Diphenylamine method. (E)
Pract 4: Estimation of RNA by Bial's Orcinol method. (E)
Pract 5: Isolation of DNA from Bacteria / liver. (E)
Pract 6: Protein estimation by Lowry et al. Method (E)

Pract 7: Isolation of nuclei. and their counting . (E)
Pract 8: Isolation of mitochondia and their quantification. (E)
Pract 9: To study restriction digestion of DNA. (E)
Pract 10: To study cell fractionation, use of sucrose density gradient. (E)

4.Organic Evolution

Practical 1: Study animal adaptations: Turtle, Draco, Exocetus, Bat, and Parrot (D)
Practical 2: Study of successive stages of evolution of man: a) Australopithecus
b)*Homo erectus* ,c*) Homo neanderthalis*,d) *Homo cromagon*
f) *Homo sapiens*.(D)
Practical 3: To record the zoogeographical distribution of animals on the world map:
(lung fishes, marsupials, flightless birds, camel, elephant, ostrich etc.)(D)

Botany
Paper V
ALGAE, FUNGI AND BRYOPHYTA (BO.331) & PLANT PHYSIOLOGY AND BIOCHEMISTRY(BO. 341)
Section I
ALGAE, FUNGI AND BRYOPHYTA (BO.331)

1. **Algae : (16 Lectures)**

- Introduction :General Characters, Classification of algae as per Chapman and Chapman (1973) upto classes only.
- Study of general characters, thallus structure, reproduction with example of –Cyanophyta, Chlorophyta, Charophyta, Phaeophyta, Rhodophyta, Pyrrophyta, Bascillariophyta, Euglenophyta, Xanthophyta.
- Study of life cycle of algae with respect to Taxanomic position occurance, thallus structure, reproduction and economic importance of- *Nostoc, Chlorella, Chara, Sargassum, Batrachopermum.*

2.Fungi : (16 Lectures)

- Introduction : General Character ,Classification of fungi as per Ainsworth et al 1971
  Mycorrihzae: Types and application.
- Study of general characters, somatic and reproductive phase of following
  classes of fungi with example-*Myxomycetes, Chytridiomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes.*
- Life cycle of fungi with reference to systematic position, thallus structure, reproduction and economic importance of following fungi- *Stemonites, Pythium, Rhizopus, Saccharomyces, Puccinia, Cercospora*

3.Bryophyta : (16 Lectures)

- General characters and economic importance, of brayophyta, Classification up to order levels as per Schuster (1957)
- Study of general characters, thallus structure and reproduction with examples of-Hepaticopsida, Anthocerotopsida
- and Bryopsida.
- Study of life cycle of *Marchentia, Anthoceros, Polytrichum* with respect
  to thallus (Morphology and Anatomy), Sporophyte structure andreproduction.

Reference Books :

1. **Vashistha B.R.Singh** Botany for degree students-Algae
2. **Das, Datta, Gangulle-**College Botany Vol I
3. **O.P. Sharma**-Algae
4. **Vashishta B.R. et al** Botany for degree students- Fungi
5. **P.D.Sharma** -The Fungi
6. **O.P.Sharma** -Fungi
7. **Chopra G..L. and Yadav D.L** A Text book of Bryophytes.
8. **Parihar, N.S.** An introduction to Embryoohyta: Bryophyte-I
9**. Puri Prem.** Brayophytes, Atmaram and Sons. Delhi.
10. **Vashishta B.R**. Botany for degree students Bryophytes- Vol-III
11.**Parihar N.S.** 1991. Bryophyta. Central Book Depot Allahabad.
12.**Puri P.** 1980. Bryophytes. Atma Ram and Sons, Delhi.
13**.Alexopoulus C.J** , **Mims C.W. and Blacwel M.I** 1996. IntroductoryMycology. John Wiley and Sons Inc.
14**.Kumar H.D.** 1988. Introductory Phycology. Affiliated East-West PressLtd., New Delhi.

Section II

PLANT PHYSIOLOGY AND BIOCHEMISTRY(BO. 341)

1.Plant physiology(24 Lectures)

- Photosynthesis **:** Ultra structure of chloroplast**,** accessory pigments and their role inphotosynthesis, light reaction, electron transport chain, light harvestingcomplexes, Calvin cycle and its regulation, photorespiration and itssignificance, HSK and CAM pathways, Bacterial photosynthesis.
- Respiration **:** Ultra structure of mitochondria, types of respiration, Glycolysis – EMPand PPP, TCA cycle and its regulation, mitochondrial ETS,chemiosmotic theory of ATP synthesis, balance sheet of ATPs inaerobic regulation, mitochondrial ETS,chemiosmotic theory of ATP synthesis, balance sheet of ATPs inaerobic and anaerobic respiration, complexes of respiratory chain,gluconeogenesis.
- Translocation of organic solutes: Mechanism of translocation : diffusion, Munch hypothesis, source andsink relationship, phloem loading and unloading
- Seed physiology **:** Types and causes of seed dormancy, methods of overcoming seeddormancy.
- Stress physiology **:** Concept of biotic, abiotic and xenobiotic stresses, Types of stresses –salinity, drought, heavy metals and allelobiogenesis

2.Biochemistry : (24Lectures)

- Energy transformations **:** Laws of thermodynamics, free energy, redox potentials, activation andbinding energy
- Amino acids and proteins **:**Structure of Proteins-primary, secondary, tertiary and quaternaryproteins), synthesis and properties of amino acids and proteins,importance of amino acids and proteins, Nonprotein amino acids – types, structure and role in plants.
- Carbohydrates **:**Classification, structure and properties of carbohydrates, synthesis andbreakdown of starch and cellulose
- Lipids : General classification of lipids, properties and functions of lipids, β oxidation.
- Enzymology **:** Classification, properties and mechanism of enzyme action, lock andkey hypothesis, active sites of enzyme and coenzyme, enzyme kinetics- Michaelis – Menton equation, factors affecting enzyme activity – pH, temperature, inhibitors (Competitive, uncompetitive and noncompetitive inhibition.)
- Metabolic pool and secondary metabolites **:** Metabolic pool and production of secondary metabolites through - malonic, mevalonic, shikimic acid, Acetyl CoA, TCA pathways,Role of secondary metabolites in plant defense.

References : -

1.Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and MolecularBiology of Plants. American Society of Plant Physiologists Maryland, USA.

2.Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) WadsworthPublishing Company, California,USA.

3.William G. Hopkins (1995) Introduction to Plant Physiology, Published by – JohnWiley and Sons, Inc.

4.Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by –Panima Publishing Corporation

5.R. G. S. Bidwell (revised edn.)-Plant Physiology

6.Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistryand Biotechnology, S.Chand Publications.

7.Leninger A.C (1987). Principles of Biochmistry, CBS Publishers and Distributers(Indian Reprint)

8.Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism(Second Edition) Longman, Essex, England.

9.Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, NewYork, USA..

10.Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York,USA.

11.Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept inPhotobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.

12.Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc.Publishes, Massachusetts, USA.

13.Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry andBiotechnology, S.Chand Publications.

Paper VI

MOLECULAR BIOLOGY (BO. 332) & PLANT PATHOLOGY (BO. 342)

Section I

MOLECULAR BIOLOGY(BO. 332)

1. Molecular Biology Introduction and Concept: (6 Lectures)

- Introduction
- Definition, Importance and application.
- Central Dogma of molecular biology.
- Model Organism for studying molecular biology.
- Molecules of cell- Carbohydrates, Lipid, Nucleic Acid, Proteins

2. Nature of genetic material : (4 Lectures)

- Brief History-Emphasizing characteristics of genetic material
- Physical and biological Evidences to prove DNA as geneticmaterial(Transformation, Transduction, Conjugation)
- Chargoff's Law
- Franklin's and Wilkin's Work
- Watson and Crick's Model of DNA
- Forms of DNA A, C, D,, E, and Z and companion between of A, B and Z.
- DNA content of the cell and C-value paradox
- RNA as genetic material- TMV
- Comparison of RNA and DNA as genetic material

3. Replication of DNA : (4 Lectures)

- Introduction and types of DNA replication.Dispersive, Conservative and Semi-conservative.
- Messelson and Stahl's Experiment.
- General feature of DNA replication.
- Molecular mechanism of DNA replication in Prokaryotes.
- Molecular mechanism of DNA replication in eukaryotes.

4. DNA damage and repair : (5 Lectures)

- Introduction
- Causes and Types of DNA damage
- DNA repair system: Photo-reaction method, dark excision repair method, Mismatch repair system and Double Stranded break repair system.

5. Organization of Gene : (5 Lectures)

- Promoters-structure and function
- Terminators
- Units of Gene-Cistron, recon, muton
- Enhancers
- Split genes
- Overlapping genes
- Comparison in prokaryotic and eukaryotic genes

6. Transcription : (6 Lectures)

- Introduction related to formation of mRNA, tRNA, rRNA
- Transcription apparatus in Prokaryotes and eukaryotes
- Transcription of mRNA in Prokaryotes
- Transcription of mRNA in eukaryotes
- Post transcriptional event eukaryotes splicing, RNA editing and processing of mRNA.

7. Genetic Code : (3 Lectures)

- Concept
- Work of Nierenberg and Khorana
- Genetic code dictionary
- Properties of genetic code with evidences

8. Translation-Protein synthesis : (5 Lectures)

- Introduction
- Structure and role of mRNA
- Structure and role of tRNA
- Structure and role of ribosome
- Mechanism of Translation-initiation, elongation and termination.

9. Gene action and Regulation : (4 Lectures)

- Relation of Gene and enzymes- one gene one enzyme hypothesis

- Regulation of metabolism
- Inducible and repressible enzymes
- Gene regulation in prokaryotes-Lac operon concept
- Gene regulation in eukaryotes-Britten and Davidson's Model

10. Genomics and Proteomics : (6 Lectures)

- Introduction
- Method of gene sequencing(BAC sequencing, Random shotgunsequencing)
- Types of Genomics- structural, functional and comparative genomics
- Future of genomics
- Proteomics-Scope and types.

Reference Books :

1.J.K.Pal and S.S.Ghaskadabi (2008) Oxford.-Fundamentals of Molecular Biology
2.R.C.Dube(2008) A Text Book of Biotechnology S. Chand
3.Verma and Agrawal Molecular Biology S. Chand
4.Devi, P. 2000 Principles and Practices of Molecular Biology
5.Lewin B. 2000. Genes VII. Oxford University Press, New York.
6.Alberts, B., **Bray, D Lewis, J., Raff, M., Roberts, K and Walter** 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York
7.Krishnamurthy, K.V 2000. Methods in Cell Wall Cytochemistry. CRCPress, Boca Raton, Florida.
8.Buchanan B.B, Gruissm W. and Jones R.L 2000. Biochemistry and Molecular.
9.De D.N 2000. Plant Cell Vacuoles : An Introduction. CISRO Publication, Collingwood, Australia.
10.Kleinsmith L.J and Kish V.M 1995. Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York,USA.
11.Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. andDarnell J. 2000. Molecular Cell Biology (Fourth Edition). W.H. Freemanand Company, New USA.
12.Rastogi V.B Concepts in Molecular Biology.
13.Twxman R.M 2003 (Third Reprint). Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi. **14.Watson J.D** et al**.** Molecular Biology of Gene.

Section II
PLANT PATHOLOGY (BO. 342)

1 Fundamentals of plant pathology (6Lectures)

Introduction, Important terminology- Incitants, Host, Parasite, Pathogen,Inoculum, Penetration, Infection, Incubation, Disease, Diseasedevelopment, Symptom, Sign, Disease cycle , Endophyte, Predisposition, Suscept, Resistance, Epidemic, Epidemiology, Etiology.Concept of plant disease, common symptoms of plant disease, types ofplant diseases according to major causal agents.Economic importance of plant diseases, general account of history ofplant pathology, Introduction to Indian Agricultural Research Institute(IARI), International Crop Research Institute for Semi Arid Tropics(ICRISAT), Contribution of Anton Bary and Prof. B.B. Mundkur.

2 Disease Development (6Lectures)

Concept of disease cycle, Inoculation, Prepenetration, Penetration,Infection, Dissemination.Epidemics- Forms, Decline,, Exponential model.Disease forecasting, Measurement of plant disease and yield loss.

3 Defence Mechanisms (3Lectures)

Concept and Definition, Types- Preexisting- Structural and chemical,Induced- Structural and Biochemical

4 Methods of Studying Plant Diseases (5Lectures)

Macroscopic study, Microscopic study,, Koch"s postulates.Culture technique, Media Types and Preparation, Pure culture methods- streak plate, Pour plate, spread plate, Serialdilution.

5 Fungal Plant Diseases (4 Lectures)

Introduction to fungi as plant pathogens.Study of Diseases- Club root of Crucifers,Downy mildew of Grapes, Head smut of Jowar,Leaf spot of Turmeric,Tikka disease of Groundnutwith reference to causal organism, symptoms and signs, disease cycleand control measures.

6 Bacterial Plant Diseases(3Lectures)

Introduction to bacteria as plant pathogens.,Study of Diseases- Citrus Canker,Black arm of Cotton with reference to causal organism, symptoms and signs, disease cycle and control measures.

7 Mycoplasma Plant Diseases (3Lectures)

Introduction to Mycoplasma as plant pathogens.,Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to symptoms and signs, disease cycle and controlmeasures.

8 Nematodal Plant Diseases (2Lectures)

Introduction to Nematodes as plant pathogens.Study of Diseases- Root knot disease of vegetables, Ear cockle of Wheat with reference to causal organism, symptoms and signs, disease cycle and control measures.

9 Viral Plant Diseases (3Lectures)

Introduction to Viruses as plant pathogens.Study of Diseases- Tobacco Mosaic Disease, Bunchy top of Bananawith reference to causal organism, symptoms and signs, disease cycle and control measures.

10 Principles of Plant Disease Control (5Lectures)

General account, Quarantine, Eradication, cultural control practices,Biological control, Curative measures, Chemical control, Use of EMS, Microbial Pesticides, Plant Quarantine, IPM

11 Molecular Diagnostics (4Lectures)

Introduction, Classical approaches,
Use of antibodies- Polyclonal antibodies, Monoclonal antibodies
Serological test-Lateral flow technique

12 Transgenic approaches for Crop Protection (4Lectures)

Pathogen derived resistance against bacterial and fungal diseases
Plantibodies, Expression of vaccines in plants

REFERENCES

1 Pathak, Khatri, Pathak, 2003, *Fundamentals of plant pathology,* Agrbios

2 .Mehrotra, R.S. 1991, *Plant Pathology,* Tata Mc Graw Hill Co.Delhi

3 Chattergee, P.B., 1997,*Plant Protection Techniques*, Bharati Bhawan, Publ.Patana

4 Agrios, G.N. 2006-*Plant Pathology*, Elsevier Academic Press.

5 Pandey, B.P.2009, *Plant Pathology*, S.Chand Co.

6 Dickinson, M.2008,-*Molecular Plant Pathology* ,Bios Scientific Publishers,London

7 Trigiano, Windham and Windham, 2003, *Plant pathology , Concepts and laboratory exercises.* CRC Press London

8 Gupta, G.P.,2004, *Text book of plant diseases*, Discovery Publ.House ,New, Delhi

9 Aneja, K.R. 2001, *Experiments in Microbiology,plant pathology, tissue culture and Mushroom production technology*, New Age International Publishers.

10 Dubey, R.C.,Maheshwari, D.K. 2005, *Practical Micrbiology*,S.Chand & CO.

11 Singh, R.S.2004, *Plant Diseases*, Oxford & IBH Publishing Co. Pvt. Ltd., Delhi.

12 Rangaswami,G.,Mahadevan,A.,2002, *Diseases of Crop plants of India* ,Prantice Hall of India.

PaperVII
ANGIOSPERMS AND EVOLUTION(BO.333) & PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY
PTERIDOPHYTES (BO. 343)
SectionI
ANGIOSPERMS AND EVOLUTION (BO.333)

1 Introduction : (2 Lectures)

Review of artificial, natural and phylogenetic systems (general account)

2 Phylogenetic systems of classification : (4 Lectures)

Engler and Prantl and Hutchinson systems with reference to outline andassumptions , merits and limitations.

3) Study of following families : (16 Lectures)

According to Bentham & Hookers system of classification with reference tosystematic position, distinguishing characters, economic importance,phylogenetic significance (if any), floral formula and floral diagram ofMagnoliaceae, Papavaraceae, Leguminosae, Asteraceae, Acanthaceae,Lamiaceae, Amaranthaceae, Nyctaginaceae, Orchidaceae, Cannaceae,Poaceae

4) Origin of angiosperms : (5 Lectures)
Monophyletic or Polyphyletic origin Origin with reference to time, place and ancestry-1) Pteridosperms theory 2) Bennettitalean theory 3) Gnetalean theory
5) Herbarium Technique : (5 Lectures)
Criteria for collecting plants for herbarium, preparation of specimen forherbarium, drying, specing and disinfecting the specimens, disinfecting orpoisoning of specimen, mounting, labeling, preservation of specimens,arrangement and maintenance, identification of specimens, dichotomouskey for identification, major herbaria of the world, importance of herbaria.
6) Phytogeographical regions of India : (2 Lectures)
7) **Endemism : (3 Lectures)**
Types of endemism-True endemics, pseudoendmics, neoendemics and palaeoendemics.Endemic plants of Maharashtra.
8) Botanical survey of India : (2 Lectures)
Organizations, aims and objectives of BSI, achievements and contributionof Western circle(Pune) of BSI
9) Floristic studies : (3 Lectures)
Floristic studies in Maharashtra(major contribution)Contribution of J.D. Hooker and H. Santapau
10) Evolution : (6 Lectures)
1a) Variations and speciations in plants:Sources of variations- Mutations and recombinations, natural selection, Allopatric and sympatric speciation, origin of deme, race and speciesb) Evolution at Molecular level.
Refernces-
1.Stewart W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
2.Cronquist, A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons, Ltd. London.
3.Davis P.H and V.H Heywood 1963. Principles of Angiosperm Taxonomy. Oliver and BoydLondon.
4.Heywood V.H 1967. Plant Taxonomy, London.
5.Lawrence, G.H.M 1951. Taxonomy of Vascular Plants. N.Y.

6.Rendle A.B. 1925. The Classification of flowering plants. 2 Vols. London.
7.Santapau H. 1953. The Flora of Khandala on the Western Ghats of India.
8.Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
9.Swingle D.B. 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
10.Takhtajan A. 1969. Flowering Plants; Origin and Disposal.
11.Pande B.P 1997. Taxonomy of Angiosperms. S.Chand.
12.Gurucharan Singh 2005- Plant systematics
13.Naik V.N.- Taxonomy of Angiosperms.
14.Yadav S.R. and Sardesai M.R.- Flora of Kolhapur District.
15.V.V.Shivrajan-Introduction to Principles plant taxonomy
16.Theodore Cooke(1903)- The flora of The Presidency of Bombay Vol. I, II, III
17.Chopra G.L.- Angiosperms
18.Datta S.C.- A Hand Book of Systematic Botany
19.Priti Shukla and **Shital Mishra-** An introduction to Taxonomy of angiosperms.

Section II

PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY (BO. 343)

1.Pteridophytes (16 Lectures)

- General characters and economic importance of Pteridophytes, classification upto order as per Sporne.
- Salient features of Psilopsida, Lycopsida, Sphenopsida and Pteropsida, with examples.
- Study of life cycle of *Psilotum, Seleaginella,Equisetum* and *Marsilea* with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte and alternation of generations.
- Heterospory and seed habit in Pteridophytes

2.Gymnosperms (16 Lectures)

- Introduction, economic importance and classification according toChamebrlain(1934).
- Study of life cycle of *Cycas, Pinus* and *Gnetum* with reference todistribution, morphology, anatomy, reproduction, gametophyte,sporophyte, seed structure and alternation of generations.

3. Palaeobotany (16 Lectures)

- Geological time scale.

Fossil- Definition, process of fossil formation, types of fossils.-impression, compression, petrifaction, pith cast and

- coal ball.
- Study of following fossil groups.
  a) Psilopsida- Salient features of order Psilophytales, external andinternal morphology of *Rhynia*.
  b) Lycopsida- Salient features of order Lepidodendrales, external andinternal morphology of *Lepidodendron, Sitgmaria, Lepidostrobus,Lepidocarpon, Lepidophyllum*
  c) Sphenopsida- Salient features of Calamitales, external and internalmorphology of *Calamites, Annularia, Calamostachys & Paleostachys*
  d) Pteridosperms- External and internal morphology of *Lyginopterisoldhamia*.
  e) Pentoxylae- Salient feature, external and internal morphology of stem[*Pentoxylon*], Leaf [*Nipaniophyllum*].

References:-

1. **Sporne K.R.** 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.
2. **Stewart W.N. and Rathwell** G.W. 1993. Paleobotany and the Evolution of plants.Cambridge University Press.
3. **Bhatnagar S.P and Moitra Alok** 1996. Gymnosperms. New Age International Pvt. Ltd.Publishers, New Delhi, 470
4. **Biswas C and Johari B.M** 2004. The Gymnosperms Narosa Publishing House, NewDelhi. 497 pp.
5. **Sporne K.R** 1965. The Morphology of Gymnosperms London, pp. 216.
6. **Bierhorst D.W.** 1971. Morphology of Vascular Plants. New York and London.
7. **Chamberlain C.J** 1934. Gymnosperms-Structure and Evolution, Chicago.
8. **Coulter J.M. and Chamberlain C.J.** 1917. Morphology of Gymnosperms, Chicago.
9. **Foster A.S and Gifford E.M** 1959. Comparative Morphology of Vascular Plants. SanFrancisco.
10. **Maheshwari P. and Vasil, Vimla** 1961. Gnetum, Delhi.
11. **Blatter E and W.S Millard.** 1929. Some Beautiful Indian Trees J.Bom. Nat Hist Soc.33:624-635.
12. **Bor N.L** 1943. Manual of Indian Forest Botany. London.
13. **Vashishta P.C., A.R. Sinha, Anil Kumar.** 2006. Gymnosperms. S.Chand.
14. **Vashishta P.C.** 2006. Pteridophytes. S. Chand**.**
15. **Parihar N.S.** 1996. Biology and Morphology of Pteridophytes. Central Book Depot,Allahabad.
16. **Arnold C.R.-**An Introduction to Palaeobotany
17. **E.H.N.Andrews-**Studies in Palaeobotany (Botany for Degree Students Vol.-V)
18. **Shukla A.C.** and **Mishra S.P.-** Essentials of Palaeobotany.

Paper VIII
GENETICS AND PLANT BREEDING GENETICS (BO. 334)& PLANT BIOTECHNOLOGY (BO. 344)
Section I
GENETICS AND PLANT BREEDING GENETICS (BO. 334)

1.Genetics (36Lectures)

Introduction:

Mendel's contribution to inheritance pattern-experiments, laws/principles, monohybrid, dihybrid, test cross, back cross.

Neomendelism

Deviations from mendelian dihybrid ratios (modified dihybrid ratios)Interaction of genes- complementary genes, supplementary ……..duplicate/

Multiple allelism

Concept, examples, *Drosophila*(eye colour), human(blood groups), selfincompatibility in plants.

Quantitative genetics

Multiple factor concept and heritabilsm. Qualitative and quantitative trait,inheritance of quantitative traits(*Nicotiana* and Maize)

Cytoplasmic Inheritance

Involving chloroplast(*Mirabilis*) and mitochondria(cytoplasmic male sterlity).Mitochondrial and chloroplast genome, interaction between nuclear and cytolpasmic genes.

Linkage and recombination

Concept, types, applications, detection of linkage.Concept and type of recombination.Estimation of recombination percentage and map distance.Two and three point test crosses and significance in gene mapping.

Sex chromosomes in Drosophila, man and Melanodrium

Balance concept of sex determination in Drosophila, Man andMelanodrium.Mechanism of sex determination.
Sex linked inheritance in Drosophila and manSex linked characters.

Alternation in genetic makeup

Spontaneous and induced mutations.
Mutagens- types and mode of action (Transaction, frame shift mutations transversions.) detection of mutations.
Changes in chromosomes structure- Origin types and effects of auto and allopolyploidy origin and meiosis in nullisomics, monosomics and trisomics

Plant breeding (12 Lectures)

Introduction, scope and importance
Plant introduction and acclimatization
Concept , objectives Advantage, disadvantage and achievement.
Selection
Concept , types-mass, pure line and clonal selection.Advantage and diadvantage
Hybridization
Concept, difficulties and precautionProcedureAchievement
Heterosis and hybrid vigour
Concept Causes of heterosis- dominance hypothesis Application
Mutation breeding
Gamma gardens Application

References:-

1.Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
2.Gupta P.K (1995) Genetics and Cytogenetics. Rastogi Publications, Meerut .
3.Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd., New Delhi.
4.Singh B.D 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
5.Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
6.Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. Macmillan Publishing Company, New York (USA).
7.Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of Genetics Saunders College Publishing, Frot Worth, USA.
8.Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
9.Allard R.W 1995. Priniples of Plant Breeding. John Wiley and Sons, Ice., Singapore.
10.Verma P.S. and Agarwal V.K.(1991**)**, Genetics. S Chand Comp. Ltd. Ramnagar, New Delhi.
11.Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
12.Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
13.Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers,New Delhi.

Section II
PLANT BIOTECHNOLOGY (BO. 344)

1. **Introduction to Biotechnology (10Lectures)**

- Introduction
- History of Biotechnology
- Traditional and Modern Biotechnology
- Global Impact and Current excitements of Biotechnology - Health care, Human genome project, Environment, genomics and proteomics, bioinformatics
- Biotechnology in India and Global Trends
- Achievements of Biotechnology-
  Genetic Foods (GMO's), Prevention and Misused biotechnology, Biodiversity conservation, Gene bank Intellectual Property Rights and Protection- forms of protection, patenting biological materials, significance of patenting in India, Cryopreservation of plant stock cells

2. **Genetic Engineering (12Lectures)**

- Introduction
- Brief history of G.E.
- Molecular Tools of G.E.-Restriction endonuclease, DNA ligase, Alkaline Phosphatase, DNA modifying enzymes.
- Tools in G.E: Gel permeation, PAGE, SDS-PAGE, 2-D gel electrophoresis,
- spectroscopy, colorimeter,
- UV-Spectrometry, Fluorescent Micrometry
- Genetic engineering and human welfare-

Insulin, Somatotropin, Human interferon genes, Genes for Vaccine, Gene Therapy
Diagnosis and Cure of Disease- DNA probe, Monoclonal antibodies, Hybridoma

3. **Bioinformatics (8Lectures)**

- Introduction
- History
- Database
- Sequence and Nomenclature
- Information sources
- Use of Bioinformatics tools in analysis

4 **Agricultural Biotechnology (18Lectures)**

- Introduction

Bio fertilizers-Algal, Bacterial, Azolla, Frankia, Mycorrhizal with reference to Structure, Characterization, Mass production and application

- Biotechnology of Biological Nitrogen Fixation-

Non symbiotic Nitrogen Fixation-Diazotrophs and their ecology, special features, Mechanism of N2 Fixation
Symbiotic N2 Fixation- establishment of symbiosis, factors affecting and mechanism of symbiotic N2 Fixation

- Genetics of Diazotrophs- Nod genes, Nif gene
- Plant Tissue Culture

Brief History Plant protoplast culture Somaclonal variation Plant tissue culture in Forestry
Application of Tissue culture in GMO's, Plant pathology, Plant breeding, molecular farming
Nutritional quality (cyclodextrins, Vit. A, quality of seed protein, Immunotherapeutic drugs, edible vaccines, edible antibodies, edible interferons) Bioethics in plant genetic engineering Gene Conservation banks

Reference Books:-

1.R. C. Dube(2008)- A Text Book of Biotechnology, S. Chand
2.P.K. Gupta-Elements of Biotechnology
3.Satyanarayana-Biotechnology
4.Kalyan Kumar De-Plant tissue culture
5.Pal J.K. and Ghaskadabi S.S.(2008)- Fundamentals of Molecular Biology.
6.Verma and Agrawal- Molecular Biology
7.Devi P.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
8.Glick B.R. and Tompson J.E. 1993 Methods in Plant Molecular Biology and Biotechnology CRC Press Boca Raton, Florida.
9.Hall R.D. (Ed.)1999 Plant cell culture Protocol human press Inc., New Jersey, USA
10.Kumar H.D. 2002 A Text Book of Biotechnology 2nd Edn. Affiliated Easyt-West Press Private Ltd New Delhi.
11.Ramawat K.G. 2003 Plant Biotechnology, S. Chand & Co. Ltd . Ramnagar New Delhi.110055
12.Trivedi P.C.2000 Plant Biotechnology, Panima Publishing Carpation, New Delhi.
13.Rajdan- Plant tissue culture.

Botany Practicals III (BO. 347)

1.Practicals based on Algae, Fungi and Brayophyta (BO. 331): (6 P)

1. Study of Algae with respect to Thallus structure and reproduction of Nosotc, Chlorella, Chara, Sargassum, Batrachospermum. (2 P)
2. Study of Fungi Stemonites, Pythium, Rhizopus, Saccharomyces, Puccinia and *Cercospora* with respect to thallus structure and reproductive structure. (2 P)
3. Study of bryophyte (Morphology and anatomy), structure of reproductive bodies and sporophyte of Marchantia, Anthoceros, Polytrichum. (2 P)

2.Practicals based on Molecular Biology ((BO. 332) 6 P)

1. Plant genomic- DNA isolation(from Cauliflower). (1 P)
2. Estimation of DNA by DPA method. (1 P)
3. Purification and quantification of DNA (1 P)
4. Isolation and estimation of RNA by Arcinol method. (1 P)
5. Problems based on transcription and translocation (2 P)

3.Practicals based on Plant Physiology and Biochemistry(BO. 341) : (6 P)

1.To determine diurnal fluctuation in TAN values of CAM plants (1 P)

2. Estimation of chlorophyll- a and b by spectrometric or calorimetric method. (1 P)
3. Estimation of proteins by *Lowery* et al. method (1 P)
4. Study activity of enzymes peroxidase/ dehydrogenase/amylase (1 P)
5. Separation of Amino acids by Paper Chromatography (1 P)
5. Demonstration of:
   a. Effect of hormones on seed germination.
   b. Ringing experiment for path of translocation
   c. Qualitative test for alkaloids, proteins, carbohydrates and tannins.
   d. Hill reaction. (1 P)

4.Practicals based onPlant Pathology : (BO. 342) (6 P)

1. Study of important plant diseases- Fungal (2), Bacterial (1), Mycoplasma (1), Nematode (1), Viral (1) with reference to causal organism, symptoms, signs and control. Ref. 1,2,4,5,7,11,12 (2 P)
2. Pathogenicity Assay OR Demonstration of Koch's postulate for a bacterial OR Fungal pathogen.OR Disease diagnosis of fungal leaf spot. Ref. 3,7,9,10. (1 P)
3. Isolation and maintenance of pure culture of bacterial OR fungal plant pathogen by streak/ Pour/ Spread plate/ Serial dilution method. Ref. 7,9,10.(1 P)
4. a) Study of Biological control OR Demonstration of Antagonism. b) Demonstration Practical- Microbial pesticides, EMS, Serological test, culture media. Ref. 2,3,4,6,7,9,10 (1 P)
5. a) Visit to plant protection lab,/plant disease clinic/Agri. clinic/Bio control lab/Plant protection research institute/KVK and report writing. b) Survey of plant diseases in nearby area and report writing. Ref. 1,2,4,5,7,11,12. (1 P)

Botany Practicals IV(BO. 348)

1.Practicals based onAngiosperms and evolution: (BO. 333) (6 P)

1. Study of any eight families (as per theory course) (4 P)
2. Identification of plants with the help of regional flora (1 P)
3. Preparation of an artificial key based on multiple characters/ androecium/ gynaecium/ vegetative characters (at least two keys) (1 P)

*Botanical excursion is compulsory for the students to study the endemic species, phytogeography and species of botanical interest. Student should submit visit report and ten herbarium specimens of local/common wild plants or photographs of rare, endemic or endangered plants species.

2.Practicals based on Genetics and plant breeding : (BO. 334) (6 P)

1. Testing goodness of fit of the observed F2 phenotypic ratio with excepted Mendelian ratios. (1 P)
2. Genetic mapping using 3 points cross data. (1 P)
3. Effect of physical or chemical mutagens on crop plants (photographs) of M1 and M2 population. (1 P)
4. Induction of tetraploidy in onion root cells. (1 P)
5. Demonstration of techniques of hybridization (emasculation, pollination, tagging and bagging etc.) (1 P)
6. Multiple translocations in *Rhoeo discolor*. (1 P)

*Visit to plant breeding station is compulsory (1 P)

3.Practicals based on Pteridophytes, Gymnosperms and Palaeobotany(BO. 343)(6 P)

1. Study of Pteridophytes (Morphology and anatomy), structure of reproductive bodies of Psilotum, Sileaginella,Equisetium and Marsilea (2 P)
2. Study of Gymnosperms (Morphology and anatomy), structure of reproductive bodies of *Cycas*, *Pinus* and *Gnetum*. (2 P)
3. Study of fossil type Impression, Compression, Petrification, Pithcast and Coal balls. (1 P)
4. Study of Fossil groups as per theory syllabus- Psilopsida, Lycopsida, Sphenopsida, Pteridosperms and Pentoxylae. (1 P)

4.Practicals based on Plant Biotechnology : (BO. 344) (6 P)

1. Preparation and sterilization of the medium, slant preparation and inoculation-MS medium. (1 P)
2. Micro propagation of some important (1 P)
3.Aseptic seed germination-legume seed (1 P)
4. Study of different bio fertilizers. (1 P)
5. Gene data retrieval from the NCBI (1 P)
6. Homology Modeling through the BLAST(For Genes) (1 P)

ENGLISH
Enriching Oral and Written Communication

Orientation

What is Communication?
Formal and Informal Communication
Non-verbal Communication
Features of Effective Communication

Vocabulary

Splitting the Fine Senses of Words
Literal and Figurative Use of Words
Word Parallels and Alternatives
Lexical Sets
Using a Dictionary/ Activator/ Thesaurus
Language Games

Oral Communication

Word Stress and Sentence Stress
Intonation
Use of Politeness Markers
Making Presentations: Important Features
Making Presentations: Preparing, Planning and Performing
Using Audio-visual Aids (from handouts to computer Graphics)
Characteristic Features of an Effective Group Discussion
Facing Interviews
(Activities/tasks like role playing, group discussion, public speaking, extempore presentation and interviews to be conducted)

Written Communication

Writing Task : identifying the focus, generating ideas, outlining, etc.
Paragraph Structure and Linking Sub-points in a Paragraph
Cohesion and unity in a paragraph
Minding Punctuation and Proofreading
Summarising
Reviewing
Aspects of Creative Writing
(Activities/tasks to be conducted like paragraph writing, essay writing, writing a review of a literary text, writing a summary of a literary text, comprehension and analysis of a literary text, preparing an advertisement, making PowerPoint Presentations)

Technology-enabled Business Communication

Telephonic conversation and manners
E-mails and e-mail etiquettes
Power Point Presentation

Suggestions for Teachers

The course is designed to acquaint the students with the basic aspects of communication and help them to become effective communicators by using different modes of communication. Teacher talk may be used for clarification of basic ideas. However, keeping in mind the essentially practical nature of the course, the teachers should engage the students through various tasks, activities, projects and assignments, and offer them guidance about carrying them out effectively. Student involvement can also be enhanced through activities like oral presentations, writing exercises, vocabulary building exercises, role playing, mock interviews, etc. The teacher should play the role of a facilitator, monitor the student activities and provide feedback wherever necessary. The interaction between and among the students needs to be encouraged for effective implementation of the course.

Suggestions for Evaluation

The evaluation pattern will be the same as is adopted for other courses in the Semester System. For the First Semester there will be a University Examination carrying 40 marks at the end of

the First Semester. There will be a continuous assessment and evaluation of the student's performance in Oral and Written Communication skills through the First Semester. The marks secured by the students in this Internal Assessment will be reduced in proportion to the value of 10 marks. Similarly, For the Second Semester there will be a University Examination carrying 40 marks at the end of the Second Semester. There will be a continuous assessment and evaluation of the student's performance in Oral and Written Communication skills through the Second Semester. The marks secured by the students in this Internal Assessment will be reduced in proportion to the value of 10 marks. The major thrust of the evaluation for both Internal Assessment and University Examinations for both the Semesters will be practical, objective, and application oriented. The focus of the evaluation should be on testing the students' ability to independently construct and properly deliver utterances in different contexts.

(e) Reading List/References:

1. Thorat, A.and Lokhandwala,M.(2009),Enriching Oral and Written Communication [OBS
2. Mohanraj J. and Mohanraj S. (2001), English Online [OBS]
3. Seely (2006), Oxford Guide to English speaking and writing [OUP]
4. Dutt, P. Kiranmal, Geetha Rajeevan, CLN Prakash (2008), A Course in Communication Skills [Foundation Books]
5. Anderson, Keith, John Maclean, Tony Lynch (2007), Study Speaking [CUP]
6. Goodale, Malcolm (2008), Professional Presentations [CUP]
7. Morley, David (2007), The Cambridge Introduction to Creative Writing [CUP]
8. Dutt, P. Kiranmal and Geetha Rajeevan (2007), A Course in Listening and Speaking (Vol. I & II) [Foundation Books]
9. Sasikumar, V., P. Kiranmal Dutt and Geetha Rajeevan (2007), Basic Communication Skills [Foundation Books]
10. O'Connor, J. D. – Better English Pronunciation (Latest Edition with CD)
11. Narayanswamy – Strengthen Your Writing (OBS)

INSTRUCTIONAL SYSTEM & EDUCATIONAL EVALUATION

Section I

INSTRUCTIONAL SYSTEM(Periods 48)

1. The systems approach to education

- System - Meaning + Characteristics
- The systems approach - Concept + Principles
- Distinction between education, instruction + Training
- Application of systems approach to education

2. Instructional System

- Meaning + Nature of Instructional system
- Components of Instructional system
- Need, Importance & uses
- Analysis of Instructional system

3. Instructional strategies + Models.

- Instruction strategies
  a)Self Instruction b) Progammed instruction
  Computer Assisted instruction
- Models of Instructional system
  Mastery Learning Model
  Synectic Model

Modified system Model

4. Application & Technology for instructional system

- Need imp + uses of Technology for instruction
- Principles of selecting of Technology for instruction
- Developing self instructional material - steps
- Developing computer Assisted instruction program

concept + steps

- Instructional design instructional for online learning - steps

5. Evaluation of Instructional system

- Process of validation of instructional Material / Program
  - Individual testing
  - Group testing
  - Field testing
  - Master validation
- Models of evaluation
  - a) Educational Decisions Model (CIPP Model)

SectionII
EDUCATIONAL EVALUATION & STATISTICS

1. Assessment Measurement and Evaluation

- Concepts of four aspects of Evaluation
- Meaning, Importance and difference
- Taxonomy of instructional objectives
- Objectives and learning our comes
- Leaning experiences characteristics, types of Merits.

2. Tools and Techniques of Evaluation:-

- Characteristics of good measuring instruments and factors affecting them.
- Evaluation Approach
- a) Formative -Summative
  Qualitative - Quantitative
- b.) Tools of evaluation:- Quantitative,& Qualitative.
- Use of these tools for internal assessment & maintaining cumulative record.
- Planning, Preparation and Standardization of test (including blue print)

3. New Trends in education

a. Question bank
b. Grading system
c. Online exam
d. Open book exam
e. Credit system
f. Exam on demand (meaning & uses only)
g. Continues remedial evaluation procedure

4. Statistical Methods and Interpretation of scores

- Need & importance of Statistic in Educational Evaluation
- Tabulation of Data
- Graphical Presentation - Histogram., Frequency Polygon.
- Measures of Central Tendencies:- Mean, Median, Mode -Meaning, Characteristics, use only
- Measures of Variability-Meaning, characteristics, use only,Range, quartile deviation, Standard deviation
- Normal Probability Curve:-Properties and uses.-Skewness and Kurtosis , Meaning & Reasons
- Coefficient of Correlation-Spearman's Rank Rule Method
- Percentile & Percentile rank -Meaning & Uses
- Standard Scores (Z& T Scores):- Meaning & uses only.

PRACTICAL FOR SECTION I

1. To develop self instruction / Program instruction / computer assisted instruction material for any unit of any school subject of your choice.

SECTION - II (ANY ONE)

1. Study of online exam, on demand exam.
2. To evaluate and reform the available unit test. b) Intrinsic evaluation

Reference books

1) Assessment + Evaluations -P.G. Pnog
2) Instructional system DesignInstructional Technology -V.K. Rao
3) Evaluation in Schools –W.N.Dandekar,Moghe prakashan.

Mathematics and Science Education

Section I

Mathematics education

1. Mathematics subject

Meaning and Nature of mathematics as a subject
Place of mathematics is school curriculum
Importance of mathematics
Correlation – concept and Types

2 .Teaching of Mathematics

Aims and objectives of Mathematics teaching
Maxims of teaching in Mathematics
Methods of teaching Mathematics
- Inductive - Deductive
- Analysis - Synthesis
- Experimental
- Heuristic

Teaching Aids -
Non-projective - chart, picture, model
Projective - Film projector, OHP, LCD, DLP
Mathematic Laboratory & Mathematic club
Planning in Mathematic teaching
a) Year plan
b) Unit plan
c) Lesson plan - General, IT based
Mathematics teacher - Qualities, Competencies

3 .Techniques and Model's of teaching in Mathematic

3.1 Techniques in Mathematics teaching
a) Term teaching
b) Simulation
c) Task analysis
d) Cognitive psychology based technique
e) Technology based technique
Models of teaching
a) Concept Attainment Model
b) Advanced organizer model

4. Content cum methodology in teaching of Mathematics

Structure of Mathematics as a subject
Curriculum - concept, methods of curriculum construction
Analysis of syllabus for one standard

Analysis of textbook
Content analysis of one unit

5. Pedagogical analysis of Mathematics

Concept of pedagogical analysis
Approaches for pedagogical analysis, concept and importance
a) Core element and value approach
b) Content cum methodology approach
c) IT based approach
d) Mastery learning approach
e) System analysis approach

6.Evaluation in Mathematics

Importance of evaluation in Mathematics
Evaluation according to areas -
Cognitive, Affective, Psychomotor,
Use of tools and technique of evaluation
a) Achievement test
b) Diagnostic test
c) Check list
Remedial teaching
Online evaluation

Reference Books:

1.Teaching of Mathematics - Eleccher
2.Teaching of Mathematics – Sidhu.S. Agarwal.
3.Teaching of Mathematics in New Education –Aiyangar
4.Teaching of Modern Mathematics – Bleccher

Section II
Science education

1. Science subject

Meaning and nature of science as subject
Place of science in school curriculum
Importance of science
Correlation - concept, importance and types

2 .Teaching of Science

Aims and objectives of science teaching
Maxims of teaching in science
Methods of teaching Science
- Demonstration
- Laboratory
- Heuristic
- Project

Teaching Aids
Non-projective - chart, picture, model
Projective - Film projector, OHP, LCD, DLP
Science laboratory, science, club, Botanical, Garden,
Science Exhibition, Aquarium, Field trip
Planning in Science teaching
a) Year plan
b) Unit plan
c) Lesson plan - General, IT based
Science teacher - Qualities, Competencies

3 .Techniques and Models of teaching

Techniques in Science

a) Team teaching

b) Simulation

c) Task analysis

d) Cognitive psychology based technique

Technology based technique

Models of teaching

a) Concept Attainment Model

b) Inquiry training model

4 .Pedagogical analysis of Science

Concept of pedagogical analysis

Approaches for pedagogical analysis, concept and importance

a) Core elements and values

b) Content cum methodology approach

c) IT based approach

d) Mastery learning approach

e) System analysis approach

5. Content cum methodology in teaching of Science

Structure of Science as a subject

Curriculum - concept, methods of curriculum construction

Analysis of syllabus for one standard

Analysis of textbook

Content analysis of one unit

6 .Evaluation in Science

Importance of evaluation in Science

Evaluation according to areas -

Cognitive, Psychomotor, Affective

Use of tools and technique of evaluation

a) Achievement test

b) Diagnostic test

c) Rating scale

Remedial teaching

Online evaluation

Reference Books:

1. Teaching of Science -Sharma and Sharma Nair

2. Teaching of Science- Ghansham Das

3. Science Education -Dr. Borse

Pedagogy Practical Course – CCM Worshops in Mathematics and Science (90 Periods)

Activities in CCM workshops

1) Preparation of the structure.

2) Analysis of syllabus.

3) Evaluation of textbook.

4) Content analysis of one unit.

5) Preparation of two lesson plans for different standard to teach the same unit.

6) Preparation of two lesson plans by using two different methods.

7) Conduct presentation of lesson.

8)Submission of Report (Two)