CH. CHARAN SINGH UNIVERSITY, MEERUT
BACHELOR OF COMMERCE

SYLLABUS
(Effective from Academic Year 2018-19 onwards)

CH. CHARAN SINGH UNIVERSITY, MEERUT

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B.COM SYLLABUS (2018-19 and onwards)

Year : I

CODE NO.	TITLE OF PAPER / COURSE	EXTERNAL MARKS
C-101	BUSINESS COMMUNICATION	100
C-102	BUSINESS STATISTICS	100
C-103	FINANCIAL ACCOUNTING	100
C-104	BUSINESS REGULATORY FRAMEWORK	100
C-105	BUSINESS ECONOMICS	100
C-106	BUSINESS ENVIRONMENT	100
	Total	600

Year: II

CODE NO.	TITLE OF PAPER/COURSE	EXTERNAL MARKS
C- 201	COMPANY LAW	100
C- 202	COST ACCOUNTING	100
C- 203	PRINCIPLES OF BUSINESS MANAGEMENT	100
C-204	INCOME TAX	100
C-205	FUNDAMENTALS OF ENTREPRENEURSHIP	100
C-206	PUBLIC FINANCE	100
	TOTAL	

Year: III

CODE NO.	TITLE OF PAPER/COURSE	EXTERNAL MARKS
C- 301	CORPORATE ACCOUNTING	100
C- 302	AUDITING	100
C- 303	PRINCIPLES OF MARKETING	100
C-304	ECONOMIC LAWS	100
C-305	E-COMMERCE	100
C-306	MANAGEMENT ACCOUNTING	100

B.COM. I YEAR
PAPER – I
BUSINESS COMMUNICATION (C-101)

Objective

The objective of this course is to develop effective business communication skills among the students.

Course Inputs:

Unit I: Introducing business communication: Basic forms of communicating; Communication models and process; Effective communication; Theories of communication; Audience analysis; Principles of effective communication

Unit III: Self – Development and Communication: Development of positive personal attitudes; SWOT analysis; Vot's model of interdependence; Whole communication.
Corporate communication: Formal and in informal communication networks; Grapevine; Miscommunication(Barriers),Improving communication. Practices in business communication; Group discussions; Mock interviews; Seminars; Effective listening exercises; Individual and group presentations and Reports writing.

Unit III: Writing skills : Planning business messages; Rewriting and editing; The first draft; Reconstructing the final draft; Business letters and memo formats; Appearance; Persuasive letters; sales letters; collection letters; office memorandum.
Report writing: Introduction to a proposal, short report and formal report, Report preparation. Oral presentation; Principles of oral presentation, Factors affecting presentation, Sales presentation, Training presentation, Conducting surveys, speeches to motivate, Effective presentation skills

Unit IV: Non –verbal aspects of communicating: Body language; kinesics proxemics, Para language. Effective listening; Principles of effective listening; Factors affecting listening exercise; oral written and video session
Interviewing skills: Appearing in interviews; Conducting interviews; Writing resume and letter of application.

Unit V: Modern Forms of Communicating: Fax; E-mail; Video conferencing; etc. International Communication: Cultural sensitiveness and cultural context; Writing and presenting in international situations; Inter-cultural factors in interactions; Adapting to global business.

PAPER – II
BUSINESS STATISTICS (C-102)

Objective

The purpose of the paper is to inculcate and analytical ability among the students

Unit I: Introduction: Meaning, Scope, Importance and limitation of statistics. Statistical investigation: Planning of statistical investigation, Census data, Statistical errors and approximation, Classification and tabulation of data frequency distribution.

Unit II: Statistical Average: Arithmetic, Geometric and harmonic means, Mode median, Qualities and percentiles, Simple and weighted averages. Uses and limitation of different averages.

Unit III: Dispersion and skewness : Range quartile deviation mean, Deviation and their coefficients, Standards deviation coefficient of variation skewness and its coefficiants.

Unit IV: Correlation : Karl parson's coefficient of correlation, Probable error and interpretation of coefficient of correlation rank difference method and concurrent deviation method

Unit V: Analysis of time series: component of time series, Calculation of secular trend– moving average method and method of least squares. Index numbers: Utility of index numbers problems in the construction of index numbers simple and weighted index numbers, base shifting fishers ideal index numbers and tests of reversibility

PAPER – III
FINANCIAL ACCOUNTING (C-103)

Objective

To import basic accounting knowledge as applicable to business

Course Inputs:

Unit I: Introduction to Accounting standards and IFRS, Human Resource Accounting, Inflation Accounting and Responsibility Accounting Theoretical concept only.

Unit II: Insolvency Accounts: Individual & Partnership firm (as per IBC_2016)

Unit III: Branch Accounts: Dependent Branch; Debtors system, Stock and debtors system; Final accounts system;Wholesale branch; Independent branch; Foreign branch; Departmental Accounts.

Unit IV: Hire – purchase and installment purchase system; Meaning of hire – purchase contract; legal provision regarding hire – purchase contract; Accounting records for goods of substantial sale values, and Accounting records for goods of small values ; Installment purchase system; After sales services.

Unit V: Royalties Accounts : Insurance claims

PAPER – IV
BUSINESS REGULATORY FRAMEWORK (C-104)

Objective

The objective of this course is to provide a brief idea about the frame work of Indian business laws.

Unit I: The Indian Contract Act, 1872 : Nature of contract classification; Offer and acceptance; Capacity of parties to contract; Free consent; Consideration legality of object; agreement declared vaid; Performance of contract; Discharge of contract; Remedies for breach of contract.

Unit II: Special contract: Indemnity; Guarantee; Bailment and pledge; Agency.

Unit III: Sale of goods act 1930 : Formation of contracts of sale ; Goods and their classification, Price; Condition, And warranties; Transfer of property in goods; Performance of the contract of sale; Unpaid seller and his rights, Sale by auction; Hire purchase agreement.

Unit IV: The consumer protection Act 1986 : Silent feature definition of consumer; Grievance redressal machinery.

Unit V: Limited liability partnership Act – 2008

PAPER – V
BUSINESS ECONOMICS (C-105)

Objective

This course in meant to acquaint the student with the principles of business economics as are applicable in business

Unit I: Introduction : Basic problems of an economy working of price mechanism.

Unit II: Elasticity of demand : Concept and measurement of elasticity of demand; Price, Income and cross Elasticities; Average revenue, Marginal revenue, And elasticity of Demand; Determinants of elasticity of demand; Importance of elasticity of demand

Unit III: Production function: Law of variable properties iso–quants; Economic regions and optimum factor combination; Expansion path; Return to scale; Internal and external economics and diseconomies; Ridge lines.
Theory of Costs: Short-run and long-run cost curves- Traditional and modern approaches.

Unit IV Market structure : Market structure and business decisions; Objectives of a business firm a perfect competition; Profit maximization and equilibrium of firm and indust short rum and long rum supply curves; Price and output determination practical applications. Monopoly; Determination of price under monopoly; Equilibrium of a firm; Comparison between perfect competition and monopoly; Multi-plant monopoly; Price discrimination. Practical application.

Unit V: a. Monopolistic competition: Meaning and characteristic; Price and output Determination under monopolistic competition; Product differentiation; selling costs; Comparison with perfect competition; Excess capacity under monopolistic competition.

b. Oligopoly: Characteristics indeterminate pricing and output; Classical models of oligopoly; Price leadership; Collusive oligopoly; Kinked demand curve.

PAPER – VI
BUSINESS ENVIRONMENT (C-106)

Objective

This course aims acquainting the students with the emargiong issue in business at the national and international level in the light of the policies of liberalization and globalization.

Unit I: Indian business environment: Concept, Components, and Importance

Unit II : Economic trend (overviews) : Income; Savings and investment; Industry; Trade and balance of payments, Money; Finance, Prices.

Unit III : Problems of growth : Unemployment; Poverty; Regional imbalances; Social injustics; Inflation paralled economy; Industrial sickness

Unit IV: Role of Government : Monetary and fiscal policy; Industrial policy; Industrial licensing Privatization; Devolution export – import policy; Regulation of foreign investment.

Unit V: Niti Aayog : Philosophy, Function and role of niti aayog.

B.COM. II
PAPER – I
COMPANY LAW (C-201)

PROVISIONS OF THE COMPANIES ACT, 2013 AND AMENDMENTS UP TO DATE RELATING to

Unit -1: Introduction to Companies Act, 2013; Important Definitions; Incorporation of a company and matters incidental thereto
(Relevant section 1 to 22)

Unit -2: Prospectus and Allotment of Securities- Public Offer & Private Placement; Share Capital & Debentures; Acceptance of Deposits by Companies; Registration of charges.
(Relevant section 23 to 87)

Unit -3: Management & Administration – Register of Members, Annual Returns, Annual General Meeting, Extra –ordinary General Meeting; Declarations and Payment of Dividend ; Accounts and Audit of Companies.
(Relevant section 88 to 148)

Unit - 4: Directors –Appointment & Qualification; Meeting of Board and its powers; Prevention of oppression & Mismanagement.
(Relevant section 149 to 195) & **(Relevant section 241to 246)**

Unit - 5: Winding up – Modes of winding up, Winding up by Tribunal, Voluntary winding up, Official Liquidator
(Relevant section 270 to 365)

PAPER – II
COST ACCOUNTING (C-202)

Objective

This course exposes the students to the basic concepts and the tools used in cost accounting.

Course Inputs:

Unit I: Introduction: Nature and scope of cost accounting; Cost concepts and classification; Methods and techniques; Installation of costing system; Concept of cost audit.

Unit II: Basics of Material, Labour and Overhead cost:

a. Concept of Material, Pricing of material issues; Treatment of material losses.
b. Labour turnover ;Idle time and overtime; Methods of wage payment-time and piece rates;
c. Classification and departmentalization of overhead, Absorption of overheads; Determination of overhead rates; Machine hour rate.

Unit III: Cost Ascertainment: Unit costing; Operating costing.

Unit IV: Job, Batch and Contract costing; Process costing including inter-process profit; Joint and By product.

Unit V: Cost Records: Integral and non-integral system; Reconciliation of cost and financial accounts.

PAPER – III
PRINCIPLES OF BUSINESS MANAGEMENT (C-203)

Objective

This course familiarizes the student with the basics of principles of management.

Course Inputs:

Unit I: Introduction : Concept, nature process and significance of management ; Managerial roles (Mintzberg); An overview of functional areas of management. Development of management thought ; Classical and nco-classical system : Contingency approaches.

Unit II: Planning : Concept, process , Types. Decision making- concept and process; Bounded rationality ; Management by objective ; Corporate planning ; Environment analysis and diagnosis ; Strategy formulation.

Unit III: Organizing : Concept, nature, process, and significance; Authority and responsibility relationship.

Unit IV: Motivating and Leading People at work : Motivation – concept; Theories-Maslow, Herzberg, McGregor, and Quchi; Financial and non-financial incentives. Leadership – concept and leadership styles; Leadership theories (Trannenbaum and Schmidt.); Likert's System Management; Communication-nature process, Network and barriers; Effective communication.

Unit V: Managerial Control: Concept and process; Effective control system; Techniques of control –traditional and modern.

PAPER – IV
INCOME TAX (C-204)

Objective

It enables the students to know the basics of Income Tax and its implications.

Course Inputs:

Unit I: Basis Concept: Income, Agricultural income, Casual income, Assessment year, Previous year, Gross total income, person; Tax evasion, Avoidance and tax planning.

Unit II: Basis of Charge: Scope of total income, Residence and tax liability, Income which does not form part of total income.

Unit III: Heads of Income: Salaries; Income from house property; Profit and gains of business or profession, Including provision relating to specific business; Capital gains; Income from other sources.

Unit IV: Computation of Tax Liability: Computation of total income and tax liability of an individual Aggregation of income; Set-off and carry forward of losses; Deduction from gross total income.

Unit V: Tax Management: Tax deduction at source; Advance payment of tax; Assessment procedures; IT Authorities.

PAPER – V
FUNDAMENTALS OF ENTREPRENEURSHIP (C-205)

Objective

It provides exposure to the students to the entrepreneurial culture and industrial growth so as to preparing them to set up and manage their own small units.

Course Inputs:

Unit I : Introduction : The entrepreneur ; Definition ; Emergence of entrepreneurial class; Theories of entrepreneurship ; Role of socio-economic environment ; Characteristics of entrepreneur ; Leadership; Risk taking ; Decision-making and business planning.

Unit II: Promotion of a Venture: Opportunities analysis; External environmental analysis-economic, social, and technological; Competitive factors; Legal requirements for establishment of a new unit, And raising of funds; Venture capital sources and documentation required.

Unit III: Entrepreneurial Behaviour: Innovation and entrepreneur; Entrepreneurial behavior and Psycho-Theories , Social responsibility.

Unit IV: Entrepreneurial Development Programmes (EDP): EDP, Their role, Relevance, And achievements; Role of Government in organizing EDPs; Critical evaluation.

Unit V: Role of Entrepreneur: Role of an entrepreneur in economic growth as an innovator, Generation of employment opportunities, Complimenting and supplementing economic growth, Brining stability and balanced regional development of industries; Role in export promotion and import substitution, Forex earning, and augmenting and meeting local demand.

PAPER – VI
PUBLIC FINANCE (C-206)

Objective

The objective of this course is to provides basic knowledge about various intricacies for Public finance

Course Inputs:

Unit I: Meaning & Scope of Public Finance Public Finance Vs Private Finance, Principle of Maximum Social Advantage, Public Budget, Techniques of Budgeting (ZBB PBB), Deficit Financing.

Unit II: Public Expenditure: Meaning & Nature Wanger's views on increasing state activities Wiseman-peacock hypothesis, Cannons and classification of public expenditure effects on production, Distribution and economic stability.

Unit III: Public Revenue: Main sources of revenue, Tax revenue, Direct and Indirect Taxes, Progressive, Proportional & Regressive Taxes, Value added tax, The Division of tax burden, Incidence of a tax, Effect on production & distribution

Unit IV: Public Debts: Role and classification of Public debts and methods of their redemption.

Unit V: Indian Public Finance: Financial Federalism under constitution, Financial Adjustment in India, Finance Commission, Review of Indian Tax System Budgetary Procedure and Financial Control in India.

B.COM. III
(PAPER – I)
CORPORATE ACCOUNTING (C-301)

Objective

This course enable the students to develop awareness about corporate accounting in conformity with the provisions of companies Act.

Course Input

Unit I: Issue of Shares and Debentures: Issue, Forfeiture and re-issue of shares, Redemption of preference shares; Issue and redemption of debentures

Unit II : Accounting for special issue : Bonus issue, Employee'ˢ stock option plan, Buy back of shares.

Unit III : Valuation of goodwill and shares, Underwriting of shares .

Unit IV: Final accounts :As per latest format Prescribed under companies Act, 2013.

Unit V: Consolidated balance sheet of holding companies with one subsidiary only.

PAPER – II
AUDITING (C-302)

Objective

This course aims at imparting knowledge about the principal and methods or auditing and their applications .

Course Inputs

Unit I : Introduction: Meaning and objective of auditing; Types of audit; Audit programme; Audit notebooks; Working papers and evidences; Consideration for commencing an audit; Routine checking and test checking; Internal check system; Internal audit and Internal control.

Unit II: Audit Procedure: Vouching; Verification of assets and liabilities.

Unit III: Audit of companies: Company auditor appointment, Powers, Duties and Liabilities. Removal of auditor as per provision of the companies Act 2013

Unit IV: Auditor's report-clean report and qualified report.

Unit V: Recent trends in auditing: Nature and significance of cost audit; Tax audit, management audit.

PAPER – III
PRINCIPLES OF MARKETING (C-303)

Objective The objective of this course is to help students understand the concept of marketing and its applications.

Course Inputs

Unit I. Introduction: Nature and scope of marketing; Importance of marketing as a business function and in the economy; Marketing concept: Traditional and modern; Selling vs. marketing; Marketing mix; Marketing environment.

Unit II. Consumer Behavior and market Segmentation: Nature, Scope, And significance of consumer behavior; Market segmentation- concept and importance; Bases for market segmentation.

Unit III. Product: Concept of product, Consumer and industrial goods, Product planning and development; Packaging. Role and Functions; Brand name and trade market; After sales service; Product life cycle concept.
Price : Importance of price in the marketing mix; Factors affecting Price of a product/service; Discounts and rebates.

Unit IV. Distributions channels and physical Distribution: Distribution channels- Concept and role; Types of distribution channels; Factors affecting choice of a distribution channel; Retailer and wholesaler. Promotion Methods of promotion; Optimum Promotion mix; Advertising media-their relative merits and limitation; Characteristics of an affective advertisement; Personal Selling as a career.

Unit V. International Marketing: Nature, Definition and scope of international marketing; Domestic marketing vs. international marketing; International marketing environment –external and inernal.

Identifying and selecting foreign market: Foreign market entry mode decisions.

PAPER – IV
ECONOMIC LAWS (C-304)

Objective It will provide a basic knowledge of Economic laws to the learners.

Unit I: Securities Laws: SEBI Act, 1992; Depositories Act. 1996.

Unit II: Environmental Laws: The Environment Protection Act, 1986; water (Prevention &. control of pollution) Act, 1974, Air (Prevention control of Pollution) Act, 1981; NGT Act, 2010

Unit III. IPR Laws: Trade Market Act, 1999; Patents 1970 The designs Act 2000; Indications of Goods (Registration & Protection) Act, 1999; copy right Act, 1957

Unit IV: Foreign exchange & Anti-corruption Laws: FEMA 1999; Prevention of Money Laundering Act, 2002.

Unit V: Industrial Laws: Factoreis Act 1948 ; Industrial Disputes Act, 1947.

PAPER – V
E-COMMERCE (C-305)

Objective : To enable the student to become competent to under stand the mechanism for excelling in E Commerce based employment and self-employment oppotunties.

Unit I. Introduction : Introduction to E commerce and Definition, E-commerce based activities, Goals of E-commerce, Technical components of E-commece, Functions, Advantages and disadvantages of E-commerce Scape of E-commerce, Electronic commerce Application Frame work of E-commerce, Supply chain Management Electronic commerce and Electronic Business.

Unit II: Planning on-line Business: Nature and dynamics of the internet. Electronic business models: B2B, B2C, C2C, C2B, website Design : Websites as market place E-commerce, Pure online vs. brick and click business; Assessing requirement for an online business desiging developing and deplaying the system.

Unit III: Technology for online-Business: Internet and its Evolution, It Infrastructure, Middleware Domain names, Contents : Text and integrating E-business applications. component of internet information technology structure, Development of internet, Extranet and their Differnence.

Unit IV: Operations of E-commerce: online-payment mechanism; Electronic Payment system; Payment Gateways; Visitors to website ; Tools for promoting websites; Risk management option for e-Payment Systems.

Unit V: Security and legal Aspects of E-commerce: Threats in E-commerce, Security of clients and Service-Provider, Cyber Laws-Relevant Provisions of information Technology Act 2000, offences, Secure electronic records and digital signatures Penalties and adjudication.

PAPER – VI
MANAGEMENT ACCOUNTING (C-306)

Objective : To enable the students to understand the practical knowledge of decision making accounting Which is related to the management.

Unit I: In**troduction:** Meaning, Nature, Scope and Function of management Accounting; Role of Accounting ;Management Accounting Vs. Financial Accounting ;Tools and Techniques of management Accounting.

Unit II: Budgetory Control ; Meaning of Budget, Budgeting and budgetory control; Objectives ,Merits and limitations of budgetary control; Types of budget: Fixed and flexible budget; Zerobard Budget ;Performance budgeting.

Unit III : Funds flow and cash flow analysis ; Ratio analysis funds flow analysis and cash flow analysis as per accounting standards; Ratio analysis classification and limitations.

Unit IV: Standard costing and analysis of variances: Meaning and nature of standard cost; Advantages and applications ; Steps in standard costing ;Variance analysis-material, Labour, Overhead and sales variances

Unit V : Marginal Costing: Concept meaning and nature of marginal cost; Marginal cost as a tool of decisions making ; Marginal costing Vs absorption costing; Break-even analysis; Exploring new markets; Make or buy decisions and shut down decisions.

Botany Syllabus for BSc I, II and III Years

Theory Paper's duration is of Three hours and duration of practicals is Four hours

B.Sc. I Year		
Papers	**Title of Paper**	**Max. Marks**
Paper I	Diversity of Viruses, Bacteria & Fungi	50
Paper II	Diversity of Algae, Lichens, & Bryophytes	50
Paper III	Diversity of Pteridophytes & Gymnosperms	50
Practical	Practical Syllabus based on theory papers	50
B.Sc. II Year		
Papers	**Title of Paper**	**Max. Marks**
Paper I	Diversity of Angiosperms: Systematics, Development & Reproduction	50
Paper II	Cytology, Genetics, Evolution & Ecology	50
Paper III	Plant Physiology and Biochemistry	50
Practical	Practical Syllabus based on theory papers	50
B.Sc. III Year		
Papers	**Title of Paper**	**Max. Marks**
Paper I	Plant Resource Utilization, Palynology, Plant Pathology and Biostatistics	50
Paper II	Molecular Biology & Biotechnology	50
Paper III	Environmental Botany	50
Practical	Practical Syllabus based on theory papers	50
	Grand Total	600

At least one Field trip in B.Sc. II is compulsory.

Subject- Botany
B.Sc. - First Year
Practical

Time: 4.00 hrs **Max Marks: 50**

1- Temporary slide preparation & Identification (Fungi)/Bacteria)	08 Marks
2- Temporary slide preparation & Identification (Pteridophyte/Gymnosperm)	08 Marks
3- Temporary Mount & Identification (Algae/ Bryophyte)	08 Marks
4- Temporary mount of rhizoid/scale/spore; or Gram staining of Bacteria	04 Marks
4- Identify and Comment upon spots (1-6)	12 Marks
7- *Viva-Voce*	05 Marks
8- Practical class record	05 Marks
Total Marks	**50**

Subject- Botany
B.Sc. -Second Year
Practical

Time: 4.00 hrs **Max Marks: 50**

1- Description, Identification and Classification of given Angiospermic Plant	08 Marks
2- To perform and write the observations, results & conclusion (Physiology)	08 Marks
3- Temporary slide preparation & Identification (Anatomy)/ Temporary Mount (Embryology)/ Biochemistry / Genetics Exercise	04 Marks
4- Cytology/Ecology Exercise	08 Marks
5- Identify and Comment upon spots (1-6)	12 Marks
6- *Viva-Voce*	05 Marks
7- Practical class record/ chart/ model/ herbarium	05 Marks
Total Marks	**50**

Subject- Botany
B.Sc. - Third Year
Practical

Time: 4.00 hrs **Max Marks: 50**

1- Biotechnology exercise (Tissue culture based)/ Plant diseases	8 Marks
2-Environmental Pollution analysis/ Biostatistics exercise	8 Marks
3-Temporary Mount/ Diagram (Pollen grains)	5 Marks
4-Structure of Different Molecules/soil types	4 Marks
5- Identify and Comment upon spots (1-5)	10 Marks
6- *Viva-Voce*	5 Marks
7- Practical class record	5 Marks
8- Collection of Model, Chart, Project etc.	5 Marks
Total Marks	**50**

The course details are as follows:-

B.Sc. I Year

Paper I: Diversity of Viruses, Bacteria, & Fungi M.M. 50

Unit-I

History, nature and classification of Viruses, Bacteria and Fungi.

History of virology and bacteriology; prokaryotic and eukaryotic cell structure (bacteria, mycoplasma and yeast); structure, classification and nature of viruses; structure (gram positive and gram negative) and classification (based on cell structure) of bacteria; classification (Ainsworth), thallus organization and reproduction in fungi; economic importance of fungi.

Unit-II

Viruses: Genome organisation, replication of plant viruses (tobacco mosaic virus), bacteriophages and viroids; techniques in plant viruses - purification, serology and electron microscopy; Economic importance of viruses

Unit-III

Bacteria: Bacterial genome and plasmids; bacterial reproduction, techniques of sterilisation and staining; economic importance.

Unit-IV

Fungi: The outline life cycles of the following:

Mastigomycotina: *Albugo, Pythium,;* **Ascomycotina**: *Saccharomyces, Aspergillus; Ascobolus;*

Basidiomycotina : *Ustilago, Puccinia, Polyporus, Agaricus;* **Deuteromycotina**: *Fusarium, Cercospora.*

Paper II - Diversity of Algae, Lichens, and Bryophytes M.M. 50

Unit-I

General characters. Range of thallus organization, classification, ultrastructure of eukaryotic algal cell and cyanobacterial cell, economic importance of algae. Lichens, classification, thallus organization, reproduction, physiology and role in environmental pollution. Ecological and economic importance of lichens.

Unit-II

The characteristics and life cycles of the following:-

Cyanophyta*, Oscillatoria* **:Chlorophyta** *Volvox*, *Hydrodictyon, Oedogonium, Chara;* **Bacillariophyta** *Navicula;* **Xanthopyta** *Vaucheria;* **Phaeophyta**; *Ectocarpus, Saragassum,* **Rhodophyta** *Polysiphonia*

Unit – III

Bryophytes, general characters, classification, reproduction and affinities. Gametophytic and sporophytic organization only of **Hepaticopsida** : *Riccia, Marchantia.*

Unit - IV

Gametophytic and soporophytic organization only of:

Anthocerotopsida: A*nthoceros;* **Bryopsida:** *Pogonatum;*

Paper III – Diversity of Pteridophytes, Gymnosperms and Elementary Palaeobotany M.M. 50

Unit - I

Pteridophytes: General features, classification, stelar system and its evolution. Heterospory and seed habit. Comparative study of morphology, anatomy, development, vegetative and reproductive systems of following:

Lycopsida - L*ycopodium, Selaginella;* **Psilopsida-** *Rhynia*

Unit – II

General and comparative account of gametophytic and sporophytic system only in

Filicopsida -*Pteridium, Equisetum. Marsilea.*

Unit - III

Gymnosperms: General characters, classification. Comparative study of morphology, anatomy, development of vegetative and reproductive parts in:

Cycadales: *Cycas*

Unit –IV

Study of morphology, anatomy, development and reproductive parts in:

Coniferales – *Pinus* ; **Gnetales -** *Ephedra*

Affinities and relationship of Gymnosperms, evolutionary significance.

Elementary Palaeobotany: general account, types of fossils, methods of fossilization and geological time scale.

Books Recommended:

1. Ganguly and Kar. College Botany Vo. II. Calcutta
2. Khan, M.1983 Fundamentals of Phycology. Bishen Singh Mahendra Pal Singh, Dehradun
3. Parihar, N.S. The Biology and Morphology of Bryophytes, Central Book Depo. Allahabad.
4. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.
5. Sharma, O.P. A Text Book of Bryophyta.
6. Singh, V., Pandey, P.C. and Jain, D.K. A text book of botany Vashishta, B.R. Text Book of Algae. New Delhi
7. Parihar, N.S. 1996 Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
8. Pandey, S.N. A Text book of Pteridophyta
9. Sharma, O.P. An Introduction to Gymnosperms, Pragati Prakashan, Meerut.
10. Vashishta, P.C. A Text book of Pteridophyta. New Delhi.
11. Vashishta, P.C. Text Book of Gymnosperm

B.Sc. II year

Paper - I: Diversity of Angiosperms: Systematics, Development & Reproduction M.M. 50

Unit - I

Systematics

Principles of classification, Binomial nomenclature; comparative study of different classification systems, viz. Linnaeus, Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist.

Herbarium techniques and important Botanic Gardens.

Unit – II

Taxonomic study of following families and their economic importance:

Dicots; Ranunculaceae, Malvaceae, Brassicaceae, Cucurbitaceac, Rosaceae, Leguminosacae, Myrtaceae, Rutaceae, Apiaceae, Apocynaceae, Asclepiadaceous, Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Asteraceae, Rubiaceae, Verbenaceae, Euphorbiaceae, and Amaranthaceae.

Monocots: Cyperaceae, Poaceae, Arecaceae. Liliaceae.

Unit - III

External morphology of vegetative and floral parts; modifications – phyllodes, cladodes, and phylloclades.

Meristems-kinds study of tissue system - epidermal, ground, and vascular.

Anatomy of roots, stems, and leaves. Cambium - its function and anomalies in roots and stems; root -shoot transition.

Unit – IV

Structure and development of male and female gametophytes – microsporogenesis microgametogenesis, megasporogenesis, and megagametogenesis, embryo sac types. Double fertilization development of embryo, endosperm development and its morphological nature, apomixis and polyembryony.

Paper II: Cytology, Genetics, Evolution & Ecology M.M. 50

Unit - I

Cell structure, cell organelles, nucleus, chromosome structure, nucleosome and solenoid model, salivary gland, lampbrush and B chromosomes.

Cell division – mitosis, meiosis; their significance, chromosomal aberrations, cell cycle.

Unit- II

Genetics, laws of inheritance; gene interaction; linkage and crossing over; cytoplasmic inheritance; sex determination.

Unit-III

Mutation- spontaneous, induced mutations, molecular mechanism and evolutionary significance; polyploidy origin, kinds and role in evolution. Evidences and theories of evolution.

Unit - IV

Ecology, relation with other disciplines. Plant types: Hydrophytes - *Hydrilla, Eichhornia, Nymphaea, Typha.*

Xerophytes – *Nerium, Casuarina, Asparagus, Calotropis, Parkinsonia.* Plant succession – xeroseres, hydroseres. Ecosystems - concept, basic types, components, & functioning. Food chain, food web, energy flow and productivity.

Paper III - Plant Physiology and Biochemistry. M.M. 5O

Unit - I

Plant and water relationship, colligative properties of water. Water uptake, conduction, transpiration, mechanism and its regulation by environmental variables.

Mineral nutrition : Macro, and micronutrients, their role, deficiency and toxicity symptoms, plant culture practices, mechanism of ion uptake and translocation.

Unit - II

Photosynthesis and Chemosynthesis : photosynthetic pigments, O_2 evolution, photophosphorylation, CO_2 fixation – C-3, C-4 and CAM plants.

Respiration : aerobic and anaerobic respiration, respiratory pathways glycolysis, krebs 'cycle, electron

transport, oxidative phosphorylation, pentose phosphate pathway, photorespiration, cyanide resistant respiration. Lipid biosynthesis and its oxidation.

Unit - III

Nitrogen metabolism : atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation,
Growth: general aspects of phytohormones, inhibitors-auxins. kinetin, gibberellins, and ethylene: action and their application; photoperiodisin and vernalization. Germination, growth movements, abscission and senescence.

Unit - IV

Biomolecules : Classification, properties and biological role of carbohydrates, Protein and lipids. Chemistry of nucleic acids, vitamins.

Discovery and nomenclature. Characteristics of enzymes, concepts of holoenzyme, apoenzyme, coenzyme and cofactors. Regulation of enzyme activity, Mechanism of action.

Bioenergetics: Laws of thermodynamics, concept of Gibb's free energy and high energy compounds.

B.Sc. III year

Paper I Plant Resource utilization, Palynology, Plant Pathology and Biostatistics M.M. 50 marks

Unit I

Centres of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Basic concepts of Plant Breeding, hybridization, heterosis. Concepts of sustainable development; cultivation, production and uses of - wheat, rice, legumes, sugarcane

Unit II

A general account of plants yielding oils, spices, beverages. An account of major fiber, medicinal, petro, plants of Uttar Pradesh.

Unit III

Etiology of viral, bacterial, fungal and insect-pest diseases: mosaic diseases on tobacco, and cucumber, yellow vein mosaic of bhindi; citrus canker, potato scab, little leaf of brinjal; damping off of seedlings late blight of potato, red rot of sugarcane

Integrated pest disease management

Unit IV

An introductory knowledge of palynology, morphology, viability and germination of pollens. Classification of data, mean, median and mode. Standard deviation, standard error, variance, co-relation, χ^2 test and experimental designs

Paper II: Molecular biology and biotechnology M.M. 50

Unit – I

Nucleic acid as genetic material, nucleotides, structure of nucleic acids, properties of genetic code, codons assignments, chain initiation of codons mechanism of protein synthesis and its regulation.

Unit - II

Replication of DNA in prokaryotes and eukaryotes, gene expression and regulation. Hormonal control and second messengers Ca^{2+}, Cyclic AMP, IP_3 etc.

Unit- III

Introduction to biotechnology, recombinant DNA technology, biotechnology and healthcare, IPR issues.

Unit- IV

Plant tissue culture, methods of gene transfer, transgenic plants, , microbial and environmental biotechnology.

Paper III- Environmental botany M.M. 50

Unit - I

Mineral resources of planet earth, Conservation of mineral resources. soils; types, properties and various problem soils; water; the source of water, physico-chemical and biological properties of water. Sustainable management of water; energy resources in India; Forests: global forest wealth, importance of forests, deforestation.

Unit - II

Environmental pollution : air, water, soil, radioactive, thermal and noise pollutions, their sources, effects and control. (greenhouse effect, ozone depletion and acid rain). CO_2 enrichment and climate change.

Unit - III

Biodiversity and Phytogeography : biotic communities and populations, their characteristics and population dynamics. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, endemism.

Unit - IV

Conservation of plants resources for agriculture and forestry.

In situ conservation sanctuaries, national parks, biosphere reserves, wetlands, mangroves.

Ex situ conservation; botanical gardens, field gene banks, seed banks, cryobanks.

Chaudhary Charan Singh University, Meerut

Chemistry Syllabus for BSc I, II, III Classes

I Year

There shall be three written papers and a practical examination as follows:

			Max. Marks
Paper – I	Inorganic Chemistry		50
Paper – II	Organic Chemistry		50
Paper – III	Physical Chemistry		50
		TOTAL	**150**
	PRACTICAL		50
		GRAND TOTAL	**200**

Candidate will be required to pass in Theory and Practical Separately.

B.Sc. – I Chemistry (Paper-I)

Inorganic Chemistry :

Unit – I

I. Atomic Structure:

Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of Ψ and Ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, effective nuclear charge.

II. Periodic Properties:

Atomic and ionic radii, ionization energy, electron affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

Unit – II

III. Chemical Bonding:

(A) Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl^-_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro-negativity difference.

(B) Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule, Metallic bond-free electron, valence bond and band theories.

(C) Weak Interactions – Hydrogen bonding, Vander Waals forces.

Unit – III

IV. s-Block Elements:

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

V. Chemistry of Noble Gasses:

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Unit – IV

VI. p-Block Elements:

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

B.Sc. – I Chemistry (Paper-II)

Organic Chemistry :

Unit – I

I. Structure and Bonding:

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonances, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

II. Mechanism of Organic Reactions:

Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations.

Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

III. Alkanes and Cycloalkanes:

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, Isomerism in alkanes, sources methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes – Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring, banana bonds.

Unit – II

IV. Stereochemistry of Organic Compounds:

Concept of isomerism, Types of isomerism;
Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse

formulae, Fischer and flying wedge formulae, Difference between configuration and conformation.

Unit – III

V. Alkenes, Cycloalkenes, Dienes and Alkynes:

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes;

Nomenclature and classification of dienes : isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes, Methods of formation, Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

Unit – IV

VI. Arenes and Aromaticity:

Nomenclature of benzene derivatives, The aryl group, Aromatic nucleus and side chain, Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckle rule, aromatic ions.

Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction;

Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene;

VII. Alkyl and Aryl Halides:

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams;

Polyhalogen compounds : Chloroform, carbon tetrachloride;

Methods of formation of aryl halides, nuclear and side chain reactions;

The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions;

Relative reactivities of alkyl halides vs allyl, vingl and aryl halides, Synthesis and uses of DDT and BHC.

B.Sc. – I Chemistry (Paper-III)

Physical Chemistry :

Unit – I

I. Mathematical Concepts and Computers:

(A) Mathematical Concepts:

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like K^x, e^x, X^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.

(B) Computers:

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic's; introduction to computer languages, programming, operating systems.

Unit – II

II. Gaseous States:

Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state;

Critical Phenomena : PV isotherms of real gases, continuity of states, the isotherms of vander Waals equation, relationship between critical constants and vander Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities : Root mean square, average and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, Liquification of gases (based on Joule – Thomson effect).

III. Liquid State:

Intermolecular forces, structure of liquids (a qualitative description).

Structural differences between solids, liquids and gases;

Liquid crystals: Difference between liquid crystal, solid and liquid, Classification, structure of nematic and cholestric phases, Thermography and seven segment cells.

Unit – III

IV. Solid States:

Definition of space lattice, unit cell;

Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals.

X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

V. Colloidal States:

Definition of colloids, classification of colloids;

Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

Liquids in liquids (emulsions) : types of emulsions, preparation, Emulsifier,

Liquids in solids (gels) : classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.

Unit – IV

VI. Chemical Kinetics and Catalysis:

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light catalyst, concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon;

Experimental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalysed reactions, classification of catalysis homogeneous and heterogeneous catalysis, enzyme catalysis, miscellanceous examples.

B.Sc. – I (PRACTICAL) 180 hrs (6 Hrs/week)

Inorganic Chemistry :

Semi micro Analysis – cation analysis, separation and identification of ions from Grops I, II, III, IV, V and VI, Anion analysis.

Organic Chemistry :

Laboratory techniques;

***Calibration of Thermometer*:**

80-82^0 (Naphthalene), 113.5-114^0 (Acetanilide)

132.5-133^0 (Urea), 100^0 (Distilled Water)

***Determination of melting point*:**

Naphthalene 80-82^0, Benzoic acid 121.5-122^0

Urea 132.5-133^0, Succinic acid 184.5-185^0

Cinnamic acid 132.5-133^0, Sallicylic acid 157.5-158^0

Acetanilide 113.5-114^0, m-Dinitrobenzene 90^0

p-Dichlorobenzene 52^0, Aspirin 135^0

***Determination of boiling point*:**

Ethanol 78^0, Cyclohexane 81.4^0, Toluene 110.6^0, Benzene 80^0

***Mixed melting point determination*:**

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

***Distillation*:**

Simple distillation of ethanol-water mixture using water condenser,

Distillation of nitrobenzene and aniline using air condenser

***Crystallization*:**

Concept of induction of crystallization,

Phthalic acid from hot water (using fluted filter paper and steamless funnel)

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water

***Decolorisation and crystallization using charcoal*:**

Decolorsation of brown sugar (sucrose) with animal charcoal using gravity filtration.

Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 g of Congo Red using 1g decolorizing carbon) from ethanol.

***Sublimation (Siple and Vacuum)*:**

Camphor, Naphtalene, Phthalic acid and succinic acid.

***Qualitative Analysis*:**

Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

Physical Chemistry :

Chemical Kinetics:

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by H_2O_4.

Distribution Law:

1. To study the distribution of iodine between water and CCl_4.
2. To study the distribution of benzoic acid between benzene and water.

Colloids:

1. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.

Viscosity, Surface Tension:

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

B.Sc. - SECOND YEAR

CHEMISTRY

There shall be three written papers and a practical examination as follows :

		Max. Marks
Paper – I	Inorganic Chemistry	50
Paper – II	Organic Chemistry	50
Paper – III	Physical Chemistry	50
	TOTAL	**150**
	PRACTICAL	50
	GRAND TOTAL	**200**

Candidate will be required to pass in Theory and Practical Separately.

B.Sc. – II Chemistry (Paper-I)

Inorganic Chemistry :

Unit – I

I. Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements.

Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.

II. Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Unit – II

III. Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit – III

IV. Chemistry of Lanthanide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.

V. Chemistry of Actinides

Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

Unit – IV

VI. Oxidation and Reduction

Electrode potential, electrochemical series and its applications, Principles involved in the extraction of the elements.

VII. Acids and Bases

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases.

VIII. Non-aqueous Solvents

Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid NH_3 and Liquid SO_2.

B.Sc. – II Chemistry (Paper-II)

Organic Chemistry :

Unit – I

I. Electromagnetic Spectrum Absorption Spectra

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer-Lambert law); molar absroptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V. spectra of conjugated enes and enones.

Infrared (I.R.) absorption spectroscopy – molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, measurement of I.R. spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds.

Unit – II

II. Alcohols

Classification and nomenclature,
Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.
Dihydric alcohols - – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.
Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.

III. Phenols :

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit – III

IV. Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method.
Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

V. Aldehydes and Ketones:

Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid

chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties.

Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones An introduction to α, β unsaturated aldehydes and Ketones.

Unit – IV

VI. Carboxylic Acids:

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, trartaric and citric acids.

Methods of formation and chemical reactions of unsaturated monocarboxylic acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

VII. Carboxylic Acid Derivatives

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anyhydrides.

Relative stability of acyl derivatives, Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterificaton and hydrolysis (acidic and basic)

VIII. Organic Compounds of Nitrogen:

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nuclephilc substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

B.Sc. – II Chemistry (Paper-III)

Physical Chemistry :

Unit – I

(Thermodynamics & Chemical Equilibrium)

I. Thermodynamics – I

Definitions of thermodynamic terms :

System, surroundings etc. Types of systems, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work.

First Law of Thermodynamics :

Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship, Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isotheral and adiabatic conditions for reversible process.

Thermochemistry :

Standard state, standard enthalpy of formation – Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoff's equation

Unit – II

II. Chemical Equilibrium

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle

Reaction isotherm and reaction isochore – Clapeyron-clausius equation and its applications.

III. Thermodynamics – II

Second Law of Thermodynamics :

Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature.

Concept of entropy:

Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases.

Gibbs and Helmholtz functions:

Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

Third Law of Thermodynamics:

Nernst heat theorem, statement and concept of residual entropy.
Nernst distribution law – thermodynamic derivation, applications.

Unit – III

(Electrochemistry – I & Solutions)

IV. Electrochemistry – I:

Electrical transport:- Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), Transport number, definition and determination by Hittorf's method and moving boundary method.

Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

V. Solutions:

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

Partially miscible liquids- Phenol – water, trimethylamine – water, nicotine-water systems, Immiscible liquids, steam distillation.

Unit – IV

(Electrochemistry – II & Phase Equilibrium)

VI. Electrochemistry – II:

Types of reversible electrodes – gas-metal ion, metal-ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, strandard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells–reversible and irreversible cells, conventional representation of electrochemical cells;

EMF of a cell and its measurements, Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K)

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pK_a, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods;

Buffers – Mechanism of buffer action, Henderson-Hazel equation, application of buffer solution, Hydrolysis of salts

VII. Phase Equilibrium:

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, 'CO_2' and 'S' systems

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

Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system

B.Sc. – II (Practical) 180 hrs. (6 hrs/week)

Inorganic Chemistry :

Calibration of fractional weights, pipettes and burettes, Preparation of standards solutions, Dilution – 0.1 M to 0.001 M solutions.

Quantitative Analysis:

Volumetric Analysis :

(a) Determination of acetic acid in commercial vinegar using NaOH.

(b) Determination of alkali content – antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.

(d) Estimation of hardness of water by EDTA.

(e) Estimation of ferrous and ferric by dichromate method.

(f) Estimation of copper using thiosulphate.

Gravimetric Analysis :

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).

Organic Chemistry :

Laboratory Techniques

A. Thin Layer Chromatography

Determination of R*f* values and identification of organic compounds:

(a) Separation of green leaf pigments (spinach leaves may be used).

(b) Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60)

(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

B. Paper Chromatography: Ascending and Circular

Determination of R*f* values and identification of organic compounds:

(a) Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid, Leucine and glutamic acid, Spray reagent – ninhydrin.

(b) Separation of a mixture of D, L – alanine, glycine, and L-Leucine using n-butanol:acetic acid:water (4:1:5), Spray reagent – ninhydrin.

(c) Separation of monosaccharide – a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1), spray reagent – aniline hydrogen phthalate.

Qualitative Analysis:

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Physical Chemistry :

Transition Temperature

1. Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O/SrBr_2.2H_2O$).

Phase Equilibrium

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

Thermochemistry

1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the entrhalpy of ionization of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.

B.Sc. - THIRD YEAR

CHEMISTRY

There shall be three written papers and a practical examination as follows:

		Max. Marks
Paper – I	Inorganic Chemistry	75
Paper – II	Organic Chemistry	75
Paper – III	Physical Chemistry	75
	TOTAL	**225**
	PRACTICAL	75
	GRAND TOTAL	**300**

Candidate will be required to pass in Theory and Practical Separately.

B.Sc. – III Chemistry (Paper-I)

Inorganic Chemistry :

Unit – I

I. Metal-ligand bonding in Transition Metal Complexes

Limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters.

II. Thermodynamic and Kinetic Aspects of Metal Complexes

A brief outline of thermodynamics stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

Unit – II

III. Magnetic Properties of Transition Metal Complexes

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

IV. Electronic spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H^2O)^6]^{3+}$ complex ion.

Unit – III

V. Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds,

Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Snl.

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls.

VI. Silicones and Phosphazenes

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

Unit – IV

VII. Hard and Soft Acids and Bases (HSAB)

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness.

VIII. Bioinorganic Chemistry

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.

B.Sc. – III Chemistry (Paper-II)

Organic Chemistry :

Unit – I

I. Spectroscopy

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

Unit – II

II. Organometallic Compounds

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

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

III. Organosulphur Compounds

Nomenclature, structural formation, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and Sulphaguanidine.

IV. Hetrocyclic Compounds

Introduction : Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole.

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

Unit – III

V. Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides, Erythro and threo diastereomers, Conversion of glucose intro mannose, Formation of glcosides, ethers and esters, Determination of ring size of monosaccharides, Cyclic structure of D(+)-glucose, Mechanism of mutarotation.

Structures of ribose and deoxyribose,

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

VI. Amino Acids, Peptides, Proteins and Nucleic Acids:

Classification, structure and stereochemistry of amino acids, Acid-base behaviour isoelectric point and electrophoresis, Preparation and reactions of α-amino acids, Structure and nomenclature of peptides and proteins, Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid-phase peptide synthesis, Structures of peptides and proteins, Levels of protein structure, Protein denaturation/ renaturation;

Nucleic acids : Introduction, constituents of nucleic acids, Ribonucleosides and ribonucleotides, The double helical structure of DNA.

Unit – IV

VII. Fats, Oils and Detergents

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

VIII. Synthetic Polymers

Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers,

Condensation or step growth-polymerization, Polyesters, plyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

IX. Synthetic Dyes

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

X. Organic Synthesis via Enolates

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate.

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

B.Sc. – III Chemistry (Paper-III)

Physical Chemistry :

Unit – I

(Introductory Quantum Mechanics, Spectroscopy, Physical Properties and Molecular Structure)

I. Introductory Quantum Mechanics:

Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (without derivation) their solution of overall solution and its defects, Compton effect, de-Broglie's hypothesis, the Heisenberg's uncertainty principle, Hamiltonian Operator.

II. Spectroscopy:

Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrophotometers, statement of the born-oppenheimer approximation, degrees of freedom.

III. Physical Properties and Molecular Structure:

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetic, Magnetic susceptibility, its measurements and its importance.

Unit – II

IV. Elementary Quantum Mechanics:

Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

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

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

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

Unit – III

V. Rotational Spectrum:

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

Vibrational Spectrum :

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

Raman Spectrum : Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

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

Qualitative description of σ, π and η M.O. their energy levels and the respective transition.

Unit – IV

(Photochemistry, Solutions, Dilute Solutions and Colligative Properties)

VI. Photochemistry :

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

Solutions, Dilute Solutions and Colligative Properties:

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

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

Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

B.Sc. – III (PRACTICAL) 180 hrs. (12 hrs./week)

Inorganic Chemistry :

Synthesis and Analysis:

(a) Preparation of sodium trioxalator ferrate (III), $Na_3[Fe(C_2O_4)_3]$ and determination of its composition by permagonometry.
(b) Preparation of Ni-DMG complex, $[Ni(DMG)_2]$
(c) Preparation of copper tetraammine complex. $[(Cu(NH_3)_4]SO_4$.
(d) Preparation of *cis*-and *trans*-bisoxalato diaqua chromate (III) ion.

Instrumentation:

Colorimetry

(a) Job's method (b) Mole-ratio method
Adulteration – Food stuffs.
Effluent analysis, water analysis

Solvent Extraction

Separation and estimation of Mg(II) and Fe(II)

Ion Exchange Method

Separation and estimation of Mg(II) and Zn(II)

Organic Chemistry :

Laboratory Techniques:

Steam Distillation

Naphtalene from its suspension in water
Clove oil from cloves
Separation of *o*-and *p*-nitrophenols

Column Chromatography

Separation of fluorescein and methylene blue
Separation of leaf pigments from spinach leaves
Resolution of racemic mixture of (±) mandelic acid

Qualitative Analysis

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

Synthesis of Organic Compounds

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol
(b) Aliphatic electrophlic substitution
Preparation of iodoform from ethanol and acetone
(c) Aromatic electrophilic substitution
Nitration
Preparation of m-dinitrobenzene

Preparation of p-nitroacetanilide

Halogenation

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

(d) Diazotization/coupling
Preparation of methyl orange and methyl red

(e) Oxidation
Preparation of benzoic acid from toluence

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

Stereochemical Study of Organic Compounds via Models

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

Physical Chemistry :

Electrochemistry:

1. To determine the strength of the given acid conductometrically using standard alkali solution.
2. to determine the solubility and solubility of a sparingly soluble electrolyte conducometrically.
3. to study the saponification of ethyl acetate condutometrically.
4. To determine the ionization constant of a weak acid condutometrically.
5. To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{++}/Fe^{+++} system on the hydrogen scale.

Refractrometry, Polarimetry:

1. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer.
2. To determine the specific rotation of a given optically active compound.
3. To determine stoichiometry and stability constant of complexes.

Molecular Weight Determination:

1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
2. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry:

1. To verify Beer – Lambert Law for $KMnO/K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement.

Syllabus of B.Sc. Mathematics

R. K. College Shamli-247776

B. Sc.- I year

Algebra & Trigonometry

U.P. UNIFIED (*w.e.f.* 2011-12)

B.A./B.Sc. Paper-I M.M. : 33 / 65

Algebra

Unit-1: Sequence and its convergence (basic idea), Convergence of infinite series, Comparison test, ratio test, root test, Raabe's test, Logarithmic ratio test, Cauchy's condensation test, DeMorgan and Bertrand test and higher logarithmic ratio test. Alternating series, Leibnitz test, Absolute and conditional convergence, Congruence modulo *m* relation, Equivalence relations and partitions.

Unit-2: Definition of a group with examples and simple properties, Permutation groups, Subgroups, Centre and normalizer, Cyclic groups, Coset decomposition, Lagrange's theorem and its consequences.

Unit-3: Homomorphism and Isomorphism, Cayley's theorem, Normal subgroups, Quotient group, Fundamental theorem of homomorphism, Conjugacy relation, Class equation, Direct product.

Unit-4: Introduction to rings, subrings, integral domains and fields, Characteristic of a ring, Homomorphism of rings, Ideals, Quotient rings.

Trigonometry

Unit-5: Complex functions and separation into real and imaginary parts, Exponential, Direct and inverse trigonometric and hyperbolic functions, Logarithmic functions, Gregory's series, Summation of series.

Calculus

U.P. UNIFIED (*w.e.f.* 2011-12)

B.A./B.Sc. Paper-II M.M. : 55 / 85

Differential Calculus

Unit-1: ε-δ definition of the limit of a function, Continuous functions and classification of discontinuities, Differentiability, Chain rule of Differentiability, Rolle's theorem, First and second mean value theorems, Taylor's theorems with Lagrange's and Cauchy's forms of remainder, Successive differentiation and Leibnitz's theorem.

Unit-2: Expansion of functions (in Taylor's and Maclaurin's series), Indeterminate forms, Partial differentiation and Euler's theorem, Jacobians.

Unit-3: Maxima and Minima (for functions of two variables), Tangents and normals (polar form only), Curvature, Envelopes and evolutes.

Unit-4(a): Asymptotes, Tests for concavity and convexity, Points of inflexion, Multiple points, Tracing of curves in Cartesian and Polar coordinates.

Integral Calculus

Unit-4(b): Reduction formulae, Beta and Gamma functions.

Unit-5: Quadrature, Rectification, Volumes and surfaces of solids of revolution, Pappus theorem, Double and triple integrals, Change of order of integration, Dirichlet's and Liouville's integral formulae.

Geometry & Vector Calculus

U.P. UNIFIED (*w.e.f.* 2011-12)

B.A./B.Sc. Paper-III M.M. : 54 / 70

Geometry

Unit-1: General equation of second degree, Tracing of conics, System of conics, Confocal conics, Polar equation of a conic and its properties.

Unit-2: Three dimensional system of co-ordinates, Projection and direction cosines, Plane, Straight line.

Unit-3: Sphere, cone and cylinder.

Unit-4: Central conicoids, Reduction of general equation of second degree, Tangent plane and normal to a conicoid, Pole and polar, Conjugate diameters, Generating lines, Plane sections.

Vector Calculus

Unit-5: Vector differentiation and integration, Gradient, divergence and curl and their properties, Line integrals, Theorems of Gauss, Green and Stokes and problems based on these.

B. Sc.- II year

DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

DIFFERENTIAL EQUATIONS

UNIT-I :

Formation of a differential equation (D.E.), Degree, Order and solution of D.E. Equation of first order and first degree : Separation of variables equations, Linear differential equation with constant coefficients. Homogeneous linear differential equations.

UNIT-II :

Differential equations of the first order but not of first degree Clairaut's equation and singular solutions, Orthogonal trajectories, Simultaneous linear differential equations with constant coefficients, Linear differential equations of the second order (including the method of variation of parameters).

UNIT-III :

Series solution of second order differential equation Legendre and Bessel's functions (P_n and J_n only) and their properties, Order, Degree and formation of partial differential equations, Partial differential equation of first order, Legendre's equations, Charpit's general method, Linear partial differential equation with constant coefficients.

UNIT-IV (i) :

Partial differential equation of the second order, Monge's method.

INTEGRAL TRANSFORMS

UNIT-IV (ii) :

The concept of transform, Integral transform and kernel, Linearity property of transforms, Laplace transform, Inverse Laplace transform, Convolution theorem, Application of Laplace transform to solve ordinary differential equations.

UNIT-V :

Fourier transforms (finite and infinite) Fourier integral, Application of Fourier transform to boundary value problems. Fourier series.

Linear Algebra & Matrices

U.P. UNIFIED (*w.e.f.* 2012-13)

B.A. B.Sc. Paper-II M.M. : 35 / 65

Section-A: Linear Algebra

Unit-1: Vector spaces and their elementary properties, Subspaces, Linear dependence and independence, Basis and dimension, Direct sum, Quotient space.

Unit-2: Linear transformations and their algebra, Range and null space, Rank and nullity. Matrix representation of linear transformations, Change of basis.

Unit-3: Linear functionals, Dual space, Bi-dual space, Natural isomorphism, Annihilators, Bilinear and quadratic forms, Inner product spaces, Cauchy-Schwarz's inequality, Bessel's inequality and orthogonality.

Section-B: Matrices

Unit-4: Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations.

Unit-5: Characteristic equation, Eigen values and eigen vectors of a matrix, Cayley-Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear (both homogeneous and non-homogeneous) equations, Consistency and general solution, Diagonalization of square matrices with distinct eigen values, Quadratic forms.

Mechanics

U.P. UNIFIED (*w.e.f.* 2012-13)

B.A./B.Sc. IInd Year–Paper-IIIrd M.M. : 34 / 70

Dynamics

Unit-1: Velocity and acceleration along radial and transverse directions, and along tangential and normal directions, Simple harmonic motion, Motion under other laws of forces, Earth attraction, Elastic strings.

Unit-2: Motion in resisting medium, Constrained motion (circular and cycloidal only).

Unit-3: Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law, Motion of a particle in three dimensions.

Statics

Unit-4: Common catenary, Centre of gravity, Stable and unstable equilibrium, Virtual work.

Unit-5: Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.

B. Sc.- III year

Analysis

C.C.S. University (*w.e.f.* 2013-14)

THIRD YEAR FIRST PAPER

Paper Code: US – 326

B.A./B.Sc. Paper-III

M.M. : 35 / 65

UNIT -1

Axiomatic study of real numbers, Completeness property in R, Archimedean property. Countable and uncountable sets. Neighbourhoods, Interior points, Limit points, Open and closed sets, Derived sets, Dense sets, Perfect sets Bolzano-Weierstrass theorem.

UNIT -2

Sequences of real numbers, Subsequences, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy's general properties of convergence, Sequential continuity, Boundeness and intermediate value properties of continuous functions, Uniform continuity, Meaning of sign of derivative.

UNIT -3

Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Improper integrals and their convergence. Comparison test, μ-test, Abel's test, Dirichlet's test, integral as a function of a parameter and its differentiability and integrability.

UNIT -4

Functions of a complex variable, Concepts of limit, continuity and differentiability of complex functions, Analytic functions, Cauchy Riemann equations (Cartesian and polar form), Harmonic functions, Orthogonal system, Power series as an analytic function.

UNIT -5

Elementary functions, Mapping by elementary functions, Linear and bilinear transformations, Fixed points, Cross ratio, Inverse points and critical points, Conformal transformations.

Linear Programming

C.C.S. University (*w.e.f.* 2013-14)

Third Year II[nd] Paper

Paper Code : US-527

B.A./B.Sc. Paper-II[nd]

M.M. : 33 / 65

Unit-I

Linear programming problems, Statement and formation of general linear programming problems, Graphical method, Slack and surplus variables, Standard and matrix forms of linear programming problem, Basic feasible solution.

Unit-II

Convex sets, Fundamental theorem of linear programming, Simplex method, Artificial variables, Big-*M* method, Two phase method.

Unit-III

Resolution of degeneracy, Revised simplex method, Sensitivity Analysis.

Unit-IV

Duality in linear programming problems, Dual simplex method, Primal-dual method Integer programming.

NUMERICAL METHODS & COMPUTER FUNDAMENTALS

C.C.S. University (*w.e.f.* 2013-14)

THIRD YEAR THIRD PAPER

Paper Code: U.S.—328

B.A./B.Sc. Paper-III

M.M. : 34 / 70

UNIT-1

Discussion of different type of Errors, Shift operator, Forward difference Backward difference and Central difference operators and their relationships, Fundamental theorem of difference calculus, Divided differences.

UNIT-2

Interpolation, Newton–Gregory's forward and backward interpolation formulae. Newton's divided difference formula, Lagrange's interpolation formula, Formulae based on central differences: Gauss, Stirling's, Bessel's and Everett's interpolation formulae, Numerical differentiation.

UNIT-3

Solution of transcendental and polynomial equations by iterative methods bisection method, Regular–falsi method and Newton–Raphson method, Successive iteration method.

UNIT-4

Basic computer organization, Computer arithmetic and Number systems: Binary, octa and hexadecimal system, Storage devices, Operating system.

UNIT-5

Computer software, Programming languages, Computer networking: LAN, WAN and Computer network topologies.

Chaudhary Charan Singh University, Meerut

Physics Syllabus for BSc I, II and III Year Classes

B.Sc.- FIRST YEAR

		Max. Marks
PAPER I	MECHANICS AND WAVE MOTION	50
PAPER II	KINETIC THEORY AND THERMODYNAMICS	50
PAPER III	CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS	50
PRACTICAL	TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)	50
TOTAL		200

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - MECHANICS AND WAVE MOTION

UNIT-I

Inertial reference frame, Newton's laws of motion, Dynamics of particle in rectilinear and circular motion, Conservative and Non -conservative forces, Conservation of energy, liner momentum and angular momentum, Collision in one and two dimensions, cross section.

UNIT -II

Rotational energy and rotational inertia for simple bodies, the combined translation and rotational and motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top. Relations between elastic constants, bending of Beams and Torsion of Cylinder.

UNIT - III

Central forces, Two particle central force problem, reduced mass, relative and centre of mass motion, Law of gravitation, Kepler's laws, motions of planets and satellites, geo-stationary satellites.

UNIT IV

Simple harmonic motion, differential equation of S. H. M. and its solution, uses of complex notation, damped and forced vibrations, composition of simple harmonic motion.

Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves, pressure and energy distribution, phase and group velocity.

Text and Reference Books

EM Purcell, Ed: "Berkeley Physics Course, Vol. 1, Mechanics" (McGraw-Hill). RP Feymman, RB Lighton and M Sands; "The Feymman Lectures in Physics", Vol. 1 (BI Publications, Bombay, Delhi, Calcutta, Madras).

J.C. Upadhyay: 'Mechanics'.

D.S, Mathur “Mechanics”,
P.K. Srivastava: “Mechanics” (New Age International).

PAPER II- KINETIC THEORY AND THERMODYNAMICS

UNIT-I

Ideal Gas: Kinetic model, Deduction of Boyle’s law, interpretation of temperature, estimation of r.m.s. speeds of molecules. Brownian motion, estimate of the Avogadro number. Equipartition of energy, specific heat of monatomic gas, extension to di- and triatomic gases, Behaviour at low temperatures. Adiabatic expansion of an ideal gas, applications to atmospheric physics.

Real Gas: Vander Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants, gas and vapour. Joule expansion of ideal gas, and of a Vander Waals gas, Joule coefficient, estimates of J-T cooling.

UNIT -II

Liquefaction of gases: Boyle temperature and inversion temperature. Principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium. Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases: Molecular collisions, mean free path and collision cross sections. Estimates of molecular diameter and mean free path.
Transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

UNIT - III

The laws of thermodynamics: The Zeroth law, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function and other applications. Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics. Different versions of the second law, practical cycles used in internal combustion engines. Entropy, principle of increase of entropy. The

thermodynamic scale of temperature; its identity with the perfect gas scale. Impossibility of attaining the absolute zero;
third law of thermodynamics. Thermodynamic relationships: Thermodynamic variables; extensive and intensive, Maxwell's general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, Van der Waals gas, Clausius-Clapeyron heat equation. Thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization, production and measurement of very low temperatures.

UNIT -IV

Blackbody radiation: Pure temperature dependence, Stefan-Boltzmann law, pressure of radiation, spectral distribution of Black body radiation, Wien's displacement law, Rayleigh-Jean's law, Plank's law the ultraviolet catastrophy.

Text and Reference Books

G.G. Agarwal and H.P. Sinha "Thermal Physics"
S.K. Agarwal and B.K. Agarwal "Thermal Physics"

PAPER III - CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS

UNIT-I

Growth and decay of currents through inductive resistances, charging and discharging
in R.C. and R.L.C. circuits, Time constant, Measurement of high resistance.
A.C. Bridges, Maxwell's and Scherings Bridges, Wien Bridge.
THINLY, NORTON and Superposition theorems and their applications.

UNIT -II

Semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, unbiased diode forward bias and reverse bias diodes, diode as

a rectifier, diode characteristics, zener diode, avalanche and zener breakdown, power supplies, rectifier, bridge rectifier, capacitor input filter, voltage regulation, zener regulator.

Bipolar transistors, three doped regions, forward and reverse bias, DC alpha, DC beta

transistor curves.

UNIT - III

Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line.

Basic AC equivalent circuits, low frequency model, small signal amplifiers, common emitter amplifier, common collector amplifiers, and common base amplifiers, current and voltage gain, R.C. coupled amplifier, gain, frequency response, equivalent circuit at low, medium and high frequencies, feedback principles.

UNIT-IV

Input and output impedance, transistor as an oscillator, general discussion and theory of Hartley oscillator only.

Elements of transmission and reception, basic principles of amplitude modulation and demodulation. Principle and design of linear multimeters and their application, cathode ray oscillograph and its simple applications.

Text and Reference Books

B.G. Streetman; "Solid State Electronic Devices", IInTdi Edition (Prentice Hall of India, New Delhi, 1986).

W.D. Stanley: "Electronic Devices, Circuits and Applications" (Prentice-Hall, New TTC'A 1flOO\ JL4y, JJI. 1OO).

J.D. Ryder, "Electronics Fundamentals and Applications", lI'' Edition (Prentice-Hall of India, New Delhi, 1986).

J Millman and A Grabel, "Microelectronics", International Edition (McGraw Hill Book Company, New York, 1988).

PRACTICALS

Every institution may add any experiment of the same standard in the subject.

Mechanics

1. Study of laws of parallel and perpendicular axes for moment of inertia.
2. Study of conservation of momentum in two dimensional oscillations.

Oscillations

1. Study of a compound pendulum.
2. Study of damping of a bar pendulum under various mechanics.
3. Study of oscillations under a bifilar suspension.
4. Potential energy curves of a 1-Dimensional system and oscillations in it for various amplitudes.
5. Study of oscillations of a mass under different combinations of springs.

Properties of matter

1. Study of bending of a cantilever or a beam.
2. Study of torsion of a wire (static and dynamic methods)

Kinetic theory of matter

1. Study of Brownian motion.
2. Study of adiabatic expansion of a gas.
3. Study of conversion of mechanical energy into heat.
4. Heating efficiency of electrical kettle with varying voltages.

Thermodynamics

1. Study of temperature dependence of total radiation.
2. Study of temperature dependence of spectral density of radiation.
3. Resistance thermometry.

4. Thermo-emf thermometry
5. Conduction of heat through poor conductors of different geometries.

Circuit fundamentals

1. Charging and discharging in R.C. and R.C.L. circuits.
2. High resistance by leakage.
3. A.C. Bridges.
4. Half wave and full wave rectifiers.
5. Characteristics of a transistor in CE,CB and CC configurations
6. Frequency response of R.C. coupled amplifier.

Waves

I. Speed of waves on a stretched string.
2. Studies on torsional waves in a lumped system.
3. Study of interference with two coherent sources of sound.

Text and reference books

D.P. Khandelwal, “A laboratory manual for undergraduate classes” (Vani Publishing
House, New Delhi).
S.P. Singh, “Advanced Practical Physics” (Pragati Prakashan, Meerut).
Worsnop and Flint- Advanced Practical physics for students.

PHYSICS

B.Sc.- SECOND YEAR

		Max. Marks
PAPER I	PHYSICAL OPTICS AND LASERS	50
PAPER II	ELECTROMAGNETICS	50
PAPER III	ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULARS SPECTRA	50
PRACTICAL	TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)	50
TOTAL		200

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - PHYSICAL OPTICS AND LASERS

UNIT-I

Interference of a light: The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes; thin films, applications for precision measurements for displacements.

Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twymann Green interferometer and its uses. Iriensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perrot interferometer and etalon.

UNIT -II

Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation.

Fraunhoffer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscopic systems, outline of phase contrast microscopy.

Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perrot etalon.

UNIT - III

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator. Analysis of polarised light.

Optical activity and Fresnel's explanation, Half shade and Biquartz polarirneters.

Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems.

UNIT-IV

Laser system: Purity of a special line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion.

Application of Lasers: Pulsed lasers and tunable lasers, spatial coherence and directionality, estimates of beam intensity; temporal coherence and spectral energy density.

Text and Reference Books

A K Ghatak, "Physical Optics" (Tata McGrew Hill).

D P Khandelwal; "Optics and Atomic Physics" (Himalaya, Publishing House, Bombay, 1988).

F Smith and JH Thomson; "Manchester Physics sries; Optics" (English Language Book Society and Joh Wiley, 1977).

Born and Wolf; "Optics"

KD Moltey; "Optics" (Oxford University Press).

Sears; "Optics".

Jonkins and White; "Fundamental of Optics" (McGraw-Hill).

Smith and Thomson; "Optics" (John Wiley and Sons).

B.K; Mathur; "Optics".

P.K. Srivastava; "Optics" (CBS).

B.B. Laud; "Lasers" (New Age).

PART II- ELECTROMAGNETICS

UNIT-I

Electrostatics

Coulomb's law, Electric Field and potentials, Field due to a uniform charged sphere, Derivations of Poisson and Laplace Equations, Gauss Law and its application: The Field of a conductor. Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charge distribution, Electric quadruple, Field due to a quadruple , Electrostatic Energy of a charged uniform sphere, Energy of a condenser.

Magnetostatics

Magnetic field, Magnetic force of a current, Magnetic Induction and Biot-Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid.

UNIT-Il

Electromagnetic Induction

Laws of Induction, Faraday's laws and Lanz's Law. Mutual and Self Induction, Vector potential in varying Magnetic field, Induction of current in continuous media, Skin effect, Motion of electron in changing magnetic field , Betatron , Magnetic energy in field, Induced magnetic field (Time varying electric field), Displacement current, Maxwell's equations, Theory and working of moving coil ballistic galvanometer.

UNIT-III

Dielectrics

Dielectric constant, polarization, Electronic polarization, Atomic or ionic Polarization Polarization charges, Electrostatic equation with dielectrics, Field, force and energy in Dielectrics.

Magnetic Properties of Matter

Intensity of magnetization and magnetic susceptibility, Properties of Dia, Para and Ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination.

UNIT -IV

Electromagnetic Waves

The wave', equation satisfied .by E and B, plane electromagnetic waves in vacuum, Poynting's vector, reflection at, a plane boundary of dielectrics, polarization by reflection and total internal reflection, Faraday effect; waves in a conducting medium, reflection and refraction by the ionosphere

Text and Reference Books

Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (Mc GrawHill). Halliday and Resnik; "Physics", Vol 2.

D J Griffith; "Introduction to Electrodynamics" (Prentice-Hall of India). Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).

A S Mahajan and A A Rangwala; "Electricity and Magnetism" (Tata McGraw-Hill). A M Portis; "Electromagnetic Fields".

Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Welsley).

Panofsky and Phillips; "Classical Electricity and Magnetism" (India Book House). S S Atwood; "Electricity and Magnetism" (Dover).

PART III - ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULAR SPECTRA

UNIT-I

Matter Waves

Inadequacies of classical mechanics, Photoelectric phenomenon, Compton effect, wave particle duality, de- Broglie matter waves and their experimental verification, Heisenberg's Uncertainty principle, Complementary principle, Principle of superposition, Motion of wave packets.

UNIT -II

Schrodinger Equation and its Applications

Schrodinger wave equation Interpretation of wave function, Expectation values of dynamical variables, Ehrenfest theorem, Orthonormal properties of wave functions, One dimensional motion in step potential, Rectangular barrier, Square well potential, Particle in a box, normalization Simple Harmonic Oscillator.

UNIT - III

Atomic spectra

Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p. d, and f states, selection rules. Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt's law. Characteristics X-rays, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

UNIT -IV

Molecular spectra

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra.

Text and Reference Books

H S Mani and G K Mehta; "Introduction to Modern Physics" (Affiliated East-West Press 1989). A Beiser, "Perspectives of Modern Physics".

H E White; "Introduction to Atomic Physics".

Barrow; "Introduction to Molecular Physics".

R P Feymann, R B Leighton and M Sands; "The Feyrnann Lectures on Physics, Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).

T A Littlefield and N Thorley; "Atomic and Nuclear Physics" (Engineering Language Book Society).

Eisenberg and Resnik; "Quantum Physics of Atoms, 'Molecules, Solids, Nuclei and Particles" (John Wiley).

D P Khandelwal: "Optics and Atomic Physics", (Himalaya Publishing House, Bombay, 1988).

PRACTICALS

Every institution may add any experiment of the standard in the subject.

Physical optics

1. Study of interference of light (biprism or wedge film).
2. Study ofF-P etalon fringes.
3. Study of diffraction at a straight edge or a single slit.
4. Use of diffraction grating and its resolving limit.
5. Resolving limit of a telescope system.
6. Polarization of light by the reflection.
7. Study of optical rotation for any system.

Electrostatics

1. Characteristics of a ballistic galvanometer.
2. Setting up and using an electroscope or electrometer.

Moving charges and magnetostatics

1. Use of a vibration magnetometer to study a field.
2. Study of field due to a current.
3. Measurement of low resistance by Carey-Foster bridge or otherwise.
4. Measurement of inductance using impedance at different frequencies.
5. Measurement of capacitance using impedance at different frequencies.
6. Study of decay of currents in LR and RC circuits.
7. Response curve for LCR circuit and resonance frequency and quality factor.

Varying fields and electromagnetic theory

1. Sensitivity of a cathode-ray oscilloscope.
2. Characteristic of a choke.
3. Measurement of inductance.
4. Study of Lorentz force.
5. Study of discrete and continuous LC transmission lines.

Atomic Physics

1. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton).
2. Absorption spectrum of iodine vapour.
3. Study of alkali or alkaline earth spectra using a concave grating.
4. Study of Zeeman effect for determination of Lande g-factor.

Molecular Physics

1. Analysis of a given band spectrum.
2. Study of Raman spectrum using laser as an excitation source

Lasers

1 Study of laser as a monochromatic coherent source

2 Study of divergence of a laser beam

Text and Reference Books

D.P. Khandelwal, “A Laboratory Manual for Undergraduate Classes (Vani Publishing

House, New Delhi).

S.P. Singh, “Advanced Practical Physics” (Pragati Prakashan, Meerut).

Worsnop and Flint- Advanced Practical physics for students.

PHYSICS

B.Sc.- THIRD YEAR

		Max. Marks
PAPER I	RELATIVITY AND STATISTICAL PHYSICS	75
PAPER II	SOLID STATE AND NUCLEAR PHYSICS	75
PAPER III	SOLID STATE ELECTRONICS	75
PRACTICAL	TWO PRACTICALS (50 MARKS) + VIVA (15 MARKS) + RECORD (10 MARKS)	75
TOTAL		300

Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

PAPER I - RELATIVITY AND STATISTICAL PHYSICS

UNIT-I

Relativity

Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether.

Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with a zero rest mass.

UNIT -II

Statistical physics

The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a prior probabilities, probability distribution and its narrowing with increase in number of particles. . The expressions for average properties. Constraints; accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states.

UNIT - III

Some universal laws: The ji- space representation, division of i- space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles. Equilibrium before two systems in thermal contact, bridge with macroscopic physics. Probability and entropy, Boltzmann entropy relation. Statistical interpretation of second law of thermodynamics. Boltzmann canonical distribution law and its applications; rigorous form of equipartition of energy.

UNIT -IV

Maxwellian distribution of0 speeds in an ideal gas: Distribution of speeds and of velocities, experimental verification, distinction between mean, r.m.s. and most probable speed values. Doppler broadening of spectral lines.

Transition to quantum statistics: 'h' as a natural constant and' its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose-Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.

Text and Reference Books

A. Beiser, "Concepts of Modern Physics" (McGraw-Hill).

B B Laud, "Introduction to Statistical Mechanics" (Macmillan 1981).

F Reif, "Statistical Physics" (McGraw-Hill 1988).

K Haung, "Statistical Physics" (Wiley Eastern, 1988).

PAPER II- SOLID STATE AND NUCLEAR PHYSICS

UNIT-I

Crystal Structure

Lattice translation vectors and lattice, Symmetry operations, Basis and Crystal structure, Primitive Lattice cell, Two-dimensional lattice types, systems, Number of lattices, Point groups and plane groups, Three dimensional lattice types, Systems, Number of Lattices, Points groups and space groups. Index system for crystal planes Miller indices, Simple crystal structures, NaCI, hcp, diamond, Cubic ZnS; and hexagonal , Occurrence of Nonideal crysal structures, random stacking of polyprism, glasses.

Crystal Diffraction and Reciprocal Lattice

Incident beam, Bragg law, Experimental diffraction method, Laue method, Rotating crystal method, Powder method, Derivation of scattered 'wave amplitude, Fourier analysis, Reciprocal lattice vectors, Diffraction conditions, Ewald method, Brillion zones, Reciprocal lattice to sc, bcc and face lattices , Fourier analysis of the basis and atomic form factor.

UNIT -II

Crystal Bindings

Crystal of inert gases, Van der Walls-London interaction, repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, ionic crystal, Madelung energy, evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.

Lattice Vibrations

Lattice Heat capacity, Einstein model, Vibrations of monatomic lattice, derivation of dispersion relation, First brillouin zone, group velocity, continuum limit, Force constants, Lattice with two atoms per primitive cell, derivation of dispersion relation, Acoustic and optical modes, Phonon momentum. Free electron theory, Fermi energy, density of states, Heat capacity of electron gas, Paramagnetic susceptibility of conduction electrons, Hall effect in metals. Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Number of orbitals in a band, conductor, Semi-conductor and insulators, Effective mass, Concept of holes.

UNIT - III

Nuclear Physics

1. **General Properties of Nucleus:**

   Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment, Bainbridge mass spectrograph.

2. **Nuclear Forces:**

   Saturation phenomena and Exchange forces, Deutron ground state properties.

3. **Nuclear Models:**

   Liquid drop model and Bethe Weiszacker mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers).

4 Natural Radioactivity:

Fundamental laws of radioactivity, Soddy-Faj an's displacement law and law of radioactive disintegration, Basic ideas about , β and ϒ decay.

UNIT-IV

1. Nuclear Reactions:

Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

2. Accelerators and detectors:

Vande Graff, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter and neutron detectors.

3. Elementary Particles:

Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions).

Text and Reference Books

Pun and Babbar, "Solid State Physics" (S. Chand).

C. Kittel, "Introduction to Solid State Physics"- Vth Edition (John Wiley & Sons). H.S. Mani and G.K. Mehta, "Introduction to Modern Physics" (Affiliated East-West Press— 1989).

A. Beiser, "Perspectives of Modern Physics".

T.A. Littlefield and N. Thoreley, "Atomic and Nuclear Physics" (Engineering Language Book Society). Eisenberg and Resnik, "Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and Particles" (John Wiley).

Ghoshal S.N.- Nuclear Physics - S. Chand & Co.

PAPER III - SOLID STATE ELECTRONICS

UNIT-I

Diffusion of minority carriers in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and semiconductor, p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.C. and D.C. resistance of junction, Reverse Breakdown.

Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

UNIT -II

Transistor parameters, base width modulation, transit time and life-time of minority carriers, Base- Emitter resistance Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic model, hybrid model and Y parameter equivalent circuit, Input and output impedances.

UNIT III

Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation. Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distorsion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

UNIT -IV

Field effect transistors and their characteristics, biasing of FET, use in preamplifiers , MOSFET and their simple uses.

Power Supplies:

Electronically regulated low and high voltage power supplies, Inverters for battery operated equipments.

Miscellaneous:

Basic linear integrated circuits, phototransistors, Silicon Controlled rectifiers, Injunction transistor and their simple uses.

Text and Reference Books

B G Streetman; "Solid State Electronic Devices", UK Edition (Prentice-Hall of India. New Delhi, 1986).

W D Stanley; "Electronic Devices, Circuits and Applications" (Prentice-Hall, New Jersey, USA. 1988).

J D Ryder; "Electronics Fundamentals and Applications" 1jnd Edition\ (Prentice-Hall of India. New Delhi, 1986). I Miliman and A Grabel; "Microelectronics", International. Edition (McGraw-Hill Book Company, New York, 1988).

PRACTICAL

NOTE:

This is a suggested list. Every institution may add any experiment of same standard in the same subject area.

Statistical Physics

1. Data from n-option systems of several relative weightages to be examined and interpreted.
2. Plotting F-D distribution in the neighbourhood of Fermi energy for different temperature values.
3. Solar wind as a thermal expansion of solar corona at one million Kelvin.
4. Study of dilute gas for experimental verification of Maxwell-Boltzman statistics.
5. Number of microscopic states of perfect gas (Gibbs-paradox).

Solid State Physics

1. Goniometric study of crystal faces.
2. Determination of dielectric constant.
3. Hysteresis curve of transformer core.
4. Hall-probe method for measurement of magnetic field

Solid State Devices

1. Specific resistance and energy gap of a semiconductor
2. Characteristics of a transistor
3. Characteristics of a tunnel diode

Electronics

1. Study of voltage regulation system
2. Study of, a regulated power supply
3. Study of Lissajuous figures using a CR0
4. Study of VTVM

5. Study of RC and TC coupled amplifiers

6. Study of AF and RF oscillators

Nuclear Physics

1. Study of absorption of alpha and beta rays.

2. Study of statistics in radioactive measurement.

Text and Reference Books

B.G. Strechman, "Solid State Electronic Devices". II Edition (Prentice-Hall of India, New Delhi, 1986).

W.D. Stanley, "Electronic Devices, Circuits and Applications" (Prentice-Hall, New Jersey, USA, 1988).

D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes (Vani Publishiing House, New Delhi). S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).

Instructions for Paper Setting

All questions carry equal marks.

Section A: One compulsory question with four parts. One part (numerical or short answer type) from each unit.

Section B: Two questions (long answer or numerical type) from each unit but only one question from each unit is to be attempted.

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Introduction to Statistics, Meaning of Statistics, Importance of Statistics, Scope of Statistics in Industry, Introduction and contribution of Indian Scholars in Statistics. Concept of Statistical population, Attributes and Variables (Discrete and Continuous), Different types of scales – Nominal, Ordinal, Ratio and Interval, Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency, Secondary data.

I.

Presentation of data : Classification, Tabulation, Diagrammatic & Graphical Representation of Grouped data, Frequency distributions, Cumulative frequency distributions and their graphical representations, Histogram, Frequency polygon and Ogives, Stem and Leaf plot, Box Plot.

II.

Measures of Central tendency and Dispersion and their properties, Merits and Demerits of these Measures. Moments, Shephard's correction for moments, Measures of Skewness and Kurtosis and their significance, Measures based on quartiles.

V

Bi-variate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's Correlation Coefficient and its properties. Spearman Rank correlation and its coefficient, Regression analysis through both types of regression equations for X and Y variables.

Random experiment, Trial, Sample point and Sample space, Events, Operations of events, Concept of equally likely, Mutually exclusive and Exhaustive events. Definition of Probability: Classical, Relative frequency and Axiomatic approaches. Discrete Probability Space, Properties of Probability under Set Theory Approach, Independence of Events, Conditional Probability, Total and Compound Probability theorems, Bayes theorem and its Applications.

I

Random Variables – Discrete and Continuous, Probability Mass Function (pmf) and Probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, Marginal and Conditional distributions,

II.

Independence of random variables. Expectation of a random variable and its properties,Expectation of sum of random variables and product of independent random variables, Conditional expectation and related problems.

V

Moments, Moment generating function (m.g.f.) & their properties, Continuity theorem for m.g.f. (without proof). Chebyshev's inequality, Characteristic Function, Cumulants and c.g.f, Weak law of large numbers for a sequence of independently and identically distributed random variables and their applications. (Statement Only)

Study with examples and applications of uniform, Binomial, Poisson , Geometric distributions. Their means, variances, measures of skewness, characteristics functions, moment and probability generating functions, rth descending factorial moments and mode. The various important properties with their proofs related to these distributions including truncated and compound.

Generations and applications of Negative Binomial, Multinomial and hyper geometric distributions. Their characteristics functions, moment and probability generating functions and descending factorial moment. Mean vectors, variance covariance matrix, marginal and conditional distributions of multinomial. Limiting compound and mode of negative binomial and hyper-geometric distributions. Theory of exceedency of hyper-geometric distribution.

Distributions of rectangular, exponential, Gamma, Beta, Cauchy and Log normal with their properties including proofs. Their mean variance, and characteristic functions. The characterizations related to above distributions along with their truncated and compound.

Sampling distributions of mean and variance, student's t, z, F and sample correlation coefficient (r) when population correlation is zero. Their means, variances, measures of skewness, characteristics and moment generating functions, limiting distributions and important properties with their proofs.

Bivariate normal distribution with its applications and important properties. Standard bivariate normal distribution. Development of the formula of recurrence relation for moments and other important related problems to this distribution. Distributions of order statistics, sample range, sample median, joint distributions of rth & sth order statistics. Distributions of minimum and maximum observations. Curve fitting by Orthogonal Polynomials.

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consistency, unbiasedness, efficiency, sufficiency and completeness, Crammer Rao-Inequality its applications and examples, Characterization of distribution admitting sufficient statistics, Rao-Blackwell theorem and Lehman-Scheffe' theorem, Uniformly minimum variance unbiased estimation.

I :

Method of maximum likelihood, Moments, Minimum Chi-Square, properties of M.L.E, existence of a best asymptotically normal estimate under regulatory conditions, Hazor Bazar theorem.

II :

Simple & Composite Hypothesis, Concept of Critical Regions, Test Functions, Two Types of Error, Power of the Test, Level of Significance, Neyman-Pearson Lemma & its Generalization, Uniformly Most Powerful Tests, UMP Test of One-sided Hypothesis for Distributions with Monotone, Likelihood Ratio Test, Randomized Tests, UMPU, Critical Regions

Census and sample surveys, advantages and disadvantages of sample surveys, Limitations of sampling, Basic principles of sample survey, Principle steps in sample survey, Sampling and non-sampling errors, Inter-penetrating, Sub-samples, Pilot survey.

I

Simple random sampling, Sampling from finite populations with and without replacement, Unbiased estimation and confidence intervals for population mean and total, Simple random sampling of attributes.

II

Reasons for stratification , choice of strata , choice of sampling unit, stratified random sampling, estimation of population mean and its variance, choice of sample sizes in different strata, variances of estimates with different allocation, effects of deviation from optimum allocations, estimation of the gain in precision due to stratification, cost function, construction of strata.

V

Estimation of sample mean and its variance, comparison of systematic sampling with simple random and stratified sampling.

Ratio and regression methods of estimation, variances of the estimates, optimum property of ratio estimates, comparison among ratio and regression and simple and biased estimates.

Estimates of mean and its variance for equal and unequal clusters, efficiency in terms of intra- class correlation, optimum unit of sampling,sampling with replacement, estimation of mean and its variance.

Sampling techniques with varying probabilities for simple random sampling with and without replacement.

Introduction of Multistage sampling, Two stage sampling with equal stage units, Estimation of its mean and variance

Analysis of Variance, One-way ANOVA, Two-way ANOVA and Three-way ANOVA with their layout and statistical analysis, Analysis of Covariance for a oneway layout with concomitant variable, Analysis of Covariance for a RBD layout with concomitant variable.

Principles of design of experiments, Uniformity trials, completely randomized, Randomized block and Latin square designs including missing plot techniques and their efficiency comparison, Split plot and strip plot designs

Factorial experiments ($2^2, 2^n$, 3^2, 3^3 systems only), Complete and Partial confounding, balanced incomplete block designs with parametric relations and analysis under a fixed effect model.

Practical Based on above theory papers

Probability Integral Transformation, Estimation Of Quantiles, Construction of Confidence Interval for Population Quantiles, Estimation & Testing, Test for Randomness, Test based on Runs & Sign for one & two samples problems, Median test, Wilcoxon and Mann-Whitney tests. Kolmogorov-Smrinov test for one and two samples.

Understands the concepts of finite differences. Define forward backward and shift operator and various other basic concepts of operators. Define forward and backward difference and their applications. Find the difference of polynomial. Define Newton forward and backward difference and their applications. Solve problems using Newton forward formula and Newton backward formula. Gains knowledge about to interpolation for equal intervals Study the concepts of interpolation for unequal intervals. Define Interpolation and various kinds of Interpolation formulae. Derive Gauss's formula and Stirling formula using Newton forward formula and Newton backward formula. Find intermediate values by using Newton's forward and backward formula and Lagrange's formula. Learn about various interpolating and extrapolating methods.

Define divided difference and its application. Learn Newton divided difference and its application. Obtain numerical solutions of algebraic and transcendental equations. Find numerical solutions of system of linear equations and check the accuracy of the solutions. Solve initial and boundary value problems in differential equations using numerical methods. Derive Simpson's 1/3 ,3/8 rules using trapezoidal rule and their application. Find the solution of ordinary differential equation of first by Euler, Taylor and Runge-Kutta methods

Objects, Decomposition, Tests of Randomness, Trend component, polynomial, logistic, Gompertz, Log-normal trend functions, smoothing of moving average , spencer's formulae and effects, Slutsky-yule effect, variate difference method, Measurement of seasonal and cyclical functions, peridogram and Harmonic Analysis.

Distribution of Income, Income and Demand elasticities. Method for estimating elasticities using family budget data and time series data, Engel's Curve and Engel's law.

Sources of Demographic data, Limitations and uses of demographic data, vital rates and ratios, Definition, construction and uses, life tables, complete and abridged construction of life table from vital statistics and census returns, uses of life tables. Logistic and other population growth curves, Measure of fertility gross and net reproduction rates, stationary and stable population theory. Uses of Lotka's stable population theory in estimation of demographic parameters, methods of inter-censal and post-censal estimation.

Concept of quality and meaning of control, Product and Process controls. Concept of 3-sigma limits. Modified and Specifications limits.Different types of control charts like `X, R, np, p and c with their applications in industry. 100% inspection sampling, sampling inspection v/s 100% inspection. Single, Double, Multiple and sequential sampling plans for attributes. OC, AOQL, ASN and ATI curves. Concept of producer's and consumer's risk.

Analyze and solve linear programming models of real life situations. Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points. Define basic feasible solutions, Slack and Surplus variable. Understand the theory of the Simplex Method. Explain simplex method. Demonstrate Big-M method. Illustrate two phase method. Prove dual of the dual is primal. Interpret dual simplex method. Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.

Define transportation problem. Find a basic feasible solution to the transportation problem by using North West corner rule, Vogel's approximation method. Apply Modi method to solve transportation problem.

Illustrate Assignment problem and travelling salesman problem. Learn about the applications to transportation,

Computer Fundamentals: Overview of computer system, block diagram of computer, Types of Computers. Micro, Mini etc., Generations of computers, Memory- primary and secondary memory devices, ROM, RAM, Computer Hardware, Software and firm ware, CPU, Various input and output devices , flowcharts and their symbols, Algorithms. High and Low level languages with examples, System Software and application software, Compilers and interpreters, operating systems. Learn about the computer network and various like: LAN, WAN etc. Learn about the Internet and Intranet and related term used in the computer communication. Some useful statistical packages.

Basic features of C++ language, constants and variables, Arithmetic and logical operators, Arithmetic and logical expressions, input-output statements, control statements, branching and looping, Do statement, formal specifications, Arrays, user and system defined functions, Subroutine sub-programmes. C++ Programs For: Statistical Methods: Measures of central tendency and dispersion, moments, correlation, regression, curve fitting for given data.

Practical Based on above theory papers

Chaudhary Charan Singh University, Meerut

Syllabus of Zoology (B.Sc. I, II, & III year)

Following Major title of papers of B.Sc. I, II, and III were finalized with their contents:

B.Sc. I		
Papers	**Title of paper**	**Max. Marks**
Paper I	Lower Non Chordata *(Protozoa- Helminths)*	50
Paper II	Higher Non Chordata *(Annelida-Echinodermata)*	50
Paper III	Cell Biology and Genetics	50
Practical	Practical Syllabus based on theory papers	50

B.Sc. II		
Papers	**Title of paper**	**Max. Marks**
Paper I	Chordata	50
Paper II	Animal distribution, Evolution and Developmental Biology	50
Paper III	Physiology and Biochemistry	50
Practical	Practical Syllabus based on theory papers	50

B.Sc. III		
Papers	**Title of paper**	**Max. Marks**
Paper I	Applied and Economic Zoology	75
Paper II	Biotechnology, Immunology, Biological Tools & Techniques and Biostatistics	75
Paper III	Ecology, Microbiology, Animal Behavior, Pollution and Toxicology	75
Practical	Practical Syllabus based on theory papers	75

Unified Syllabus of Zoology for U.P.State Universities
Subject- Zoology
B.Sc. - First Year
Practical

1-	Dissection (Major)	12 Marks
2-	Dissection (Minor)	05 Marks
3-	One Temporary Mount	03 Marks
4-	One Permanent Mount	05 Marks
5-	Cytology & Genetics Preparation/Prepared slides	05 Marks
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	*Viva-Voce*	05 Marks
7-	Practical class record	05 Marks
	Total	**50**
	Marks	

Unified Syllabus of Zoology for U.P.State Universities

Subject- Zoology
B.Sc. -Second Year
Practical

1-	Dissection (Major)	10 Marks
2-	Permanent Mount	05 Marks
3-	Comment upon Physiology Apparatus	05 Marks
4-	(i) Suitable preparation of Hemin crystals from the blood (ii) Detect the Sugar /albumin / acetone from urine sample	05 Marks
5-	Stained Preparation of (i) Striped or Unstriped muscles (ii) Cartilage (hand cut Section) (iii) Blood film/Aereolar tissue	05 Marks
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	*Viva-Voce*	05 Marks
7-	Practical class record	05 Marks
	Total	**50**
	Marks	

Unified Syllabus of Zoology for U.P.State Universities

Subject- Zoology
B.Sc. - Third Year
Practical

1-	Dissection (Major)	12 Marks
2-	Permanent Mounting	06 Marks
3-	Temporary Mounting	05 Marks
4-	Identify and Comment upon Spots (1-8)	16 Marks
5-	Economic Zoology *(Comments on a suitable Specimen/ life cycle of Silk worm, Honey bee, Lac insect & Food Fishes)* (02)	06 Marks
6-	Biological Tools and Techniques *(Comment)*	06 Marks
7-	Biostat / Microbiology / Immunology / Behavior	06 Marks
8-	Ecology/ Pollution/ Toxicology (Exercise or Comment	06 Marks
9-	*Viva-voce*	06 Marks
10-	Practical Class record / Project / Collection	06 Marks

Total **75**

Marks

Unified Syllabus of Zoology for U.P. State Universities
B.Sc. Part I, II & III

There will be three written papers and one practical examination.

Question No. 1 in each class will be compulsory & comprehensive based on units I to IV and of short Answer type. This will carry 40% of total marks *(i.e. 20 marks in I & II year and 30 marks in III year).* There will be two questions from each unit carrying 60% of the marks, of which one question from each unit has to be attempted.

B.Sc. Part I

Paper I- Lower Non Chordata (*Protozoa to Helminths*)

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

Unit-I

Protozoa - *Euglena*, *Monocystis* and *Paramecium.*

Unit-II

Porifera - *Sycon*

Unit-III

Coelenterata - *Obelia* and *Aurelia*
Ctenophora - Salient features

Unit-IV

Platyhelminthes - *Fasciola* (liver fluke) and *Taenia* (tape worm)
Nematehelminthes - *Ancylostoma* (hook worm)

Paper II- Higher Non Chordata (*Annelida to Echinodermata*)

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

Unit-I

Annelida - *Nereis*

Unit-II

Arthropoda - *Palaemon* (prawn)

Unit-III

Mollusca -*Pila* (apple-snail)

Unit-IV

Echinodermata -*Pentaceros* (excluding development)

Paper III- Cell Biology & Genetics

Unit-I

Cell Biology I: Structure and function of cell, Ultra structure of Plasma membrane

Unit-II

Cell Biology II: Structure and function of cell organelles with special emphasis on mitochondria, golgi bodies, nucleus, ribosome and endoplasmic reticulum.

Unit-III

Genetics-I: Structure of Chromosomes, Watson & Crick Model of DNA, Differences between DNA & RNA, Cell Division: Mitosis and Meiosis. Mendel's principles of heredity on chromosomal basis, Monohybrid cross, test cross, dihybrid cross, back cross incomplete dominance, Multiple Alleles, Blood group inheritance. Linkage and crossing over, interaction of genes. The role of DNA in heredity.

Unit-IV

Genetics II: Sex determination, sex differentiation, prenatal detection of genetic diseases (amniocentesis), Sex-linked characters, Genetic diseases and abnormalities, chromosomal aberrations, Eugenics.

B.Sc. Part I
ZOOLOGY PRACTICAL SYLLABUS

PROTOZOA

(a) **Amoeba :** Examination of culture. Prepared Slide *Amoeba proteus* and *A. verrucosa*.

(b) **Euglena :** Culture examination for *Euglena.* Prepared slides.

(c) **Monocystis** : Examination of contents of seminal vesicles of *Pheretima* or *Eutyphoeus* for different life- history stages and permanent preparation. Prepared slides.

(d) **Plasmodium :** Preparation of blood film (Leishmen's stain). Prepared slides showing the parasites.

(e) **Paramecium**
Culture examination.

(f) Demonstration of ciliary movements in *Paramecium.*
Addition to mucilage to restrain active movement. Treatment with Methyl green for staining. Feeding experiment with Congo Red and Yeast. Trichocysts (discharged), Prepared slides for structure, binary division and conjugation.

(g) Examination of pond water for different kinds of protozoa with special reference to *Arcella* and *Vorticella.*

(h) Study of prepared slides **:**
Polystomella, Gregarina, Trypanosoma and Noctiluca.

(i) Examination of rectal protozoans *Opalina, Balantidium* and *Nyctotherus.*

PORIFERA

(a) **Sycon**

General characters

Spicules glycerine preparation.

Transverse and longitudinal sections-prepared slides.

(b) Gemmule of *Spongilla* permanent preparation.

(c) Different kinds of spnge spicules and sponging fibres of *Euspongia*-prepared slides.

(d) *Euplectella* (Venus,s flower-basket) *Spongilla* (fresh-water sponge), *Euspongia* (bath sponge).

COELENTERATA

(a) **Hydra**
Live specimens.
Prepared slides of entire specimens.
Longitudinal and transverse sections-prepared slides.

(b) **Obelia**
Clolony-prepared slide.
Medusa-prepared slide.

(c) **Aurelia**
General morphology.
Tentaculocyst-prepared slide.
Prepared slides and models of life-history stages.

(d) ***Physalia*** (Portguese man of war), *Corallium* (red coral), *Fungia* (Mushroom coral), *Madrepora* (staghom coral), *Pennatula* (sea pen), *Sagartia* of *Metridium* (sea anaemone)

PLATHYHELMINTHES :

(a) **Fasciola**
Specimens *in situ* and prepared slides.
Transverse sections and prepared slides.
Larval forms-prepared slides.

(b) ***Taenia*** **:** Prepared slides of scolex, mature and gravid proglottids and transverse section of mature proglottid.

(c) *Planaria, Polystomum, Paramphistomum, Schistosma, Echinococcus* and *Dipylidium* Cysticercus (Bladder worm) and Cysticercoid.

(d) Examination of type worms of pigeon of fowl *in situ*

(e) Permanent preparation of mature and gravid proglottids of *Cotugnia* and *Raellietina.* **:**

NEMATHELMINTHES

(a) ***Ascaris***

External characters.
Dissected specimens of male of female.
Transverse section of male and female-prepared slides.

(b) *Ascaris lumbricoides* (from man) specimens *Enterobius vermicularisi* (from man).
Ancylostoma duodenale *(from man)* prepared slides.

ANNELIDA

(a) ***Nereis***

External characters.
Dissected specimens.
Parapodium-permanent preparation.
Transverse sections-prepared slides.

(b) ***Pheretima***

External characters.
Dissection.
Glycerine preparations of setae *in situ* and brain.
Permanent preparations of ovary and septal nephridia.
Prepared slides of transverse section through various regions.

(c) *Heteronereis, Arenicola, Aphrodite, Eutypoeus, Dero, Branchellion, Haemadipsa, Bonellia* (female).

ARTHROPODA

(a) ***Palaemon***

External characters; Examination of appendages.
Dissections.
Glycerine preparation of hastate plate.
Permanent and glycerine preparations of statocysts.

(b) ***Periplaneta***

External characters. Differences between nmale and female.
Dissections.
Cirulation of blood in the wing of cockroach.
Glycerine preparation of mouth appendages, salivary glands and trachea.
Permanent preparations of salivary glands, Malpighian tubules, ovaries and testes.

(c) ***Anopheles* and *Cules***

Glycerine preparation of mouth parts of male and female. Wings-prepared slides.
Life history-prepared slides.
Difference between *Anopheles* and *Culex*

(d) ***Musca***

External characters.
Glycerine preparation of proboscis

(e) *Daphnia, Cyclops, Balanus, Eupagurus* (hermit crab) *Scylla* (crab), *Sacculina* (on crab). Larval forms Nauplius, Zoaea), *Lepisma* (Silver fish), *Schistocerca* (locust), O*dontotermes*
(white ant), Cimex (bed bug), Pediculus (louse), *Papilio* (butterfly), *Bombyx* (Silk moth), *Apis* (honey- bee), Polistes (wasp), *Camponotus* (Black ant), *Xenopsylla* (rat flea), or *Ctenocephalus* (dog flea), *Thyroglutus* (millipede), *Scolopendra* (centipede). Lycosa (wolf-spider), *Lxodes* (trick), *Limulus* (King carb).

MOLLUSCA

(a) ***Lamellidens***

External characters
Dissection
Permanent preparations of gill lamella.
Transverse section through middle region of body-prepared slides.
Glochidium (larva) prepared slides.

(b) ***Pila***

External characters.
Dissection.
Permanent preparations of gill lamella and osphradium.

(c) Chiton, *Teredo, Turbinellai* (Shankh), *Laevicaulis* (slug), *Doris, Aplysia, Dentalium Nautilus, Sepia* and *Margaritifera* (Pearl Oyster).

ECHINODERMATA

(a) ***Pentaceros:***

External characters
Dissected specimens.
Pedicellaria-prepared slides.
Transverse section of arm-prepared slide.

(b) ***Echinus*** (Sea urchin), *Ophiothrix* (brittle star), *Holothuria* (sea cucumber) and *Antedon* (feather star).

CYTOLOGY

(a) Cell-Structure – Prepared slides

(b) Cell Division – Prepared slides

(c) Preparation of giant chromosomes

(d) Preparation of onion root tip for the stages of mitosis

B.Sc. Part II (THEORY) Zoology

There will be three written papers and one practical examination. The following courses are prescribed.

Paper I: Chordata

Unit- I

Hemichordata: Classification and detailed study (habit, morphology, anatomy, physiology and development) of *Balanoglossus*

Cephalochordata: Classification and detailed study (habit, morphology, anatomy and physiology) of *Branchiostoma* (*Amphioxus).*

Unit -II

Urochordata: Classification and detailed study (habit, morphology, anatomy, physiology and post embryonic development) of *Herdmania*

Unit-III

Classification of different classes of vertebrates (**Pisces, Amphibia, Reptilia**,) up to order with characters and examples. Poisonous and non poisonous snakes and biting mechanism. Neoteny

Unit-IV

Classification of different classes of vertebrates (**Aves and Mammalian**) up to order with characters and examples. Dentition in mammals.

Paper II: Animal distribution, Evolution and Developmental Biology

Unit-I

Animal distribution: Geological and geographical distribution with their characteristic fauna; fossils.

Unit-II

Origin of Life, concept of species (classical & modern concept)

Evolution: Evidences (including physiological and serological); Theories of evolution (including Neo-Lamarckism, Darwin-Wallace theory of natural selection, Neo-Darwinism, Modern synthetic theory). Evolution of Man. Mutation

Unit-III

Developmental Biology I:Aims and scope of Developmental Biology.
Gametogenesis, Fertilization, Egg: structure and types.
Types & patterns of cleavage

Unit-IV

Developmental Biology II: Process of Blastulation & Gastrulation. Fate Map.
Development of Chick up to formation of Primitive streak and mammal (*in out line*)
Extra embryonic membranes of chick.
Placentation and types of Placenta.

Paper III: Physiology and Biochemistry

General physiology (in outline) with special reference to mammals

Unit-I

Physiology of digestion, respiration, and blood and circulation

Unit-II

Physiology of excretion and osmoregulation, neural transmission, muscles

Unit-III

Physiology of endocrine system, thermoregulation

Unit-IV

General chemistry and classification of carbohydrates, lipids and proteins; Enzymes

B.Sc. Part II

ZOOLOGY PRACTICAL SYLLABUS

Urochordata

(a) Herdmania

(i) External characters
(ii) Dissection
(iii) (a) Permanent preparation of branchial wall
(b) Section of test and glycerine prepration of spicules.
Glycerine and permanent prepration on neural gland complex (neural gland, nerve ganglion and dorsal tubrcele).
(iv) Larva and metamorphosis- prepared slides.

(b) (i) Thaliacea : *Pyrosoma, Doliolum*
(ii) Larvacea : *Oikopleura* .

Cephalochordata

Branchistoma *(Amphioxus)*

(i) General features
(ii) (a) Permanent prepration of the pharyngeal wall
(b) Oral hood and velum- prepared slides
(c) Transverse section through the body – prepared slides.
(d) Models illustrating development

Cyclostomata

Petromyzon (Lamprey) - External characters

Chondrichthyes

(a) Fish

(i) External characters
(ii) Exo-skeleton Glycerine and permanent preparation of placoid scales
(iii) Myotomes
(iv) Endoskeleton

(1) Axial skeleton
(a) skull
(b) Visceral Skeleton
(c) Vertebral column

(2) Appendicular skeleton
(a) Pectoral girdle and fins
(b) Pelvic girdle, fins and claspers
(c) Median fins

(v) Dissection
(a) Digestive system
Examination of the folds of stomach and " scroll valve"
(b) Vascular system

Heart, ventral aorta, dorsal aorta, arterial arches (afferent and efferent)

(c) Gills
(d) Urinogenital system
(e) Nervous system : Cranial nerves
(f) Internal ear
(g) Eye muscles
(h) Permanent preparation of ampullae of Lorenzini
(i) Section through various regions of the body of adult and embryo
(j) Embryo with yolk-sac placenta

(b) *Pritis* (Saw fish), *Astrape* (Indian electric ray) *Chimaera* (rabbit fish) Slide showing development of placoid scales.

Osteichthyles

(a) *Labeo rohita* (rohu)- General morphology and dissected specimen.
(b) *Acipenser* (sturgeon), *Lepiodosteous* (gar-pike), *Hippocampus* (sea hourse) *Antennarius* (Indian angler), *Angulla* (eel), *Pleuronectes* (sole), *Exocoetus* (flying fish), *Clarius* (cat fish), *Anabas* (climbing perch) and *Neoceratodus* (lungfish).
(c) Different kinds of scales- prepared slides

Amphibia

(a) *Rana tigrina* (The Indian bull-frog)
Development of frog from modles
(b) Urodela :
Necturus, Ambystoma and Axolotal larva
(c) Anura :
Bufo, Rhacophorus (tree frog), *Alytes* (midwife toad).
(d) Gymnophiona : *Ichthyopnis*

Reptillia

(a) *Varanus*
(i) External characters
(ii) Skeleton

(1) Axial Skeleton
(a) Skull
(b) Vertebral column
(c) Ribs and sternum

(2) Appendicular Skeleton
(a) Pectoral girdle and fore-limb.
(b) Pelvic girdle and hind-limb.

(b) ***Lacertilla***
Varanus (Indian monitor), *Holoderma* (poisonous lizard) *Hemidactylus* (wall lizard),*Chamaeleon* (garden lizard) *Draco* (flying lizard).

(c) ***Ophidia***
Difference between poisonous and non-poisonous snakes, *Naja* (cobara), *Vipera* (viper), *Typhlops* (burrowing snake) and *Python*. Biting mechanism of a poisonous snake (model).

(d) Chelonia : Derman armature
(e) Crocodilia : Difference between Alligator, Crocodile and Gavialis.
(f) Extinct reptiles, Models (five)
Dimetrodon, Diplodocus, Pteranodon, Tyrannosaurus* and *lchthyosaurus

Aves

(A) ***Columba livia intennedia*** **(pigeon)**

(i) Esternal Characters. Structure of Feather. Varieties of feathers. Developments of feather-prepared slide.

(ii) Skeleton of fowl Axial skeleton:

(a) Skull

(b) Vertebral column

(c) Ribs and sternum

(2) Appendicular skeleton.

(a) Pectoral girdle and fore-limb

(b) Pelivic girdle and hind-limb.

(B) (i) Archaeornithes-Archaeopteryx (cast)

(ii) Neornithes:

(a) Palaeognathae: ***Struthio*** (ostrich);

(b) Neognathae: ***Gallus*** (fowl), ***Anser*** duck, ***Corvus*** (crow) , ***Psuttacuka*** (parrot) and ***Pavo*** (peacock).

Perching mechanism: Model

Skulls and Beaks of Birds.

Feet of birds: Models

(C) Embryonic membrances-whole mount of 72 hour's chick embryo

Mammalia

(A) (i) Prototheria: *Ornithorhynchus* (Platypus)

(ii) Metatheria *: Macropus* (Kangaroo).

(iii) Eutheria :

(a) Edentata: *Dasypus* (Armadillo)

(b) Pholidota: *Manis* (Scaly ant-eater).

(c) Cetacea: *Platanista* (Ganges dolphin).

(d) Perissodactyla: *Equus cabalus* (horse), *Equus vulgaris* (ass), *Equus zebra* (zebra), *Rhinoceros unicornis* (rhinoceros).

(e) Artictyla: *Camelus dromedaries* (A rabian camel), *Giraffa camelopardalis* (giraffe) Box (ox), *Ovis* (sheep), *Capra* (goat), *Cervus* (deer), *Sus* (dog).

(f) Proboscidea: *Elephas indicus* (elephant).

(g) Carnivora: *Felis domesticus* (Cat), *Panthera leo* (lion), *Acinonyx tigris* (Cheetah), C*anis familiari* (dog), *Ursus* (bear) *Hyaena* (hyanea), *Phoca* (seal)

(h) Rodentia: *Mus* (domestic rat), *Hystrix* (Porcupine)

(i) Lagomorpha: *Lepus* and *Oryctolagus* (hare and rabbit)

(j) Insectivora: *Erinaceu*s (hedge-hog), *Crocidura* (chhachhundar)

(k) Chiroptera: *Pteropus* (Flying-fox).

(l) Primates: *Macaca* (rhesus monkey), *Hylobates* (gibbon), *Simia* (Orang-utan), *Anthropo pithecus* (chimpanzee), *Gorilla, Homo sapiens* (man).

Histology

(i) Tissues: Preparation of the following
(a) Epithelia:
(i) Squamous (ii) Ciliated and (iii) Stratified
(b) Muscular:
(i) Striped muscles (ii) Unstriped muscles.
(c) Connective
(i) Areolar tissue (ii) Tendon the leg muscles of frog (tease and examine in glycerine)
(ii) Adipose tissue from insect and frog (iv) cartilage (free hand sections of frogs hyoid and suprascapula, train with haematoxyline and (v) Bone (Decalcified).
(d) Blood; Preparation of Vertebrate blood film, stain with Leishmann's stain.
(e) Nervous: Neurons
(f) Histology of various organs-prepared slides.

Physiology

(i) Experiments to be performed by candidates: Test for amylase. Osmolarity of blood, Hemin crystals and test for sugar and acetone in urine Determination of haemoglobin % in blood sample (s).
(ii) Detection of amino acids in blood of an animal by paper chromatography.

General :
Candidates will be required, to show knowledge of the method of microscopic techniques and to examine, describe or dissect the types prescribed. Candidates will also be required to submit their notebooks containing a complete record of laboratory work initiated and dated by the teacher for the determination of result of examination.

B. Sc. Part III (THEORY) Zoology

There will be three written papers and one practical examination. The following courses are prescribed.

PAPER-I Applied and Economic Zoology

Unit-I

Parasitology:

(a) Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: *Trypanosoma, Giardia and Wuchereria,*

Unit-II

Vectors and pests: Life cycle and their control of following pests:
Gundhi bug, Sugarcane leafhopper, Rodents.
Termites and Mosquitoes and their control

Unit-III

Animal breeding and culture: Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture, Lac-culture.

Unit-IV

Wild Life of India: Endangered species. Important sanctuaries; national parks of India; Different projects launched for the preservation of animal species; *in-situ* and *ex-situ* conservation of wild life.

PAPER-II Biotechnology, Immunology, Biological Tools and Techniques and Biostatistics

Unit-I

Biotechnology: Genetic Engineering (concept and recombinant DNA technology) and its application in agriculture & medical areas and energy production. Biotechnology of food-processing, pharmaceuticals (e.g. use of microbes in insulin production) and fermentation.

Unit-II

Immunology. Concepts of immunity, types of immunity, Antigen and Antibodies, vaccines of different diseases and immunological reactions.

Unit-III

Biological Tools and Techniques: Principles and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer & Centrifuge.
Microscopy (light, transmission and scanning electron microscopy)
Chromatography and Electrophoresis.

Unit-IV

Biostatistics: Sampling, Measures of central tendency (mean, median and Mode) and dispersion (variance, standard deviation and standard error); Correlation and Regression

PAPER-III Ecology, Microbiology Animal Behavior and Pollution and Toxicology.

Unit- I

Ecology: Ecosystem: Concept, components, fundamental operations, energy flow, food-chain, foodwebs and trophic levels, ecological niche, abiotic and biotic factors. Population: Characteristics and regulation. Ecological succession. Adaptation: Aquatic, terrestrial, aerial and arboreal.

Unit-II

Microbiology: Morphology, physiology and infection (outline) of bacteria and viruses. Bacterial and viral diseases.

Unit-III

Animal Behavior: Introduction to Ethology, Patterns of behavior (taxes, reflexes, instinct and motivation); biorhythms; learning and memory, Migration of fishes & birds.

Unit-IV

Pollution and Toxicology: Concept, sources, types (air, water, soil, noise & radiation), and control of environmental pollution. Exposure of toxicants (routes of exposure, and duration and frequency of exposure); dose -response relationship categories of toxic effects.

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B.Sc. Part III
ZOOLOGY PRACTICAL SYLLABUS

Permanent Preparation of: *Euglena*, *Paramecium* and rectal protozoans from frog.

- Stool examination for different intestinal parasites.
- Study of prepared slides/ specimens of *Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Paramphistomum, Schistosoma, Echinococcus, Dipylidium, Enterobius, Ascaris and Ancylostoma*;

Permanent Preparation of *Cimex* (bed bug)/ *Pediculus* (Louse), *Haematopinus* (cattle louse), fresh water annelids, arthropods; and soil arthropods.

- Larval stages of helminths and arthropods.
- Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatid insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.
- Collection and identification of pests.
- Life history of silkworm, honeybee and lac insect.
- Different types of important edible fishes of India.
- Prepared slides of plant nematodes.
- Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter
- Microbiological Techniques: Media Preparation and sterilization, inoculation and Monitoring.

Study of an aquatic ecosystem, its biotic components and food chain.

- Preparation of chromosomes, Test for carbohydrate Photochemical demonstration of proteins and lipids, using hand sections using hand sections, endocrine glands (Neurosecretory cells) of cockroach.

Demonstration of developmental stages of chick.

- Project Report/ model chart making.

Dissections :

- **Cockroach** : Central nervous system
- ***Wallago*** : Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.
- Practical exercises based on Biostatistics, Microbiology, Immunology, Biotechnology, Animal Behavior, Pollution & Toxicology.

I Sem. J. 1005

(2)

Code No-105

Course – I Modern Concepts of Crop Production

Crop growth in relation to environment, agroecological zones of India; concepts of potential yield and it's realisation; modern concepts in tillage: zero or minimum, conservation tillage etc., optimisation of plant population and planting geometry in relation to soil fertility, solar radiation and available moisture regimes: Mitscherlich, Baule and Inverse-yield-nitrogen laws, biotic and abiotic stresses; concept of ideal plant type; crop modelling for maximixing crop yield; crop response production functions; cropping and farming systems for sustainable agriculture; organic farming-crop residue recycling and management; crop production under protective agriculture, precision agriculture, crop and growth analysis.

Practicals

Field exercises on zero or minimum and conservation tillage, calculation of available soil moisture, fitting of response curves and working out optimum economic dose of fertilisers, leaf area measurement, determining RGR, LAR, VLR, RLGR, NAR, SLW, LAI, LWR, CGR, HI & LAD. Visit to various farms related to organic farming and report submission.

Suggested Readings

Baker C.J., Saxton K.F. and Ritchie W.R. 1998. No Tillage Seeding- Science and Practice. CAB International, UK.

Carroll P.W. 1961. Crop Adaptation and Distribution, Eurasia Pub., New Delhi

Gardner F.P., Pearce G.R. and Mitchell R.L. Physiology of Crop Plants, Scientific Pub. Jodhpur.

Lal R. Tillage system in the Tropics-Management Options and Sustainability Indicators FAO, Rome.

Palaniappan S.P. and sivarama K. 1996. Cropping Systems in the Tropics- Principles and Management. Newage International Pub. P211.

Reddy K.R. and Hodges H.R. Climate Change and Global Productivity. Cabi Pub.

Reddy S.R. 2000. Principles of Agronomy. Kalyani Pub., New Delhi. pp 458.

Reddy S.R. 2000. Principles of Crop Production. Kalyani Pub., New Delhi. pp 428.

Sankaran S.and Mudaliar T.V.S. Principles of Agronomy. The Bangalore Printing & Pub. Bangalore.

Ramana 22/7/03

22/7/03

(3)

I Sem.

Code No-106

Course – II Agronomy of Kharif Crops

Origin, history, distribution, adaptation, classification, morphology, phenology, physiology, varietal improvement and production technology of rice, maize, sorghum, millets, pigeon-pea, mungbean, urdbean, groundnut, soybean, cotton, jute, sunhemp and other important regional crops of the area; Quality components and industrial uses of the main and by-products and their post-harvest handling for marketing.

Practicals

Seed bed preparation for kharif crops, sowing methods, calculations based on ploughing of field, selection and treatment of seed, estimation of seed rate, fertilizer requirement, identification and control of weeds, cropping scheme, rotational and cropping intensity, rapid plant tissue tests, study of various crops grown on research farm and adjoining farmer's fields, observations on plant growth and yield characteristics, yield estimation, judging of maturity and determination of harvesting stage and estimation of cost of cultivation.

Suggested Readings

Das P. C. 1997. Oilseed Crops of India. Kalyani Pub. , New Delhi. pp 273

Pal M., Deka J. and Rai R. K. 1996. Fundamentals of Cereal Crop Production. Tata Mc-Graw Hill Pub. , New Delhi. pp 400

Prasad R. (eds) 1999. A text book of rice Agronomy. Jain Brothers, New Delhi. pp 238

Prasad R. (eds) 2001. Field Crop Production. ICAR, New Delhi.

Singh C. 1983. Modern Techniques of Raising Field Crops. Oxford & IBH, New Delhi. pp 523

Singh S. S. 1998. Crop Management. Kalyani Pub. , New Delhi. pp 524

Yadav D. S. 1992. Pulse Crops. Kalyani Pub. , New Delhi. pp 303

22/7/03

22/7/03

(9)

Course – III Management of Problem Soils [Code No - 107]

Origin, nature, properties and distribution of saline, sodic, calcareous, acid and waterlogged soils; plant response to soil reaction, nutrient imbalance in problem soils, extent of damage to crops; crop tolerance to salinity, sodicity, acidity and waterlogging; reclamation of problem soils; role of soil amendments and soil drainage; agronomic practices in relation to problem soils; wasteland- dimensions, causes, need and practices of management; managing the eroded and ravine lands; soils requiring unusual management- organic, acid sulphate, sandy, forest, rangelands and disturbed soils.

Practicals

Determination of soil pH, Electrical Conductivity and CEC, different anions and cations present in soil; determination of SAR in soil, lime and gypsum requirement, drainage and leaching requirement; visit to problematic areas to acquaint with production constraints.

Suggested Readings

Mohsin M.A., Sarkar A.K. and Mathur B.S. 1995. Acid Soil Management. Kalyani Pub., New Delhi.

Singh K.N., Kumar A. and Sharma D.K.1993. Management of Problem Soils, Fifty years of Agronomic Research in India, ISA, New Delhi.

Semani L.L.1996. Crop Production in Acid Soils. Agrotech Pub. Academy, Udaipur.

USDA 1954. Diagnosis and Improvement. Saline and Alkali Soil. USDA Handbook-60, USDA, Washington. DC. pp160.

Ramuc 22/7/03.

22/7/03.

Ch. Charan Singh University, Meerut
M.Sc. (Ag.) Syllabus for all Subjects
I- Semester

I. Yr.

M.M. : 50

Course- IV

Statisticals Methods (J-204) Code No-204

Introduction to statistics, various measures of central tendency and dispersion. Probability and probability distribution : Random experiment, Events, Mathematical and statistical definitions of probability, Law of addition and law of multiplication of probability (simple problems based on them). Random variable, Binomial distribution, Poisson distribution and Normal distribution, Properties of above distributions.

Theory of sampling: object and advantage of sampling, Types of sampling, Simple random sampling, Stratified sampling, Cluster sampling, Multi-stage sampling.

Correlation and regression : Bivariate data, Bivariate frequency distribution, karl pearson's correlation coefficient, Rank correlation, Regression lines, Regression coefficients and their relation with correlation coefficient, Multiple regression, Multiple and Partial correlation coefficients (upto three variables).

Suggested Readings :

1- Chandel, S .R.S. A Hand Book of Agricultural Statistics. Achal Prakashan Mandir, Kanpur.

2- Gupta, S.C. and Kapoor, V.K. Fundamentals of Mathematical Statistics: S. Chand and Sons, New Delhi.

3. Murthy, M.N. Sampling Theory and Methods. Statistical Publishing Society, Calcutta

4- Rohatgi, V.K. An Introduction to probability theory and Mathematical statistics.

5- Wilks, S.S. Mathematical Statistics. John wiley and sons, New York

ANUJ KUMAR 10MER – M.Sc (Ag.) (II-Sem.)

Course - V

Principles and practices of water management

Water and its role in plants; water resources of india; major irrigation projects and extent of area and crops irrigated in India and different states; soil-water movement and water availability, uptake, transport and transpiration in plants; soil-water-plant relationship; plant response to water stress; scheduling, depth and methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and polyhouses; water use efficiency; water management of crops and croping systems; soil, plant and meteorological factors determining water needs of crops and croping systems; soil, plant and meteorological factors determining water needs of crops; crop plant adaptation to moisture stress condition; quality of irrigation water; effect of saline water and soil salinity on plant-water relation and management of crops; excess soil water and plant growth; water management in problem soils; drainage requirments of crops and methods of field drainage, their layout and spacing, irrigability of lands.

Practical

Measurement of soil moisture using tensiometer, pressure plate and membrane; making of soil moisture characteristic curves; water flow measurement using different devices determining soil profile moisture deficit and irrigation requirements; computation of water requirement of crops using modified Penman formula; measurement of water flux under saturated and unsaturated conditions; determination of infiltration rates and hydraulic conductivity.

Suggested Readings

Israelsen, O.W. and Jensen, V.E. 1962. Irrigation principles and practices. John Wiley and Sons, New Delhi. Chapman and Sons Ltd. London, pp. 405.

Joseph, A.P., Dikshit, S.V., Reye, N.D. and Mildner, W.F. 1972. Hand Book on Drainage of Agricultural Land Part I. Principles of Drainage - water management Division (Department of Agriculture), Ministry of Agriculture, New Delhi-I, pp.32.

Lenka, D. 1999, Irrigation and Drainage. Kalyani Publishers. L.D.H., New Delhi pp. 397

Michael, A. M. 1978 Irrigation : Theory and Practice. Vikas Publishing House, New Delhi, pp. 801

Paliwal, K.V. 1972 Irrigation with saline water WTC, IARI, New Delhi. pp 198

Pither, S.S. and Sandhu, B.S. 1987 Irrigation of Food Crops-Principles and Practices. ICAR, New Delhi pp 140

Reddy, S R. 2000 Principles of Crop Production Kalyani Pub., New Delhi pp 428

ANUJ KUMAR PIPER

Course - VI

Soil fertility management and fertilizer use

Soil fertility and productivity; soil composition in relation to crop production - organic and inorganic constitutents; essential plant nutrients; deficiency and toxicity symptoms of major and micronutrients and remedial measures; transformation and dynamics of major plant nutrients; kinds of fertilizers - straight, complex and bulk blended; methods of fertilizer application; crop response to nutrients; fertilizer use efficiency, agronomic chemical and physiological; methods of increasing fertilizer use efficiency nutrient interactions; fertilizer application in cropping systems -direct, residual and comulative effects integrated plant nutrient supply, systems-organic manures, compost, green manures, vermi-compost, bio-fertilizers, crop residue and inorganic fertilizers; sustainable agriculture and soil fertility; fertilizers and environment; fertilizer use in problem soils; soil moisture-nutrients interactions.

Practical

Determination of soil pH, organic C, total N, available N, P,K & S in soils; total N,P,K &S in plants; interpretation of interaction effect and computation of economic and yield optima.

Suggested Readings

Cooke, G.W. 1967 The control of Soil Fertility, Crosby Lockwood, Loncon. pp. 526

Fageria, N. K., Baligar, V.C. and Jones, C.A. 1991. Growth and Mineral Nutrition of Field Crops, Marcel Dekker, New York

Prasad, R and Power, J.F. 1997 Soil Fertility Management for Sustainable Agriculture, CRC-Lewis, Boca Raton, FL, USA. pp. 356

Tandon, H.L.S. 1992 Management of Nutrient Interactions in Agriculture FDCO Pub., New Delhi; pp. 142

Tisdale, S.L., Nelson, W.L., Beaton, J.D., Havlin, J. L. 1995. Soil Fertility & Fertilizers, Prentice Hall of India, Pub. New Delhi, pp. 634

M.Sc Ag. III Sem. III

Course - VIII M.Sc (Agro) III Sem J-(3-5) J.3005

Principles and practices of weed management

Classification and characteristics of weeds; special weed problems including aquatic and parasitic weeds ecology and physiology of major weeds; ecophysiology of crop-weed competition including allelopathy; weed indices; principles and methods of weed control, concept of integrated weed management; weed control through bioherbicides, mycoherbicides and allelochemicals; herbicides history, development and their classification; mode and mechanism of action of herbicides; herbicides selectivity, herbicide mixtures, adjuvants and safeners; degradation of herbicides in soil and plants; effect of herbicides in relation to environment; herbicide resistance in weeds and crops; weed management in major crops and cropping systems; weed shifts in cropping systems; control of weeds in non-cropped situations.

Practical

Identification of important weeds of different crops; preparation of a weed herbarium; weeds survey in crops and cropping systems; crop-weed competition studies; preparation of spray solutions of herbicides for high and low-volume sprayers; use of various types of spray pumps and nozzles and calculation of swath width; economics of weed control; herbicide resistance analysis in plant and soil; Bioassay of herbicide resistance.

Suggested Readings

Aldrich, R.J. and Kramer, R.J. 1997. Principles in Weed Management Panama Pub. New Delhi.

Ashton, F.M. and Crafts, A.S. 1981. Mode of action of herbicides. 2nd Edition Wiley-Inter-Science, pp. 524

Gupta, O.P. 2000. Weed Management -Principles and Practices. Agrobios. India Pub pp. 269

Jimdahl, R.L. 1999. Fundamentals of Weed Science, 2nd Edition Academic Press, New York, pp. 556

Mandal, R.C. 1990 Weed, Weedicides and Weed Control-Principles and Practices, Agro-Botanical Pub, Bikaner.

Rao, V.S. 2000. Principles of Weed Science, Oxford and IBH, Pub., New Delhi pp. 555

Subramanian, S., Ali, A.M. and Kumar, R.J. 1997. All About Weed Control, Kalyani Pub New Delhi pp. 315

चौथा सेमे. COS 03252

तीसरा सेमे. COS – 03257

2 सेमे. COS 96259

SEMESTER - III

COURSE -XI AGRONOMY OF FODDER, FORAGE, MEDICINAL AND AROMATIC CROPS/ORGANICS FARMING

THESIS - IN LIEU OF COURSE X

Adaptation, distribution, varietal improvement, Agrotechniques and quality aspects including anti-quality factors of important fodder crops like teosinte, maize, bajra, guar, cowpea, oats, barley, berseem, senji, lucern and clovers, year round fodder production and management, preservation and utilization of forage and pasture crops; principles and methods of hay and silage making, chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition value of poor quality fodder. Economics of forage cultivation.

Medicinal and aromatic crops

Importance of medicinal and aromatic plants in human health, national economy and related industries; classification of medicinal and aromatic plants according to botanical, characteristics and uses; climate and soil requirements; cultural practices; yield and important constituents of medicinal and aromatic plants (Isabgol, citronella, palmarosa, Rauwolfia, poppy, Asaphoetida, Nux vomica, rosadle, mentha, basil, geranium etc).

Practical

Exercises on farm operations in raising fodder crops; exercises on canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica cellulose etc. of various fodder and forage crops and antiquality components like HCN in sorghum and such factors in other crops; hay and silage making and economics of their preparation.

Identification of crops based on morphological and seed characteristics; raising of herbarium of M&A plants; quality characters in medicinal and aromatic plants; methods of analysis of some essential oils and other chemicals of importance in M&A plants.

Suggested Readings

Wheeler, W.A. 1950. Forage and Pasture Crops. D. Van Nostrand Company Inc., New York.

Whiteman, P.C. 1980, Tropical Pastures. Oxford University Press, Oxford.

Narayanan, T.R. and Dobadghao P.M. 1972. Forage Crops of India, ICAR, New Delhi.

Singh, P. and Srivastava, A.K. 1990. Forage Production Technology. IGFRI, Jhansi.

Handa, S.S. 1984. Cultivation and Utilization of Aromatic Plants. RRL, CSIR, Jammu.

Handa, S.S. 1984. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu.

Hussain, A. 1993. Medicinal Plants and their Cultivation. CIMAP, Lucknow.

Hussain, A. 1994. Essential Oil Plants and their cultivation. CIMAP, Lucknow.

Course - IX

Soil conservation and watershed management

Soil erosion-definition, nature and extent of erosion; types of erosion, factors affecting erosion; soil conservation-definition, methods of soil conservation-agronomic measures, contour cultivation, strip cropping, cover crops, vegetative barrier, improved dry farming practices; mechanical measures-bunding, gully control, bench terracing; role of grasses and pastures in soil conservations; wind breaks and shelter belts; watershed management-definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping system for watershed; development of cropping system for watershed areas; alternate land use systems; agroforestry, ley farming; Jhum management- basic concepts, socio-ethnic aspects, its layout, drainage considerations and agronomic management; rehabilitation of abandoned jhum lands and measures to prevent soil erosion.

Practical

Study of different types of erosion; field studies of different soil conservation measures; runoff and soil loss measurement; laying out runoff plot and deciding treatments; identification of different grasses and trees for soil conservation; visit to a soil constration research centre, demonstration and training centre.

Suggested Readings

Arakeri, H.R. and Roy, D. 1984. Principles of Soil Conservation and Water Management Oxford and IBH Publishing Co., New Delhi

Datta, S.K. 1986 Soil Conservation and Land Management. International Book Distributors, Dehradun, India.

Dhruvanarayana, V.V. 1993. Soil and Water Conservation Research in India. ICAR, New Delhi.

Ghumare, N.K. 1962 Studies on Behaviour of Contour Bunds. Soil and Water Conservation in India10:27-32

Gurmel Singh, C.Rambabu and Subhas Chandra. 1981 Soil loss prediction research in India, CSWCRFTI, Dehradun, India

Gurmel Singh, C. Venkataraman, G., Sastry, and Joshi, P. 1990. Manual of Soil and Water Conservation Practices Oxford and IBH Publishing Co., New Delhi

Murthy, V.V.N. 1995, Land and Water Management Engineering, Kalyani Publishers, Ludhiana, India

Rama Rao, M.S.V. 1962 Soil Conservation in India, ICAR, New Delhi

Reddy, S.R. 1999. Principles of Agronomy Kalyani Publishers, New Delhi, pp. 458

Sakara Reddi, G.H. and Sithapathi Rao, C. 1967. A Manual on Soil conservation Department of Agriculture, Government of AP, Hyderabad, India

Tripathi, R.P. and Singh, H.P. 1993 Soil Erosion and Conservation. Wiley Eastern Limited New Delhi

Course - X

Organic Farming

Organic farming-concept and definition, its relevance to India and global agriculture and future prospects; Land and water management-land use, minimum tillage, shelter zones, hedges, pasture management, agro-forestry, water use efficiency; Soil fertility-nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, biofertilizers; Farming systems-crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity, control of weeds, diseases and insect pests; Animal Husbandry, dairy farming, sheep and goat and piggery etc. Integrated pest management-biological agents and pheromones, biopesticides; socio-economic impacts; Marketing and export potential-inspection, certification, labelling and accreditation procedures; Organic farming and national economy.

Practical

Aerobic and anaerobic methods of making compost, making of vermincompost Identification and nursery raising of important agroforestry trees and trees for sheeting bells; Efficient use of biofertilizers-technique of treating legume seeds with Rhizobi uncultures, use of Azotobacter, Azospirullum and PSB cultures in field; Visit to a organic farm; Quality standards, inspection, certification and labelling and accreditation procedures for farm produce from organic farms.

Suggested Readings

Ananthakrishnan, T.N. (editor) 1992 Emerging Trends in Biological Control Phytophagous insects Oxford & IBH, New Delhi, p. 255

Gaur, A.C. 1982 A Manual of Rural Composting FAO/UNDP Regional Project Document. FAO, Rome, pp. 102.

Lampkin, N. 1990 Organic-Farming. Farming Press Books, Ip switch, U.K.

Palaniappan, S.P and Anandurai, K. 1999. Organic Farming-Theory and Practice Scientific Pub., Jodhpur, pp. 257

Reddy, M.V. (editor) 1995 Soil organism and Litter decomposition in the Tropics, Ox-ford & IBH, New Delhi. Pp. 274

Singh, SP (editor) 1994. Technology for Production of Natural Enemies, Project Directorate of Biological Control, Bangalore, pp. 22.

Trivedi, R.N. 1993 A Text Book of Environmental Sciences, Anmol Pub, New Delhi, pp. 410

Veeresh, G.K., Shivashankar, K and Suiglachar, M.A. 1997. Organic Farming and Sustainable Agriculture, Association for Promotion of Organic Farming, Bangalore.

Venkata Rao, B.V. 1995 Small farmer focused integrated rural development: socioeconomic environment and legal perspective: Pub 3. Parisaraprajna Parishtana, Bangalore, pp. 12.

WHO 1990 Public Health Impact of Pesticides used in Agriculture. Who, Paris

Woomer, P.L. and Swift, M.J. 1994. The Biological Management of Tropical Soil Fertility. T.S.B.F. & Wiley

SEMESTER - IV

COURSE - XII

DRY-LAND AGRONOMY

J 401

Definition, concept, characteristics of drylands and rain-fed farming; significance and dimension of dryland farming in Indian agriculture; constraints limiting crop production in dryland areas; characterization of environment for water availability; types of droughts; adaptation of crop plants to droughts; drought management strategies; preparation of appropriate crop plants for dryland areas; mid-season corrections for aberrant weather conditions; water-harvesting concepts, techniques and practices; use of mulches, kinds, effectiveness and economics; antitranspirants; soil and crop management techniques, tillage, seeding, fertilizer use, crop and varietal choice; concept of watershed management and its application in India.

PRACTICAL - 405

Rainfall probability analysis for crop planning; measurement of soil and water losses; in situ soil moisture conservation practices; mulches, including live mulches for minimizing evaporation losses; measures to manage prolonged drought during crop season; dry-seeding practices due to delayed monsoon rains; visit to a dryland research centre; study of on-going watershed management programmes and agroforestry systems.

Suggested Readings

Gupta, U.S. (Edited) 1995. Production and Improvement of Crops for Drylands. Oxford and IBH Publishing Company, Pvt. Ltd., New Delhi.

Jodha, N.S. Technology Options and Economic Policy for Dryland Agriculture. Concept Publishing Co. New Delhi.

Kanitkar, N.U. 1944. Dry Farming in India, ICAR, New Delhi.

Katyal, J.C. and Farrington, J. 1995. Research for Rainfed Farming. CRIDA, Hyderabad.

Ramaswamy, P. 1982. Dry farming technology in India. Agricole Publishing Academy, New Delhi.

Singh, R.P. 1988. Improved Agronomic Practices for Dryland Crops, CRIDA, Hyderabad.

Singh, S.D. 1998. Arid Land Irrigation and Ecological Management. Scientific. Pub., Jodhpur.

Singh, S.D. Water Harvesting in Desert. Manak Publications, New Delhi.

SEMESTER - IV

COURSE -XIII AGRO-FORESTRY AND SUSTAIABLE AGRICULTURE

J 402

Definition, concept, scope; historical perspective, agroforestry systems; agri-silviculture, silvipasture, agri-silvipasture, agri-horticulture, aqua-silviculture; alley cropping and energy plantation; agroforestry systems for forage and fuel wood production, resource conservation; improvement of degraded lands' biological diversity and sustainable agriculture and environmental protection; associative influence in relation to above-ground and underground interferences; allelopathy in various agroforestry systems-direct and indirect effect; efficient agroforestry design/models for different agroclimatic conditions; tree-crop-animal relationship; food-fodder-fuel systems; Productivity and sustainability; alternate land use systems through agroforestory; social acceptability and economic viability; agroforestry intervations with multipurpose tree species; Nutrive value of tree leaf, economics of AF systems.

PRACTICAL - 405

Identification of various tree species, planting methodology and techniques, study of litter fall and biomass deposits, organic matter and nutrient conservation; poloroding and defoliation, coppicing; light and temperature measurements; visit to a institute related to agroforestry.

Suggested Readings

Hegde, H.G., Rehvani, L.L. and Kelkar, V.D. (ed.) 1989. Promotion of Fodder of Fuelwood Trees. BAIF Development Research Foundation, Pune.

Jha, L.K. and Sen-Sarma, P.K. 1997. A Manual of Forestry Extension Education. APH Publishing Corp. New Delhi.

Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer, Netherlands.

Pathak, P.S. and Roy M.M. 1994. Agroforestry Systems for Degraded Lands. Oxford & IBH Publishing, New Delhi.

Tejwani, K.G. 1994. Agroforestry in India, Oxford & IBH Pub., New Delhi.

Willsie, C.P. 1961. Crop Adaptation and Distribution. Asia Pub. House (Pvt.) New Delhi, pp. 448

Crop Ecology & Geography, J.4007, IV Sem

Principles of crop ecology, Ecological factors, determinants of productivity of crops, Ecological limits of crop growth, Crop adaptation to ecological optima. Crop adaptation, Genotype shift and its ecological implication. Genotype effect; Agro-ecological and agro-climatic regions of India. Geographical distribution of cereals, pulses, oilseeds, fodder and forage and commercial crops (sugarcane, potato and tobacco). Adverse effect of factors and crop productivity. Physiological characters of crops. Remote sensing

Practical

- Crop distribution in different agroclimatic and agro ecological zones.
- Phenological studies on different
- Studies on plant and their parts
- Measurement of weather parameters, and interpretation.
- Visit to Agromet observatory and related institutions

(2) Principles of Seed Technology (IV - Semester) 3(2+1)

Introduction to Seed Production, Importance of Seed Production, Seed policy, Seed demand forecasting and planning for certified, foundation and breeder seed production, Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality: Definition, Characters of good quality seed, Different classes of seed, Production of nucleus & breeder's seed, Maintenance and multiplication of pre-release and newly released varieties in self and cross-pollinated crops; Seed Production, Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites); Foundation and certified seed production of rice (varieties & hybrids); Foundation and certified seed production of sorghum and bajra (varieties, hybrids, synthetics and composites); Foundation and certified seed production of cotton and sunflower (varieties and hybrids); Foundation and certified seed production of castor (varieties and hybrids); Foundation and certified seed production of tomato and brinjal (varieties and hybrids); Foundation and certified seed production of chillies and bhendi (varieties and hybrids); Foundation and certified seed production of onion, bottle gourd and ridge gourd (varieties and hybrids); Seed certification, phases of certification, procedure for seed certification, field inspection and field counts etc.; Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Seed control order: Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Varietal Identification through Grow-Out Test and Electrophoresis; Seed Drying: Forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, building requirements, types of air distribution systems for seed drying, selection of crop dryers and systems of heated air drying, recommended temperature and depth of the seeds, management of seed drying, Planning and layout of seed processing plant; Establishment of seed processing plant. Seed processing: air screen machine and its working principle, different upgrading equipments and their use, Establishing a seed testing laboratory. Seed testing procedures for quality assessment, Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist-O-matic treater), Seed packing and seed storage, stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, constructional features for good seed warehouse, measures for pest and disease control, temperature control; Seed marketing, marketing structure, marketing organization, sales generation activities, promotional media, pricing policy; Factors affecting seed marketing.

Practical: Seed sampling principles and procedures; Physical Purity analysis of Field and Horticultural crops; Germination analysis of Field and Horticultural crops; Moisture tests of Field and Horticultural crops; Viability test of Field and Horticultural crops; Seed health test of Field and Horticultural crops; Vigour tests of Field and Horticultural crops; Seed dormancy and breaking methods; Grow out tests and electrophoresis for varietal identification; Visit to Seed production plots of Maize, Sunflower, Bajra, Rice, Sorghum, Cotton, Chillies and Vegetables. (Add or delete crops of the region); Visit to Seed processing plants; Visit to Seed testing laboratories, Visit to Grow out testing farms; Visit to Hybrid Seed Production farms; Varietal identification in seed production plots; Planting ratios, isolation distance, roguing etc

in irrigation water (quality parameters)

(5) Field Crops- II (*Rabi*) (VI - Semester) **3(2+1)**

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* crops: Cereals: wheat, barley; Pulses: chickpea, lentil, peas, french bean; Oilseeds: rapeseed and mustard, sunflower, safflower and linseed; Sugar crops: sugarcane and sugarbeet, Medicinal and aromatic crops such as mentha, lemon grass, citronella, palma rosa, isabgol and posta; Commercial crops: potato and tobacco. Forage crops: berseem, lucerne and oat.

Practical: Seed bed preparation and sowing of wheat, sugarcane and sunflower; Calculations on seed rate; Top dressing of nitrogen in wheat and study of fertilizer experiments on wheat

and mustard; Identification of weeds in wheat and grain legumes, application of herbicide and study of weed control experiments; Morphological characteristics of wheat, sugarcane, chickpea and mustard; Yield contributing characters of wheat; Yield and quality analysis of sugarcane; Crop distribution in the state and the region; Important agronomic experiments of *rabi* crops and visit to research stations related to *rabi* crops.

Ch. Charan Singh University, Meerut

M.Sc. Botany Syllabus

Course Title

I Semester		Total Marks(Int.+Ext.)
Course I/ H1001	Angiosperm Taxonomy, Plant Resources and Utilization	50+50
Course II/ H1002	Biology and Diversity of Viruses and Bacteria	50+50
Course III/ H1003	Biology and Diversity of Algae and Bryophytes	50+50
Course IV/ H1004	Biology and Diversity of Pteridophytes, Gymnosperms and Palaeobotany	50+50
Practical -I (H501)(4 Hours)	Based on Courses I-IV	100
	Total marks	500

II Semester	Course Title	Total Marks
Course V/ H 2001	Fungal Biodiversity and Elementary Plant Pathology	50+50
Course VI/ H 2002	Cell and Molecular Biology	50+50
Course VII/ H2003	Genetics, Cytogenetics and Plant breeding	50+50
Course VIII/H2004	Anatomy and Reproduction in Angiosperms	50+50
Practical II (H 601) (4 Hours)	Based on Courses V-VIII	100
	Total marks	500

III Semester	Course Title	Total Marks
Course IX/ H3001	Plant-Soil-Water relations; Growth and Development	50+50
Course X/H3002	Phytochemistry and Metabolism	50+50
Course XI/H3003	Plant Ecology and Phytogeography	50+50
Course XII/H3004	Elementary Biotechnology	50+50
Practical III (H 701) (4 Hours)	Based on theory courses IX-XII	100
	Total marks	500

IV Semester	Course Title (Compulsory Courses)	Total Marks
Course XIII/H4001	Modern Phytotechniques and Biostatistics	50+50
Course XIV/H4002	Biodiversity conservation and Plant Resources	50+50
	Elective Courses (Any two courses)	
Course XV /H4003	Recombinant DNA technology	50+50
Course XVI /H4004	Plant Tissue Culture	50+50
Course XVII /H4005	Microbial Biotechnology	50+50
Course XVIII /H4006	Environmental Biotechnology	50+50
Course XIX /H4007	Stress Physiology of Plants	50+50
Course XX /H4008	Applied Plant Physiology	50+50
Course XXI /H4009	Diversity in Plants, their origin and evolution	50+50

Course XXII /H4010	Elementary Computer Knowledge and Bioinformatics	50+50
Course XXIII/H4011	Plant Pathology	50+50
Practical IV (H801)(4 Hours)	Based on theory courses XIII-XIV and two out of XV-XXIII	100
	Total marks	500
	Grand Total	2000

A candidate can select any two elective courses from XV to XXIII (as per availability in the institution) to serve as specialization. Each course will have 4 hours theory and 4 hours practical in each week.
A minimum of 30% marks separately in internal and external assessment of each course and an aggregate of 40% marks in all the courses is required for passing. In case of failing to obtain 30 % marks in internal assessment of any paper, the candidate will not be eligible to appear in external examination of that course.
Internal assessment will be based on :
Quizzes -2: (from first Unit) Each for 5 marks
Tests-2: for 15 marks each (based on 2 units each)
Seminar/ Term Paper: 10 marks in each paper

Course – I: Angiosperm Taxonomy, Plant Resources and Utilization 50 Hours

Unit- I 10 Hours

Taxonomy of Angiosperms:

1. History of plant Taxonomy.
2. International Code of Botanical Nomenclature (ICBN). Salient feature, important rules and recommendation, Binomial nomenclature, botanical gardens and herbaria.
3. Taxonomic evidences: Morphology, Plant anatomy, Palynology, Embryology, Cytology, Phytochemistry, Genome analysis and DNA hybridization technique in relation to taxonomy, numerical taxonomy, serotaxonomy.

Unit- II 10 Hours

4. The species concept: Taxonomic hierarchy, species, genus, family and other categories, Principles used in assessing relationship, delimitation of taxa and attribution of rank. Variation and specialization in plants.
5. Phylogenetic systems of classification: Hutchinson, Cronquist, Takhtajan and Dahlgren. Outlines, merits and demerits.
6. Basic knowledge of phylocode and A P G system.

Unit- III 10 Hours

7. Range of floral structure and phylogeny in:

I. **Dicotyledons:**

a. Magnoliidae with special reference to Magnoliaceae, Lauraceae, Piperaceae,
b. Hamamelidae with special reference to Moraceae, Juglandaceae and Casuarinaceae,
c.Caryophyllidae with special reference to Cactaceae, Chenopodiaceae and Polygonaceae,
d. Dilleniidae with special reference to Tiliaceae, Sterculiaceae, Violaceae,
e. Rosidae with special reference to Lythraceae, Combretaceae,
f. Asteridae with special reference to Boraginaceae, Scrophulariaceae, Bignoniaceae
,

Unit- IV 10 Hours

II.**Monocotyledons:**

a. Alismatidae,
b. Commelinidae with special reference to Commelinaceae and Zingiberaceae,
c. Arecidae with special reference to Araceae,
d. Liliidae with special reference to Amaryllidaceae

8. Cradle of flowering plants.

Unit- V 10 Hours

Plant resource utilization:

12. Botanical names, families, Plant part(s) used and uses of the important plants belonging to following categories:
    Fiber plants
    Spices and condiments
    Beverages
    Medicinal plants
    Non-wood plant products (NWPPs): rubber, dyes, resin, gums etc.

Course – II: **Biology and Diversity of Viruses and Bacteria** **50 Hours**

Unit – I **10 Hours**

1. Development of microbiology as science, important contribution of pioneer microbiologists; golden era of microbiology.
2. Isolation, purification and cultivation of microbes.
3. Important criteria used for classifications of microorganisms (morphological, ecological, biochemical, molecular and numerical).

Unit – II **10 Hours**

Bacteria:

4. Classification of bacteria based on Bergey's manual of determinative bacteriology.
5. Archaeobacteria and Eubacteria: Characters, Ultrastructure, nutrition, genetic recombination (Transformation, Transduction, Conjugation), and economic importance.
6. Cyanobacteria: salient features and biological importance.

Virus:

7. Biological nature, characteristics and ultrastructure of Plant, animal and bacterial virus, replication, transmission and economic importance of viruses.

Unit – III **10 Hours**

8. **Phytoplasma**: General characteristics, structure, reproduction and role in causing plant diseases.
9. General Structure, reproduction and importance of viroids, virusoids, prions and Retrovirus.

Unit – IV **10 Hours**

10. **Host-parasite interaction**: a brief idea of recognition and entry process of bacteria, viruses into animal & plant-host cells, alteration of host cell. Virus induced cancer; bacteria and plant two-component signaling systems; bacterial chemotaxis and quorum sensing. Hormones and their receptors, signaling through G–protein coupled receptors, regulation of signaling pathways.
11. **Innate and adaptive immune system**: Types of Immunity, antigens, antigenicity, structure and function of antibody molecules, monoclonal antibodies, Antigen-antibody interactions (serology), activation & differentiation of B and T Cell, B & T cells receptors, MHC molecules compliment system, immune response during bacterial (tuberculosis), parasitic (malaria) and Viral (HIV) infections, vaccine.

Unit – V **10 Hours**

12. Distribution of microbes in air, water, soil and human body.
13. Microbes for control of pollution.
14. Microbial enzymes and their applications.
15. Microbes in nanobiotechnology.

Course III: Biology and Diversity of Algae and Bryophytes 50 Hours

Unit – I 10 Hours

Algae:

1. Classification and salient features of different classes of Algae.
2. Algal pigments, food reserves, flagellation and their importance in classification.
3. Thallus organisation, reproduction and life cycle patterns.
4. Economic importance of algae as food, feed, source of chemicals and drugs, Algal biofertilizers, uses in industry and Algal blooms.

Unit – II 10 Hours

5. Comparative study of classes of Chlorophyceae, Xanthophyceae and Bacillariophyceae, with reference to:

a. Range of structure of plant body including ultrastructure.
b. Methods of reproduction.
c. Variation in life cycles.

Unit – III 10 Hours

6. Comparative study of Phaeophyceae and Rhodophyceae with reference to:
   a. Range of structure of plant body.
   b. Range of mode of reproduction.
   C. Variation in life cycles.

Unit – IV 10 Hours

Bryophytes:

7. Classification of Bryophytes and their distribution in India.
8. Range of thallus structure (plant body) and anatomy in Bryophytes (with suitable examples)
9. A general account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales.

Unit – V 10 Hours

10. Evolutionary tendencies in sporophytes of Bryophytes (Progressive sterilization of sporogenous tissue)
11. Reproduction, life history, Inter-relationship, affinities of various groups of Bryophytes.
12. Ecology and economic importance of Bryophytes.

Course – IV: Biology and Diversity of Pteridophytes, Gymnosperms and Palaeobotany **50 Hours**

Unit – I **10 Hours**

Pteridophytes:

1. Classification of Pteridophytes; specific characters of important classes.
2. Salient features, comparative organography, systematics, reproduction and Phylogeny of the following:
   a. Psilopsida: Psilophytales (*Rhynia, Horneophyton*) and Psilotales (*Psilotum, Tmesipteris*).
   b. Lycopsida: Protolepidodendrales (*Protolepidodendron*), Lepidodendrales (*Lepidodendron, Stigmaria*), Lepidospermales (*Lepidocarpon*) and Isoetales (I*soetes*).
   c. Sphenopsida: Hyeniales (*Calamophyton*), Sphenophyllales (*Sphenophyllum*) and Calamitales (*Calamites*).
   d. Pteropsida: Coenopteridales — A general account. Ophioglossales (*Ophioglossum, Botrychium*), Marattiales (*Marattia, Angiopteris*), Osmundales (*Osmunda*), Filicales (*Cyathea, Dryopteris, Pteridium*), Marsileales (*Marsilea*), Salviniales (*Salvinia*, *Azolla*) and Indian Fossils.

Unit – II **10 Hours**

3. Telome concept.
4. Stelar system and evolutionary tendencies.
5. .Heterospory and evolution of seed habit.
6. Apogamy, apospory, parthenogenesis.
7. Soral evolution in Pteridophytes.
8. Alternation of generations.

Unit – III **10 Hours**

Gymnosperms:

a. Classification and distribution of gymnosperms with special reference to India. Study of morphology, structure and life history as illustrated by the following:Pteridospermales: Palaeozoic and Mesozoic group with reference to Lyginopteridaceae (*Lyginopteris*), Medullosaceae (*Medullosa*), Glossopteridaceae and Caytoniaceae.
b. Bennettitales: Cycadeoidaceae, Williamsoniaceae, Wielandiellaceae.
c. Cycadales: A detailed account including distribution *of living C*ycads.
d. Pentoxylale*s: A gene*ral account.
e. Cordaitales: A general account of Cordaitaceae and Poroxylaceae.
f. Ginkgoales: *Ginkgo*.
g. Coniferales: *Abies, Cedrus, Cryptomeria, Cupressus. Podocarpus, Cephalotaxus* and *Araucaria.*
h. Taxales: A general account.
i. Ephedrales, Welwitschiales and Gnetales: A general account.

Unit – IV **10 Hours**

10. Evolutionary tendencies in Gymnosperms.
11. Economic importance of Gymnosperms.

Unit – V **10 Hours**

Paleobotany:

12. Geological areas and distribution of plants in geological time scale.
13. Types of Fossils, Process of fossilization and fossil preservation methods.
14. Techniques of study of fossils.
15. Distribution of fossils in India

Course – V: Fungal Biodiversity and Elementary Plant Pathology 50 Hours

Unit – I 10 Hours

1. General characters of fungi, cell structure and nutrition.
2. Range of Thallus organization in fungi.
3. Unique aspects of (i) fungal cells, (ii) molecular biology of fungi
4. Types of reproduction in fungi.
5. Classification of fungi as proposed by Ainsworth (1973) Alexopoulus, Mims& Blackwell (1996).Recognition of Fungi as a separate kingdom; splitting of the fungi (Fungi and allied organisms into three kingdoms- Protista, Chromista and Fungi.
6. Nutrition and growth in Fungi including factors affecting fungal growth.
7. Differentiation in fungi: control of i) Dimorphism. ii) conidiation. iii) mating (with the help of Sex hormones).
8. Heterothallism, Heterokaryosis, parasexuality and physiological specialization in Fungi.

Unit – II 10 Hours

9. A general account and affinities of the following groups with special reference to systematic position, structure and reproduction of organisms mentioned hereunder:

I. The Fungi belonging to kingdom Protozoa:
a. Myxomycota (myxomycetes): *Stemonites, Ceratiomyxa*,
b. Plasmodiophoromycota (Plasmodiophorales) *Plasmodiophora*.
II. The Fungi belonging to Kingdom Chromista:
   a. Oomycota: Saprolegnia, Phythium, Phytopthora, Albugo,
III. The Kingdom Fungi:
a. Chytridiomycota: *Synchytrium*,
b. Blastocladiomycota: *Allomyces, Coelomomyces*
c. Zygomycota: *Saksanaea, Pilobolus, Entomophthora*
d. Ascomycota : *Taphrina, Phyllactinia, Erysiphae, Neurospora, Peziza*
e. Basidiomycota: *Puccinia, Uromyces, Hemiliea, Melampsora, Tilletia, Ustilago*
f. Anamorphic fungi (Deuteromycotina): With reference to their telomorph, also wherever possible; *Cercospora, Helminthosporium, Curvularia, Alternaria, Fusarium, Colletotrichum, Aspergillus, Penicillium*.

Unit – III 10 Hours

10. Fungal interactions: I. Role of antibiotics, hyphal interference,II. Mycoparasitism, III. Commensalism, Mycorrihizae, Lichens (Structure, types, reproduction, importance),
11. Fungi as biocontrol agents.
12. Symptoms of fungal, bacterial and viral plant diseases.
13. Causes of plant diseases.
14. Host-parasite relationship, role of enzymes and toxins in disease development.
15. Effect of infection on physiology of host.
16. Effect of environment on disease development-epiphytotics.

Unit – IV 10 Hours

17. Disease control by Physical methods, chemical methods, crop rotation, plant quarantines, resistance
18. Integrated pest management mechanism, its advantages, disadvantages and future prospects.

19. Principles of biological control of air- borne and soil-borne plant diseases.

Unit – V **10 Hours**

23. Etiology and control of the following crop diseases:

Paddy : Paddy blast, Bacterial leaf blight.
Wheat : Black Stem rust, Bunt of wheat, Flag smut.
Jowar : Grain Smut.
Sugercane : Smut, Red rot.
Cotton : Wilt
Grape : Downy and powdery mildew
Apple : Apple scab
Groundnut : Tikka disease.
Fibre : Rust of *Linum*.
Coriander : Gall of coriander.

Course VI : Cell and Molecular Biology of Plants 50 Hours

Unit – I 10 Hours

1. The Dynamic cell: Structural organization of plant cell, specialized plant cell.
2. Microscopy: Principle, parts and functioning of electron microscopes including stereoscopic binocular, dark field illumination, confocal, phase contrast, fluorescence and polarizing microscopes, camera lucida, SEM, TEM. STEM.
3. Cell envelopes: Ultra-structure, chemical foundation and functions of cell wall, Biological membranes with special emphasis on plasma membrane and tonoplast membrane.

Unit – II 10 Hours

4. Plant Cell inclusions, their structure and function; Mitochondria and Chloroplast.
5. Nucleus & Nucleolus: Structure, nuclear pores, nucleosome concept.
6. Chromatin Organisation: Chromosome structure and composition, Centromere, Telomere, Euchromatin and Heterochromatin, Karyotypes, Polytene, Lamp brush chromosomes and Sex chromosomes.

Unit – III 10 Hours

7. Ribosomes, Dictyosomes, Lysosomes, ER, Microbodies and Plasmodesmata.
8. Cell cycle & Apoptosis: Biochemical and genetic mechanism–
   a) Mitosis, spindle formation mechanism, cytokinesis, cell plate formation, Cytoskeleton with emphasis on spindle apparatus, motor movements.
   b) Meiosis and its significance
   c) Programmed Cell Death (PCD).

Unit – IV 10 Hours

9. Nucleic Acids: Nature, Structure, types of DNA (A, B, Z-DNA) and RNA, (t-RNA, micro-RNA) difference between DNA & RNA; DNA replication (Origin and fork) and its biosynthesis, extra chromosomal replications, DNA damage and repair, transposons and mechanisms of transposition.
10. Genetic Code: Discovery, Properties and cracking of genetic code.

Unit – V 10 Hours

11. Protein Synthesis: Basics, mechanism of protein synthesis in prokaryotes and eukaryotes, transcription, RNA processing, reverse transcription, translation and regulation of protein synthesis in prokaryotes (Structural, regulatory genes and operon model).
12. Control of gene expression at transcription and translation level: Regulation of gene expression in phages, viruses, prokaryotes and eukaryotes, role of chromatin in regulating gene expression and gene silencing.

Course – VII: Genetics, Cytogenetics and Plant Breeding **50 Hours**

Unit – I **10 Hours**

Genetics:

1. Mendel's Laws of inheritance and modified ratios.
2. Allelic and non allelic interaction of genes.
3. Multiple alleles: alleles, coat colour in rodents, blood groups in Humans, self incompatibility.

Unit – II **10 Hours**

4. Linkage and crossing over: chromosome mapping, linkage groups, mechanism of chromosome pairing and synaptonemal complex.
5. Sex determination in man, Drosophila and plants.
6. Maternal effects and Extra- nuclear inheritance.

Unit – III **10 Hours**

7. Biochemical genetics, concept of gene.
8. Structural changes in chromosomes: Deficiency, duplication (meiotic pairing & phenotypic effects), Inversions, translocations, (meiotic pairing, Chromosome disjunction), multiple translocations.
9. Numerical changes in chromosomes and Haploidy:

a) Euploidy/Polyploidy : Classification, production, role in evolution, utility in crop improvement.

b) Aneuploidy : Trisomics, tetrasomics, monosomy, multisomy- meiotic behaviours, breeding behaviour.

c) Apomixis : Cytogenetic basis and types of Apomictic reproduction

Unit – IV **10 Hours**

10. Mutation: Types of mutations, spontaneous and induced mutations, Physical and chemical mutagens, gene mutations, induction and detection of mutation, mutation by transposons.
11. Concept of gene: gene structure and expression; gene fine structure, cis-trans test, Biochemical genetics, introns.

Unit – V **10 Hours**

Plant breeding:

12. Methods of plant breeding.
9. 13. Genetic basis of inbreeding, hybridization and heterosis, exploitation of hybrid vigour.
10. 14. Plant breeding work done in India with special reference to potato, maize, rice, wheat, sugarcane and cotton.

Course VIII : Anatomy and Reproduction in Angiosperms 50 Hours

Unit-I 10 Hours

Plant Anatomy:

1. Shoot development: organisation of shoot apical meristem (SAM), Cytological and molecular analysis, Leaf (Marginal meristem).
2. Root development: organisation of root apical meristem (RAM), Cell fates and lineage differentiation of vascular tissue, regulation of root growth.

Unit – II 10 Hours

3. Epidermal structures, ontogeny and classification of stomata, trichomes and secretory glands
4 Phloem: Structure and development of sieve elements, P-Proteins.
5. Xylem: Structure and development of tracheary elements.
6. Vascular cambium: normal and abnormal functioning.
7. Nodal Anatomy: evolution of nodal vasculature.

Unit - III 10 Hours

Embryology:

8. Formation of floral organs: floral development molecular basis of floral organ determination. Morphology of stamen, carpel and placentation, (MADS Box) Homeotic genes.
9. Megasporangium (ovule): Structure and development.
10. Female gametophyte: Megasporogensis, organisation and types of embryo sac, gene function during megagametogenesis, ultra structure of embryo sac.
11. Anther: Structure, microsporogenesis, tapetum, pollen development, including pollen wall, pollen germination and pollen tube growth, development of male gametophyte, palynology and its applications.

Unit – IV 10 Hours

12. Pollen-Pistil interactions, Pollination mechanism and vectors, double fertilization.
13. Sexual Incompatibility: its genetic basis, molecular aspects, physiology and biochemistry. Barriers to fertilization, methods to overcome incompatibility.

Unit – V 10 Hours

14. Polyembryony: causes, classification and applications.
15. Endosperm: development, types, haustoria, mosaic endosperm, ruminate endosperm, xenia, metaxenia.
16. Embryogenesis: nutrition and growth of embryo; development of dicot and monocot embryos.
17. Fruit growth and development: with special reference to legumes and cucurbits.
18. Seed anatomy
19. Apomixis and Parthenocarpy: types and importance.

Course IX : Plant-Soil-Water Relations & Growth and Development 50 Hours

Unit – I 10 Hours

Soil - water-plant relations:

1. Functional aspects of plant cell structure: colloidal systems, Water as a universal solvent,pressures and potentials.
2. Active and passive absorption of water. Factors affecting water absorption
3. Role of micro and macro mineral nutrients, their physiological functions and deficiency symptoms, Hydroponics.
4. Mechanism of ion (mineral) absorption. Factors affecting mineral absorption.

Unit – II 10 Hours

5. Driving forces and resistances in transpiration; stomatal movement mechanism.
6. Ascent of sap, Translocation of solutes in plants; sensor- regulator system, sucrose sensing mechanism.
7. Stress Physiology: Plant response to biotic and abiotic stress, mechanism of stress tolerance, HR and SAR, water deficit and drought resistance mechanism of salinity, metal toxicity, freezing heat and oxidative stress resistance,

Unit – III 10 Hours

Growth & Development:

8. Discovery, chemical structure, physiological role, mechanism of action, bioassay and practical applications of following plants hormones:

a. Auxins
b. Gibberellins
c. Cytokinins

9. Hormone receptors, cell signaling and Signal transduction

Unit – IV 10 Hours

10. Elementary idea of structure and functions of ABA, Ethylene, Ascorbic Acid, Brassinosteroids, Polyamines, Jasmonic acid and Salicylic acid.
11. Sensory photobiology: detection structure, chemistry, physiology, function and mechanism of action of phytochromes, cryptochromes and phototropins.
12. Photoperiodism; Photoinduction and vernalization, Role of florigen, vernalin, phytochrome and C/N ratio in flowering.

Unit – V 10 Hours

13. Dormancy: Dormancy of seeds and buds, gene expression during dormancy.
14. Seed germination and seedling growth, metabolism of nucleic acid, mobilization of reserved food material, hormonal control of seedling growth, gene expression during seedling growth.
15. Endogenous rhythms
16. Plant movements
17. Ageing and Senescence

Course X : Phytochemistry and Metabolism 50 Hours

Unit- I 10 Hours

Energy flow:

1. Fundamentals of thermodynamics and bioenergetics
2. Buffers, pH Scale, redox potential
3. Structure and functions of ATP;
4. Forces stabilizing macromolecules

Unit – II 10 Hours

Fundamentals of Enzymology:

5. Classification, mechanism of enzyme action and catalysis, Allosteric mechanism, active sites, isoenzymes, Coenzymes, steady state enzyme kinetics, Michaelis - Menten equation and its significance.
6. Conformation of proteins: secondary, tertiary and quaternary structure; domains; motif and fold, Ram Chandran's Plot
7. Protein catabolism: Lysosomal and ubiquitin targeted proteolysis.

Unit – III 10 Hours

Photochemistry and Photosynthesis and Carbohydrate Metabolism:

8. General concept, Photosynthetic apparatus, Photosynthetic cycle, pigments, light harvesting and non-cyclic complexes, Photo-oxidation of water, electron and proton transport, Photophosphorylation.
9. Carbon assimilation – the calvin cycle (C_3 cycle), Photorespiration and its significance, the C_4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

Unit – IV 10 Hours

Respiration and fatty acid metabolism:

10. Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, oxidative phosphorylation; coupled reaction group transfer biological energy transducers,
11. Pentose phosphate pathway, glyoxylate cycle, alternative oxidase system;
12. Structure and function of fatty acids, biosynthesis and their catabolism.

Unit – V 10 Hours

Nitrogen and sulphur metabolism:

13. Overview of biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, nucleotide metabolism.
14. Sulphur uptake, transport and assimilation.

Secondary metabolites:

15. Elementary idea of secondary metabolities like alkaloids, lignin and phenolics (terpenes, phenols) with emphasis on flavonoids.

Course XI : Plant Ecology and Phytogeography 50 Hours

Unit – I 10 Hours

1. Ecological factors (light, air, water, topographic, edaphic, biotic)
2. Ecological concepts of species: Genecology and Ecological niche.
3. Population Ecology: Basic concepts, characteristics of population and population structure.
4. Community Ecology: Composition, characters, structure, origin and development of community: methods of study of structure of community.

Unit – II 10 Hours

5. Ecological succession: Process concept and trends. Climax. (Xerosere, hydrosere)
6. Ecosystem Ecology: Structure and functions, with example of a natural and artificial ecosystem, Energy flow in ecosystem.
7. Production Ecology: Measurement methods and productivity in different ecosystems.

Unit – III 10 Hours

8. Preliminary Knowledge of I.B.P. (International Biological Programme), M.A.B (Man and Biosphere Programme).
9. Pollution: Kinds of pollution (Air, Water, Soil and Noise) and green house gases, Ozone hole, and global warming.

Unit – IV 10 Hours

10. Recycling of waste: Biogas, utilization and disposal of organic wastes and inorganic wastes,
11. Biodiversity and It's conservation.
12. Biogeochemical cycles of C,N,P,S, and Hydrological cycle, Nutrient sources, Nutrient budgets in terrestrial communities and aquatic communities.
13. Soil erosion and conservation, rainwater harvesting, chipko movement, van mahotsava, Afforestation, reforestation.

Unit – V 10 Hours

Phytogeography

14. Principles of phytogeography, vegetation types and Phytogeographical regions of India. Age and area hypothesis, continental drift, endemism, Hot spots, Plant exploration. Invasion and introduction.
15. Remote sensing: Concepts, principles, processes, tools, techniques in acquisition of R.S. data. Application in ecological and meteorological research

Course XII: Elementary Biotechnology 50 Hours

Unit – I 10 Hours

1. Definition, Basic concepts, Principles and scope of Biotechnology.
2. Recombinant DNA technology, basic concept in genetic engineering, tool and techniques of recombinant DNA technology.
3. Enzymology of genetic engineering: Restriction enzymes, DNA ligase, Polymerase etc.

Unit – II 10 Hours

4. Cloning vehicles: Plasmids, Cosmids, Lambda phage, Charon phage, shuttle vectors, 2μ DNA plasmids, yeast plasmids.
5. Gene cloning: principles and techniques, choice of vectors, DNA synthesis and sequencing, Analysis and expression of cloned genes in host cells, Polymerase chain reaction (PCR), RFLP, DNA finger printing (Southern and Northern blotting), gene therapy, Genetic counselling.
6. Gene libraries: mRNA isolation, cDNA synthesis, cloning and amplification of gene libraries, Genomic DNA libraries, YACs, BACs Transposable elements, techniques of gene mapping and chromosome walking.

Unit – III 10 Hours

7. Transgenic (Genetically modified) Plants: Genetic engineering of plants, Aims, strategies for development of transgenic plants (with suitable examples, *Agrobacterium* – the natural genetic engineer, T-DNA and transposon mediated gene-tagging, chloroplast mediated transformation and its utility,
8. Intellectual Property Right (IPR), possible ecological risk and bioethics.

Unit – IV 10 Hours

9. Plant cell and Tissue culture: General introduction, history, scope, cell and tissue culture techniques.
10. Design and functioning of tissue culture laboratory.
11. Cell proliferation measurements, cell viability testing, culture media preparation and cell harvesting methods, concepts of cellular differentiation and totipotency.

Unit – V 10 Hours

12. Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitation of protoplast research.
13. Application of plant tissue culture: clonal propagation, artificial seed, production of hybrids and somaclones, organ culture, production of secondary metabolites, natural products, cryopreservation and germplasm conservation.

Course XIII: Modern Phytotechniques and Biostatistics 50 Hours

Unit I 10 Hours

Basic Botanical techniques:

1 Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram's stains, Acetocarmine

2. Microtomy: dehydration, clearing and embedding of material, section cutting, dewaxing.
3. Collection and preparation of herbarium sheets; preservation and storage of plant materials

Unit II 10 Hours

Biophysical methods

4Instrumentation, principle and Methods of fractionation- Cell sorting, Chromatography, Electrophoresis, Centrifugation, X- ray diffraction

Unit III 10 Hours

Methods of quantitative analysis-

1. Spectrophotometry, MS, NMR, ESR, ORD/CD spectrometers,
2. Radioisotopic methods: Geiger Muller & Liquid Scintillation Counters.
3. Immunological methods: immunodiffusion, immuno- electrophoresis, crossed immuno-electrophoresis, counter- RIA, ELISA , Immunoblotting

Unit IV 10 Hours

Statistical methods

1. Classification and presentation of data, , graphical presentation: frequency polygon and curve, &cumulative frequency curve. Distribution
2. Measures of Central tendency: mean, mode, median and their properties .
3. Measures of dispersion: Mean deviation, standard deviation and coefficient of variation.

Unit V 10 Hours

11. Simple correlation, coefficient and regression,
12. Principle of experimental designs, randomized block and latin square designs and analysis of variance (ANOVA).
13. Tests of significance, t-tests, X_2 test for goodness of fit.

Course XIV: Biodiversity Conservation and Plant Resources 50 Hours

Unit - I 10 Hours

1. Biodiversity: Definition; factors responsible for determination of Biodiversity;
2. Global concern over climate change.
3. Levels of Biodiversity: Genetic, Species, Ecological, Evolutionary and Agrobiodiversity.
4. Diversity Measures: (Diversity Indices)- Alpha(α), Beta (β), Gamma(γ) Diversity.

Unit - II 10 Hours

5. Biodiversity Conservation Initiatives

a) *In situ* Stratagy : National parks, Wild life sanctuaries, biosphere reserves and world heritage sites.

b) *Ex-situ* Stratagy : By seeds, reclamation, Afforestation, tree Plantation, seed banks, gene banks, cryobanks

c) General account of activities of BSI, NBPGR for conservation and non-formal conservation efforts

d) Restoration or Rehabilitation of Endangered species.

Unit - III 10 Hours

6. Biodiversity at world level: Biodiversity at global and country level, wild plant wealth.
7. Ecosystem diversity in India: Desert, forest, Grassland ecosystem, wetland, Mangroves.
8. Species Diversity: Endemic species, cultivated plants/Agro- diversity, Endangered plants.

Unit - IV 10 Hours

9. Loss of Biodiversity:

a) Causal factors – Developmental pressure, encroachment, exploitation, human induced and natural floods, earthquake, cyclone, landslides, Disaster management.

b) Threat to Ecosystem, species and genetic Diversity.

Categories of threats : Endangered, Vulnerable, Rare and Threatened

Unit - V 10 Hours

10. Plant resources, Concept, Status and Concern
11 Basic concepts of local plant diversity and its economic importance
12. World centres of primary diversity of domesticated plants
13. Biodiversity protection laws and policies, management of natural resources.

ELECTIVE COURSES

Course XV: Recombinant DNA Technology **50 Hours**

Unit – I **10 Hours**

1. Genetic Engineering – Definition and explanation, restriction enzymes and restriction modification system.
2. Cloning and expression vectors – Definition and explanation: plasmids, cosmids, phagemids, fd, fl, and M13 vectors, transposons vectors.
3. Artificial chromosomes as vector.
4. Expression vectors; Use of promotors and expression cassettes, Virus expression vectors, binary and shuttle vectors.

Unit – II **10 Hours**

5. Reconstruction of chimeric DNA – staggered cleavage, addition of Oligopolymer tailing, blunt end ligation.
6. Cloning in bacteria vs. cloning in Eukaryotic cells.
7. Preparation of molecular probes and their uses; labeling of probes, radioactive vs non-radioactive. Techniques used in probing DNA, RNA & Protein electrophoresis, Southern, Northern and Western blotting.
8. Techniques of restriction mapping.

Unit – III **10 Hours**

9. Polymerase chain reaction – Principles, techniques and modification, gene cloning vs. PCR, application and uses of PCR.
10. Chromosome walking, Chromosome jumping, Chromosome landing, map based cloning.
11. Compliment DNA, its cloning and cDNA library.

Unit – IV **10 Hours**

12. RFLPs & RAPD and their applications.
13. Gene sequencing.

Unit – V **10 Hours**

14. Protein Engineering- definition and explanation, Steps involved, methods used, Achievements and future prospectus.
15. Drug designing – methods used, blocking enzyme activity, blocking hormones receptors, inhibition of DNA/RNA synthesis.
16. Chemical synthesis vs recombinant DNA technology in protein engineering and drug designing.

Course XVI: Plant Cell, Tissue and Organ Culture 50 Hours

Unit – I 10 Hours

1. Planning and organization of tissue culture laboratory; Basic techniques of plant tissue culture.
2. Induction and maintenance of callus and cell suspension culture.
3. Study of differentiation through organogenesis and embryogenesis.

Unit – II 10 Hours

4. Cell line selection through suspension culture for the production of stress resistant plants, their application in crop improvement.
5. Tissue culture techniques for haploid production and their application in agriculture.
6. Meristem culture for mass and clonal propagation of ornamental plants, virus resistant plants and forests trees.

Unit – III 10 Hours

7. In-vitro Pollination, shotgun wedding, embryo rescue technique and embryo culture.
8. Encapsulation of somatic embryos and shoot apices for artificial seeds.
9. Cryopreservation techniques for germplasm conservation.

Unit – IV 10 Hours

10. Protoplast isolation, culture and regeneration.
11. Somatic hybridization and selection mechanism for hybrids and cybrids, with special reference to crop plants.
12. Delivery systems for gene transfer in plant through co-cultivation of explants and *Agrobacterium* or thorough direct methods-electroporation, silicon carbide method.

Unit – V 10 Hours

13. Transgenic plants: Use of transgene for – herbicides, insecticides, virus, drought, salinity and insect resistance; male sterility and restoration systems, molecular forming.
14. Industrial application of plant tissue culture for:

i) Secondary metabolism for commercial purpose.
ii) Scale up and down stream processing for secondary metabolites.

Course XVII: Microbial Biotechnology 50 Hours

Unit – I 10 Hours

1. Sources and characters of industrial microbes, their isolation and methods for induction of mutations; stabilization of mutants and their isolation.
2. Fermentation technology; microbial growth, application of fermentation; batch, fed batch and their continuous cultures of microbes.
3. Patent protection for biological inventions.

Unit – II 10 Hours

4. Bioreactors: Principles and their design.
5. Microbial transformations with special reference to steroids and alkaloids, polysaccharides.

Unit – III 10 Hours

6. Microbiology and up gradation of alcoholic beverages.
7. Commercial production of organic acids like acetic, lactic, citric and gluconic acids.
8. Commercial production of important amino acids, insulin, steroids, vitamins and perfumes.
9. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.

Unit – IV 10 Hours

10. Immobilization of microbial enzymes and whole cells and their applications in industries.
11. Use microbes in food, feed and dairy; Bioprocess engineering; Down stream processing, various steps for large-scale protein purification.
12. Single cell proteins, physiological aspects, SCP from hydrocarbons, waste materials and renewable resources, improvement in SCP production.
13. Industrial sources of enzymes; Cellulases, Xylanases, Pectinases, Amylases, Lipases, and Proteases, their production and applications.

Unit – V 10 Hours

14. Bioconversion of waste for fuel and energy.
15. Petroleum Microbiology
16. Commercial production of biofertilizers and biopesticides.

Course XVIII: Biotechnology- II: Environmental Biotechnology 50 Hours

Unit – I 10 Hours

1. Pollution and Pollutants: Cost of pollution, Kinds of Pollution and Pollutants- Air, Water, and Soil Pollution, Their effects on Plants and Ecosystems;
2. Role of Plants in Pollution Management.

Unit – II 10 Hours

3. Climate Change: Greenhouse Gases (CO_2, CH_4, N_2O, CFCs: sources and roles), Ozone layer and Ozone hole, Consequences of Climate change (acid rain, global warming, sea level rise, UV radiation).

Unit – III 10 Hours

4. Ecosystem Stability: Concept (resistance and resilience), Ecological Perturbations (natural and anthropogenic) and Their Impacts on Plants and Ecosystems, Ecology of Plant Invasion, Environmental Impact Assessment (EIA), Ecosystem Restoration.
5. Environment and energy, Energy resources – Renewable and Non-renewable. Natural resources, Loss of Diversity, causes and consequences, Environmental Auditing, Conservation of Biodiversity.

Unit – IV 10 Hours

6. Ecological Management: Concepts, Sustainable Development, Remote sensing and GIS as Tools for Resources Management.

Unit – V 10 Hours

7. Phytoremediation: Prevention and Control, Methods of reducing Environmental impacts of Chemicals, Weedicides, Pesticides and Fertilizers. Biotechnological advances in pollution control through GEMs.

Course XIX: **Stress Physiology of Plants** **50 Hours**

Unit-I **10 Hours**

1. Biological stress vs. Physical Stress, Types of stresses and general methods of measurement of stress response (Strain),
2. Stress physiology in crop improvement
3. Response to UV stress: Injury and resistance mechanism

Unit- II **10 Hours**

4. Response to low temperature stress: Chilling, freezing, frost injury and mechanism of resistance, Adaptations
5. Response to high temperature stress: Injury and mechanism of resistance, Heat shock proteins, Adaptations

Unit –III **10 Hours**

6. Response to nutrient deficiency stress
7. Heavy metal stress, injury and mechanism of resistance, adaptations
8. Salinity stress, Ionic and salt stress injury, mechanism of resistance

Unit-IV **10 Hours**

9. Response to water deficit: Desiccation, Dehydration injury; Mechanism of resistance, Adaptations
10. Response to water excess: Flooding, hypoxia, Mechanism of resistance, Adaptations

Unit-V **10 Hours**

11. Causative agents for Biotic Stresses
12. Mechanism of Resistance against Fungal, Bacterial and viral pathogens

Course XX: **Applied Plant Physiology** **50 Hours**

Unit –I **10 Hours**

Crop Productivity

1. Role of crop physiology in agriculture,
2. Crop growth and productivity, phenology-crop productivity, growth factors related to biomass - concept of growth rates- canopy photosynthesis (leaf area and net assimilation rates as determining factors).
3. Light interception as a major function of leaf area-index, LAD canopy architecture- Light extinction coefficient relative growth rate. Net assimilation rate. Biomass and yield relations. Assimilate partitioning, yield and yield structure analysis.

Unit-II **10 Hours**

Physiology of Crop species

4. Concept of source and sink, factors influencing source and sink size and productivity. Environmental factors determining crop growth. Light, temperature and VPD, effect of photoperiod and thermoperiod on duration of growth stages.
5. Growth and development of crop species. Juvenility, shoot growth, types of shoots, patterns of shoot growth, cambial growth and its regulation. Physiological aspects of pruning and dwarfing.
6. Growth measurements. Water relations of tree species, water uptake and transport. Concepts of transpiration rate and water use efficiency. Sexual and asexual propagation.
7. Rootstock and scion interactions.

Unit-III **10 Hours**

Post-Harvest Physiology

8. Senescence and ageing in plants. Ethylene – the senescence hormone, leaf senescence. Monocarpic plant senescence. Biochemistry and molecular biology of flower senescence.
9. Gene expression during senescence.
10. Concept of physiological maturity of seeds - post harvest changes in biochemical constituents in field crops - loss of viability, loss of nutritive value, environmental factors influencing post-harvest deterioration of seeds.

Unit-IV **10 Hours**

11. Physiological and biochemical changes during fruit ripening and storage. Senescence and post harvest life of cut flowers.
12. Physical, physiological and chemical control of post - harvest deterioration of fruits, vegetables and cut flowers and its significance during storage and transport.
13. Molecular approach in regulation of fruit ripening. Transgenic technology for improvement of shelf-life.

Unit-V **10 Hours**

Chemistry of Plant Production Chemicals

1. Essential plant nutrients (major, secondary and micro), organic manures (farm yard, compost, sewage sludge, green manure, biogas slurries, etc.), production and manufacture and uses of various nitrogenous, phosphatic, potassic and complex fertilizers and fertilizer mixtures, liquidfertilizers, biofertilizers, integrated plant nutrient systems.
2. Nutrient use efficiency (principles and approaches). Soil conditioners and amendments.

Course XXI: Diversity in Plants, their origin and evolution 50 Hours

Unit – I 10 Hours

Sustainable Development:

1. Global movement for sustainability
2. People's mandate on sustainable development
3. Strategies for sustainable development
4. Contribution of telecommunication and information technology to sustainability
5. Social perspectives for sustainable development
6. Political perspectives for sustainable development
7. Concept of circular economy

Unit – II 10 Hours

Origin of Agriculture :

8. Meaning of Agriculture, Development of Agriculture
9. Origin of cultivated plants, Indo-Burmese Centre of Origin,
10. Contribution of Vavilov,
11. Domestication of crop plants
12. Plant introduction

Unit - III 10 Hours

Green revolution:

13. Benefits and adverse consequences, beyond green revolution
14. Plants as Avenue trees: Selection of avenues and avenue trees, planting schemes
15. Plants as Pollution control agents: Tolerance of plants to different pollutants

Unit - IV 10 Hours

Origin, evolution and cytotaxonomy of

16. Cereals and millets (wheat, paddy, bajra and jowar),
17. Legumes (peas, gram, soybean, black gram, lentil and cowpea),
18. Sugarcane and starches (beetroot, potato, sweet potato,),
19. Origin of Forage and fodder crops.

Unit - V 10 Hours

20. A general account of non-wood forest products (NWFPs) such as bamboos, gum, tannins, dyes, resins and beverages.
21. A general account of the organizations and functions of Indian Council of Agricultural Research (ICAR). Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT)

Course XXII: Elementary Knowledge of Computers and Bioinformatics 50 Hours

Unit –I 10 Hours

1. Computer System- Definition; Components (Input/Output unit, Control Unit., Primary Storage Unit, Arithmetic and Logic Unit); Types of Memory, Generation of Computers
2. Number System & Logic Gates- Application of Number Systems (Decimal Number System, Binary Number System, Hexadecimal Number System) & Conversions (Decimal to Binary, Binary to Decimal, Decimal to Hexadecimal, Hexadecimal to Binary); Addition operation in Binary Number System; Introduction to Logic Gates(AND, OR, NOT, NAND, NOR, XOR XNOR); Introduction to Software.

Unit- II 10 Hours

3. Bioinformatics - Introduction; Definition & Concept, Role of Bioinformatics, Introduction of Internet in Biology & objectivity, Services of Internet used for Biological Data, Human Genome Project.

Unit- III 10 Hours

4. Database System- Definition; Purpose of Database System; Advantages of Database System, Relational Database- Definition; Relational Data Model, Database- Primary Databases & Secondary Databases, Sequence Databases(EMBL, GenBank, DDBJ, SWISS-PROT, PIR, TrEMBL), Protein Family/Domain Databases (PROSITE, Pfam, PRINTS & SMART)

Unit- IV 10 Hours

5. Sequence comparison algorithm, Dynamic programming, Dot plot matrix, sequence scoring schemes (weight matrix as Identify scoring, genetic code scoring scheme chemical scoring, observed Substitution matrix and Gap penalties),Sequence database similarity searching algorithms, local alignment, global alignment, FAST A, BLAST (BLASTP, BLASTN, BLASTX, TBLASTN, TBLASTX) and similarity searching scores and their statistical interpretation

Unit-V 10 Hours

6. Motifs and Domains, algorithm for multiple alignments, Biological motifs, micro array, Phylogenetic prediction: Relationship of Phylogenetic analysis to sequence alignment, Genome complexity and phylogenetic analysis, concept of evolutionary trees. Maximum parsimony method, distance method, maximum likelihood method

Course XXIII: PLANT PATHOLOGY 50 Hours

Unit 1: 10 Hours

Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Physiologic specialization, Koch's postulates. Growth, reproduction, survival and dispersal of plant pathogens. Factors influencing infection, colonization and development of symptoms. Preparation and sterilization of common media. Methods of isolation of pathogens and their identification. Methods of inoculation. Measurement of plant disease. Molecular detection of pathogens in seeds and other planting materials: Nucleic acid probes, Southern, Northern and Western hybridization, ELISA and PCR.

Unit 2: 10 Hours

Mechanisms of pathogenesis: recognition phenomenon, penetration, invasion, primary disease determinants. Enzymes and toxins in relation to plant disease. Mechanisms of resistance. Phytoalexins. PR proteins. Antiviral proteins. SAR. HR and active oxygen radicals. Management of pathogens through satellite, antisense - RNA. Ribozymes, coat protein, hypovirulence, cross protection/useful genes and promoter technology, biosafety and bioethics.

Unit 3: 10 Hours

Fungal diseases of crops with special reference to etiology, disease cycle, perpetuation, epidemiology and management (Ergot of rye, Early blight of potato, Soft rot of sweet potato, Downy mildew of cereals, Brown spot of rice, Leaf spot of oat, Wilt of gram, White rust of crucifers, Club root of brassica, Fruit rot of chillies, Fruit rot of tomato, Rust of linum, Powdery mildew of Dalbergia, Black mold rot of onion, Wilt of chick pea). Post harvest diseases in transit and storage; aflatoxins and their integrated management.

Unit 4: 10 Hours

Diseases of crop plants caused by bacteria, viruses, viroids, phytoplasmas (Angular leaf spot of cotton, Potato scab, Soft rot of potato, Citrus canker, Crown gall of apple, Fire blight of apple, Tundu disease of wheat, Ear rot of wheat, Gummosis of sugarcane, Papaya mosaic/ringspot, Yellow vein of ladyfinger, Potato spindle tuber, Little leaf of brinjal). Mode of transmission and pathogen vector relationships. Epidemiology and management.

Unit 5: 10 Hours

General principles of plant quarantine. Exotic pathogens and pathogens introduced into India. Genetic basis of disease resistance and pathogenicity: gene for gene hyphothesis; breeding for disease resistance. Production of disease free seeds and planting materials. Seed certification. Chemical nature and classification of fungicides and antibiotics: their bioassay and compatibility with other agricultural chemicals; resistance to fungicides/ antibiotics; effect on environment. Spraying and dusting equipments, their care and maintenance. Important cultural practices and their role in disease management, solarization, integrated disease management (IDM). Microorganisms antagonistic to plant pathogens in soil, rhizosphere and phyllosphere microbes and their use in the control of plant diseases; soil fungistasis. Plant growth promoting Rhizobacteria (PGPRs).

Ch. Charan Singh University, Meerut

SYLLABUS

M.Sc. CHEMISTRY

I, II, III & IV Semester

Effective from 2010-11 & Onwards For Regular Students

Paper	Course	Hrs.	Marks		Total	Duration of Exam
			Ext.	Int.		
	FIRST SEMESTER					
CH 101	Inorganic Chemistry-I	60	50	50	100	3 Hrs.
CH 102	Organic ChemistryI	60	50	50	100	3 Hrs.
CH 103	Physical Chemistry-I	60	50	50	100	3 Hrs.
CH 104	Mathematics for chemists* Or Biology for Chemists *	30 2H/w	25	25	50 Qf. only 40%	2 Hrs.
CH 105	Computer for Chemists	60	50	50	100	3 Hrs.
	Lab I Inorganic Chemistry Organic Chemistry Physical Chemistry	200	100	100	200	18 Hrs 6 x 3
	Grand Total	**510**	**300**		**600**	**32 Hrs.**
	SECOND SEMESTER					
CH 201	Inorganic Chemistry-II	60	50	50	100	3 Hrs.
CH 202	Organic Chemistry-II	60	50	50	100	3 Hrs.
CH 203	Physical Chemistry-II	60	50	50	100	3 Hrs.
CH 204	Group Theory & Solid State	60	50	50	100	3 Hrs.
	Lab II Inorganic Chemistry Organic Chemistry Physical Chemistry	240	100	100	200	18 Hrs 6 x 3
	Grand Total	**480**	**300**		**600**	**30 Hrs.**

Paper	Course	Hrs.	Marks		Total	Duration of Exam
			Ext.	Int.		
	THIRD SEMESTER					
CH 301	Photochemistry & Bioorganic Chemistry	60	50	50	100	3 Hrs.
CH 302	Spectroscopy	60	50	50	100	3 Hrs.
CH 303	Bioinorganic and Biophysical Chemistry	60	50	50	100	3 Hrs.
CH 304	**Elective I**	60	50	50	50	3 Hrs.
	Lab III Analytical Chemistry Biochemistry	240	100	100	200	12 Hrs 6 x 2
	Grand Total	**480**	**300**		**600**	**24 Hrs.**
	FOURTH SEMESTER					
CH 401	Environmental Chemistry	60	50	50	100	3 Hrs.
CH 402	**Elective-II**	60	50	50	100	3 Hrs.
CH 403	**Elective-III**	60	50	50	100	3 Hrs
CH 404	**Elective-IV**	60	50	50	100	3 Hrs.
	Lab IV Organic Synthesis	240	100	100	200	18 Hrs
	Grand Total	**480**	**300**		**600**	**30 Hrs.**

* To be qualified during the course.

The students has to select the Elective Papers from the set of Elective Papers in the following areas of Specialization

1. Organic Chemistry. 2. Inorganic Chemistry
3. Physical Chemistry

Chemistry (from Egyptian *keme* (chem), meaning "earth") is the science concerned with the composition, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. It is a physical science for studies of various atoms, molecules, crystals and other aggregates of matter whether in isolation or combination, which incorporates the concepts of energy and entropy in relation to the spontaneity of chemical processes. Modern chemistry evolved out of alchemy following the chemical revolution (1773).

Disciplines within chemistry are traditionally grouped by the type of matter being studied or the kind of study. These include inorganic chemistry, the study of inorganic matter; organic chemistry, the study of organic matter; biochemistry, the study of substances found in biological organisms; physical chemistry, the energy related studies of chemical systems at macro, molecular and submolecular scales; analytical chemistry, the analysis of material samples to gain an understanding of their chemical composition and structure. Many more specialized disciplines have emerged in recent years, e.g. neurochemistry the chemical study of the nervous system.

Chemistry is the central science and impacts on all facets of our lives. An understanding of chemistry is necessary to all other sciences from astronomy to zoology. All of the materials used by engineers and technologists are made by chemical reactions and we all experience chemical reactions continuously, whether it be breathing or baking a cake, driving a car or listening to a battery driven minidisk player. Chemistry is concerned with all aspects of molecules, their physical and chemical properties, their composition and structure, their synthesis and use in the 21st century.

Chemistry is fundamental. To understand why an autumn leaf turns red, or why a diamond is hard, or why soap gets us clean, requires an understanding of chemistry. To design a synthetic fiber, a life-saving drug, or a space capsule requires knowledge of chemistry. The behavior of atoms, molecules, and ions determines the sort of world we have to live in, our shapes and sizes, and even how we feel on a given day. Chemists are very much involved in tackling the problems faced by our modern society. On a given day, a chemist may be studying the mechanism of the recombination of DNA, measuring the amount of insecticide in drinking water, comparing the protein content of meats, developing a new antibiotic, or analyzing a moon rock. So chemistry is worth studying, just because it is such a good antidote for ignorance.

3. Objectives:

The broad objectives of the course have been listed below:

1. Demonstrate broad knowledge of descriptive Chemistry.
2. Demonstrate the basic analytical and technical skills to work effectively in the various fields of chemistry.
3. Demonstrate critical thinking and analysis skills to solve complex chemical problems, e.g., analysis of data, synthetic logic, spectroscopy, structure and modeling, team-based problem solving, etc.
4. Demonstrate the ability to calculate the physical properties of chemical reagents, predict outcomes of chemical reactions, and perform critical analysis of data.
5. Demonstrate an ability to conduct experiments in the above sub-disciplines with mastery of appropriate techniques and proficiency using core chemical instrumentation and modeling methods.
6. Demonstrate the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
7. A mastery of a broad set of factual chemical knowledge concerning the properties of substances, molecules and atoms.
8. Develop skills in quantitative modeling of static and dynamic chemical systems.
9. Develop a detailed understanding of the relationship between changes in chemical composition or state and changes in energy content.

10. Develop laboratory competence in relating chemical structure to spectroscopic phenomena.
11. Students need to learn and understand the concepts of safe laboratory practices. Students should learn and understand safe disposal techniques, understand and comply with safety regulations, understand and use material safety data sheets (MSDS) and recognize and minimize potential chemical and physical hazards in the laboratory.
12. Demonstrate the ability to synthesize, separate and characterize compounds using published reactions, protocols, standard laboratory equipment, and modern instrumentation.

4. Learning and Teaching

Seminar sessions will be organized to discuss the learning objectives and to review progress at regular intervals and to provide support in topics of polymer science and technology. Students will bring their own case studies to the seminars for discussion. The seminars will also provide opportunities for students to reflect on individual jobs and to discuss the wide range of careers available and use this to expand their personal development plans.

5. Learning Outcomes

On successful completion of this module students should have the ability to:

1. think critically and analyze chemical problems.
2. present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
3. work effectively and safely in a laboratory environment.
4. to use technologies/instrumentation to gather and analyze data.
5. use the power of computers in applications in chemistry.
6. work in teams as well as independently.
7. to apply modern methods of analysis to chemical systems in a laboratory setting.

FIRST SEMESTER

CH-101 COURSE-I
INORGANIC CHEMISTRY-I 60Hrs

1. Stereochemistry and Bonding in Main Group Compounds 12 Hrs

VSEPR, Walsh diagrams (tri atomic molecules),d π-Pπ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

2. Metal-Ligand Equilibria in Solution 8 Hrs

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

3. Reaction Mechanism of Transition Metal Complexes 24 Hrs

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories. Kinetics of Substitution Reactions- acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism. Anation reactions, reactions without Metal-Ligand bond cleavage. Substitution reactions in square planer complexes, the trans effect, mechanism of the substitution reaction.

Redox reactions (electron transfer reactions) -Mechanism of one electron transfer reactions [such as Henry Taube's classical reaction of $(NH_3)_5Co^{3+}$-Cr^{2+} , Inner sphere type reactions]. Outer-sphere type reactions (cross reactions) and Marcus-Hush theory (No mathematical treatment).

4. Metal-Ligand Bonding 16 Hrs

Adjusted CFT, Limitations of crystal field theory. Octahedral, tetrahedral and square planar complexes.

CH-102 COURSE-II
ORGANIC CHEMISTRY-I 60Hrs

1. Nature of Bonding in Organic Molecules 10 Hrs

Delocalized chemical bonding, Conjugation, hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, antiaromaticity, w-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.

2. Stereochemistry 15 Hrs

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity. Enantiotopic and diastereotopic atoms, groups and faces. Stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

3. Reaction Mechanism: Structure and Reactivity 15 Hrs

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity - resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

4. Aliphatic Nucleophilic Substitution 15 Hrs

The SN2, SN1, mixed SN1 & SN2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Classical and nonclassical carbocations, Phenonium ions, nonbornyl system, Common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations.

The SNi mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

5. Aliphatic Electrophilic Substitution 5 Hrs

Bimolecular mechanisms- SE2 and SE1. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

CH-103

COURSE-III
PHYSICAL CHEMISTRY-I

I Quantum Chemistry **60Hrs**

30 Hrs

1. Introduction to Exact Quantum Mechanical Results The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

2. Approximate Methods The variation theorem, linear variation principle. Perturbation theory (first order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

3. Angular Momentum Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, operator using ladder operators, addition of angular momenta, spin, anti symmetry and Pauli's exclusion principle.

4. Electronic Structure of Atoms Electronic configuration, Russell-Saunders terms and coupling schemes, Slater-Condon parameters, term separation energies of the pn configuration, term separation energies for the dn configurations, magnetic effects: spin-orbit coupling and Zeeman splitting, introduction to the methods of self-consistent field, the virial theorem.

5. Molecular Orbital Theory Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

II Thermodynamics **30 Hrs**

1. Classical Thermodynamics Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity.

2. Statistical Thermodynamics Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers).

Partition functions - translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.

Heat capacity behaviour of solids - chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, distribution law and applications to metal. Bose-Einstein statistics - distribution law and application to helium.

3. Non Equilibrium Thermodynamics Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility.

CH-104

COURSE-IV
MATHEMATICS FOR CHEMISTS

I Vectors and Matrix Algebra **60Hrs**

10 Hrs

A-Vectors

Vectors, dot, cross and triple products etc. The gradient, divergence and curl. Vector calculus, Gauss theory, divergence theorem etc.

B-Matrix Algebra

Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, skew-Hermitian, unit, diagonal, unitary etc,) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigenvalues and eigenvectors, diagonalization, determinants (examples from Huckel theory).

Introduction to tensors; polarizability and magnetic susceptibility as examples.

II Differential Calculus **10 Hrs**

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc), exact and inexact differentials with their applications to thermodynamic properties.

Integral calculus, basic rules lor integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar), curve sketching.

III Elementary Differential Equations **7 Hrs.**

Variables-separable and exact first-order differential equations, homogeneous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. Solutions of differential equations by the power series method. Fourier series solutions of harmonic oscillator and Legendre equation etc., spherical harmonics, second order differential equations and their solutions

IV Permutation and Probability **3 Hrs**

Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the kinetic theor, of gases etc., curve fitting (including least squares fit etc.) with a general polynomial fit.

CH-104 **BIOLOGY FOR CHEMISTS** **60Hrs**

I. Cell Structure and Functions

Structure of prokaryotic and eukaryotic cells, inlracellular organel les and their functions, comparison of plant and animal cells. Overview of metabolic processes - cataboiism and anabolism. ATP - the biological energy currency.

II. Carbohydrates **8 Hrs**

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol amino sugars, N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides Structural polysaccfiandes - cellulose and chitin. Storage polysaccharicdes - starch and glycogen, Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolinlds. Role of sugars in biological recognition, Ascorbic acid.

Carbohydrate metabolism-Kreb's cycle, glycolysis. Glycogenesis and glycogenolysis. guconeogenesis, pentose phosphate pathway,

III. Lipids **6 Hrs**

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids cholesterol, bile acids, ptrostaglandins. Lipoproteins-composition and function, role in atherosclerosis,

Properties of lipid aggregates-micelles, bilayers, liposomas and their possible biological

functions. Biological membranes, Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids.

IV. Amino-acids, Peptides and Proteins **6Hrs**

Chemical and enzymatic hydrolysis of proteins to peptides. Secondary structure of proteins, forces responsible for holding of secondary structures, α-helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein- folding and domain structure. Quaternary structure.

Amino acid metabolism-degradation and biosynthesis of amino-acids, sequence determination: chemical/enzymatic/mass spectral, racemiation/detection.

V. Nucleic Acids **5 Hrs.**

Purine and pyrimidine bases of nucleic acids, & their syntheiss base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids, The chemical basis for heredity, an overview of replication of DNA transcription translation and genetic code. Chemical synthesis of mono and trinucleoside.

CH-105 COURSE-IV

COMPUTERS FOR CHEMISTS 60Hrs

This is a theory-cum-Laboratory course with more emphasis on laboratory work.

1. Introduction to Computers and Computing **8 Hrs**

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer languages. Operating systems with DOS as an example. Introduction to UNIX and Windows. Data Processing, principles of programming. Algorithms and flow-charts.

2. Computer Programming in FORTRAN/C/BASIC **12 Hrs**

The language feature are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C and the feature may be replaced appropriately. Elements of the computer language. Constants and variables. Operations and symbols. Expression. Arithmetic assignment statement input and output. Format statement. Termination statements. Branching statements such as IF or GO TO statement.

LOGICAL variables, Double Precision variables. Subscripted variables and DIMENSIONS. DO statements. FUNCTION and SUBROUTINE. COMMON and DATA statements.

Decision control structure, case4 control structure, functions, introduction to arrays, programmes based on above.

3. Programming in Chemistry **15 Hrs**

Development of small computer course involving simple formula in chemistry such as Vander Waal's equation, pH titration, kinetics, radioactive decay. Evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equation with in the Huckel theory. Elementary structural features such as bond lengths, bond angels, dihedral angels etc. of molecule extracted from a database such as Cambridge database.

4. Use of Computer Programmes **25 Hrs**

Execution of linear regression, X-V plot, Numerical integration and differentiation as well as differential equation solution programmes. Monte –Carlo and Molecular dynamics. Introduction to MS Office (MS Word, MS Excel, MS PowerPoint). Lab sessions based on MS Office package, Introduction to Internet Explorer.

PRACTICAL SYLLABUS I-SEMESTER

PHYSICAL PRACTICAL

1. To find out the strength of the given HCl solution by titrating it against N/10 NaOH using pH meter.
2. To find out the strength of the given CH_3COOH solution by titrating it against N/10 NaOH using pH meter.
3. To find out the strength of HCl and CH_3COOH in a mixture of both by titrating it against N/10 NaOH using pH meter.
4. To determine the solubility of a given salt at room temperature and also draw its solubility curve.
5. To find out the heat of solution of oxalic acid by solubility method.
6. To standardize the given $KMnO_4$ solution by titrating it against standard Ferrous Ammonium Sulphate solution.
7. To determine the critical solution temperature of phenol water system.
8. To determine the viscosity of given sample of oil at different temperature using Red Wood Viscometer.

INORGANIC PRACTICAL

1. To analyze the mixture of two components.
2. To analyze the mixture of three components.
3. To prepare Hexa-Ammine (II) Chloride.
4. To prepare potassium Dioxalato Cuprate (II) Dihydrate.
5. To prepare Potassium Trioxalato Chromate (III).
6. To prepare Tetrammine Cupric Sulphate.
7. To prepare Sodium Ferric Oxalate.
8. To prepare crystals of Potassium Tris Oxalate Aluminate (III).

ORGANIC PRACTICAL

1. To identify the given organic compound and prepare its derivatives.
2. To analyze the given organic mixture (water separation).
3. Single step preparations
   - Hydrolysis • Bromination • Nitration • Oxime formation • Reduction
   - Hoffmann Bromide reaction • Benzoin condensation reaction etc.
4. To determine the iodine value of the given fat sample.
5. To determine the saponification value of the given fat sample.

SECOND SEMESTER

CH-201 COURSE-I

INORGANIC CHEMISTRY-II 60Hrs

1. Electronic Spectra and Magnetic Properties of Transition Metal Complexes **22 Hrs**

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1-d9 states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover

2. Metal π-Complexes **18 Hrs**

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding. Structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as Ligand

3. Metal Clusters **12 Hrs**

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

4. Nuclear Chemistry **8 Hrs**

Radioactive decay & equilibrium. Nuclear Reactions, Q-value cross-sections, types of reactions, Chemical effects of nuclear transformations Fission & Fusion, Fission products & fission yields. Radioactive techniques, tracer techniques.

CH-202 COURSE-II ORGANIC CHEMISTRY-II 60Hrs

1. Aromatic Electrophilic Substitution **6 Hrs**

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

2. Aromatic Nucleophilic Substitution **5 Hrs**

The SNAr, SN 1, benzyne and SRN 1 mechanisms. Reactivity - effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

3. Free Radical Reactions **8 Hrs**

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

4. Addition to Carbon-Carbon Multiple Bonds **6 Hrs**

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

5. Addition to Carbon-Hetero Multiple Bonds **12 Hrs**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

6. Elimination Reactions **5 Hrs**

The E2, E1 and E1 CB mechanisms and their spectrum. Orientation of the double bond. Reactivity - effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

7. Pericyclic Reactions **18 Hrs**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward—Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions - conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloaddditions - antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, Sigmatropic

shifts involving carbon moieties, 3,3- and 5,5- Sigmatropic rearrangements. Claisen, Cope, Sommelet Hauser Rearrangement, Ene reaction.

CH-203 COURSE-III PHYSICAL CHEMISTRY –II 60Hrs

1. Chemical Dynamics **20 Hrs**

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions.

Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions (Belousov -Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme, reactions, general features of fast reactions, study of fast reactions by flow method: relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of molecular motions, probing the transition state, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger - Kassel-Marcus [RRKM] theories of unimolecular reactions).

2. Surface Chemistry **20 Hrs**

A. Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Elementary treatment of BET equation, catalytic activity at surfaces.

B. Micelles Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilization, micro emulsion, reverse micelles.

C. Macromolecules Polymer - definition, types of polymers, kinetics of radical polymerization, mechanism of polymerization.

Molecular mass, number and mass average molecular mass, molecular mass determination (Elementary treatment of Osmometry, Viscometry, Sedimentation and Light scattering methods), chain configuration of macromolecules, calculation of average dimensions of various chain structures.

3. Electrochemistry **20 Hrs**

Electrochemistry of solutions. Debye-Huckel - Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy -Chapman, Stern.

Over potentials, exchange current density, derivation of Butler -Volmer equation, Tafel plot.

Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces - theory of double layer at 'Semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Electrocatalysis - influence of various parameters, Hydrogen electrode. Bioelectrochemistry, Polarography theory, Ilkovic equation, half wave potential and its significance.

Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

CH-204 COURSE-IV

GROUP THEORY, SPECTROSCOPY & DIFFRACTION METHODS & SOLID STATE 60Hrs

1. Symmetry and Group Theory in Chemistry 11 Hrs

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh. Dnh etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy.

2. Unifying Principles 5 Hrs

Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scattering. Uncertainty relation and natural line width, and natural line broadening,transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels.

3. Vibrational Spectroscopy 12 Hrs

A. Infrared Spectroscopy Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, p,a,R branches, Breakdown of Oppenheimer approximation; vibrations of poly atomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal-ligand vibrations, normal co-ordinate analysis.

B. Raman Spectroscopy Classical and quantum theories of Raman effect. Pure rotational, vibrational and Vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

4. Electronic Spectroscopy 10 Hrs

A. Atomic Spectroscopy Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

B. Molecular Spectroscopy Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

C. Photoelectron Spectroscopy Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy - basic idea.

5. Magnetic Resonance Spectroscopy 10 Hrs

A. Nuclear Magnetic Resonance Spectroscopy Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant 'J'. Classification (ABX, AMX, ABC, A2B2 etc.), spin decoupling; basic ideas about instrument, NMR, studies of nuclei other than proton - 13C.

B. Electron Spin Resonance Spectroscopy Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine

coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

6. X-ray Diffraction 10 Hrs

Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity' and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran diagram.

PRACTICAL SYLLABUS II- SEMESTER

PHYSICAL PRACTICAL

1. To find out the surface tension of the given liquid by drop weight method at room temperature.
2. To determine the parachor value of given liquid.
3. To find out the surface tension of CH_3COOH, C_2H_5OH, n-Hexane at room temperature and hence calculate the atomic parachors of C, H, and O.
4. To compare the cleaning powers of two samples of detergents supplied to you.
5. To determine the critical micelle concentration of soap.
6. To find out the strength of HCl solution by titrating it against N/10 NaOH using conductometer.
7. To find out the strength of given NH_4OH by titrating it against HCl solution using conductometer.
8. To find the velocity constant of the hydrolysis of methyl acetate catalyzed by i. HCl ii. H_2SO_4
9. Determine the relative strengths of two acids i.e. HCl & H_2SO_4 by studying the hydrolysis of methyl acetate.

INORGANIC PRACTICAL

1. Acidimetry- Alkalimetry titration.
2. Oxidation –Reduction titration.
3. Silver Nitrate titration.
4. Complexometric - EDTA titration.
5. pH-metry titration.
6. To estimate Copper and Nickel in the given solution.
7. To estimate Iron and Nickel in a given solution.

ORGANIC PRACTICAL

1. Analysis of binary organic mixtures
   • Separartion with $NaHCO_3$ • Separation with NaOH • Separation with HCl
2. Two step preparations
   • To prepare Anthranilic Acid from Phthaic Anhydride. • To prepare o- Chlorobenzoic Acid from Phthalamide. • To prepare Benzil from Benzaldehyde. • To prepare Benzanilide from Benzophenone.

THIRD SEMESTER

PAPER-I PHOTOCHEMISTRY (COMPULSROY FARALL BRANCHES)

1. Basic of Photochemistry

Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped Flow techniques, Energy dissipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages-primary and secondary processes.

2. Photochemical Reactions

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited

molecule, quantum, yield, transfer of excitation energy, actinometry.

3. **Properties of Excited States**
Structure, dipole moment, acid-base strengths, reactivity. Photochemicalkinetics-calculation of rates of radiative processes. Bimolecular deactivation quenching.
4. **Determination of Reaction Mechanism**
Classification, rate constants and life times of reactive energy states-determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical-photo-dissociation, gas-phase photolysis.
5. **Photochemistry of Alkenes**
Intromolecular reactions of the olefinic bond-geometrical isomerism, cyclisat ion reactions, rearrangement of 1,4 and 1,5-dienes,
6. **Photochemistry of Carbonyl compounds**
Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β, γ–unsaturated and α, β, unsaturated compounds; Cyclohexadienones. Intermolecular .....buchi Reaction.
7- **Photochemistry of Aromatic Compounds**
Isomerisations, additions and substitutions.
8. **Miscellaneous Photochemical Reactions**
Photo-Fries reactions of anilides. Photo Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photo degradation of polymers, Photochemistry of vision.

PAPER-II SPECTROSCOPY (COMPULSORY FOR ALL BRANCHES)

1. **Ultraviolet Visible Spectroscopy**
Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds ultraviolet spectra of aromatic and heterocyclic compounds Steric effect in biphenyls.
2. **Infrared Spectroscopy Instrumentation and sample handling.**
Characteristic vibrational frequencies of alkanes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines, Detailed study of Vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds), Effect of hydrogen bonding and solvent effect on vibrational frequencies. Symmetry and shapes of AB, A_2, AB_2, AB_3, AB_4, AB_5, and AB_6, mode of bonding of ambidentate ligand, ethylenediamine and diketonato complexes, application of resonance
3. **Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD)**
Definition, deduction of absolute configuration, octant rule for ketones.
4. **Nuclear Magnetic Resonance Spectroscopy**
General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism, of measurement chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), Intensity of NMR regnals, chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra) virtual coupling, stereochemistry hindered rotation, karlus curve variation of coupling constant with dihedral angle. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transforms technique, Nuclear Overhauser Effect

(NOE) Resonance of other nuclei-F, P. Some applications including biochemical systems.

5. **Carbon-13 NMR Spectroscopy**
General Considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants, Introduction to 2 D NMR.
6. **Electron Spin Resonance Spectroscopy**
Hyperfine coupling, spin polarization for atoms and transition metalions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as pH_4, F_2- and (BH3).
7. **Mossbauer spectrocopy**
Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin, (2) Sn^{2+} and Sn^{4+} compounds –nature of M-L bond, coordination number, structure and (3) detection of oxidation state and in equivalent MB atoms.

PAPER-III ANALYTICAL CHEMISTRY (COMPULSORY FOR ALL BRANCHES)

1. **Introduction**
Classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting an analytical method.
2. **Errors and Evaluation :**
Definition of terms of mean and median, precision-standard deviation, relative standard deviation, accuracy, absolute error. Types of error in experimental data-determination (systematic), intermediate (random) and gross. Sources of errors and the effect upon the analytical results methods for reporting analytical data. Statistical evaluation of data indeterminate errors. The use of statistics.
3. **Radiochemical methods :**
Elementary working, Principles of Geiger Muller, Ionization, proportional and γ-ray counters. Neutron radiation sources, radio tracer techniques. Nautron Activation Analysis (NAA) : Principle, Techniques and applications in preparation of some commonly used radioactive isotopes. Use of radioactive isotopes in analytical and physiochemical problems, Isotopic Dilution Analysis (IDA), substoichiometric IDA, advantages and limitations of IDA and comparison of IDA with NAA. Principle of Radiometric Titrations, Types, Experimental techniques and its applications.
4. **Thermal methods of Analysis :**
Introduction of different thermal methods, Thermogravimetry- TGA & DTA, static thermogravimetry, quasithermogravimetry and dynamic thermogravimetry, Instrumental and balances, X-Y recorder, thermogram, factors affecting thermograms. Application of thermogravimetry.
Differential Scanning Calorimetry (DSC) : Introduction, instrumentation, DSC-curves, factors affecting DSC curves and applications.
Thermometric Titrations : Introduction, Instrumentation, apparatus, theory and applications.
5. **Chromatographic Techniques :**
Adsorption and Partition Chromatography, Paper Chromatography, Thin Layer chromatography Ion exchange and Gas chromatography, HPLC, Size Exclusion Chromatography, their principles, techniques and important applications.

6. Electroanalytical Techniques :

A- Voltametry : General introduction, Principle, Instrumentation, types of Voltammetry Paleography (Principle & Instrumentation), Cyclic Voltammetry, Pulse Methods. Stripping Technique : Anodic and Cathodic Stripping Voltametry and their applications in the trace determination of metal ions and biologically important compounds.

B. Ion Selective Electrodes : Electrical Properties of membrane, Glass electrode with special reference to H^+, Na^+, K^+ ions, operation of solid membrane electrode, operation of liquid membrane electrode, coated type ion electrode. Applications of ion selective electrode in determination of some toxic metal and some anions (F^-, Cl^- Br, I^-, and NO^-_3).

PAPER-IV BIOINORGANIC CHEMISTRY ELECTIVE 1

1. Introduction:

Chemistry of amino acids proteins and their derivatives; methods of isolation and identification; Primary, secondary, tertiary and quaternary structures of proteins; determination and biochemical applications of the structures proteins; Nomenclature of nucleosides and nucleotides; Effects of acid and alkali on hydrolysis of nucleic acids; Structure of DNA and RNA ; prokaryotic versus eukaryotic organisms.

2. Metal Ions in Biological Systems :

Essential and trace metals.

3. Na+/K+ pump :

Role of metals ions in biological processes.

4. Bioenergetics and ATP Cycle

Standard Gibbs energy change in biochemical reactions, exergonic and endergonic. Hydrolysis of ATP, synthesis of ATP and ADP. DNA polymerization, glucose storage, metal complexes in transmission of energy, chlorophylls, photo system I and photo system iI in cleavage of water.

5. Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

6. Electron Transfer in Biology

Structure and function of metalloproteins in electron transport processcytochromes and ion-sulphur proteins, synthetic models.

7. Nitrogenase

Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model systems.

PAPER-IV BIOORGANIC CHEMISTRY ELECTIVE 1

1. Introduction:

Chemistry of amino acids proteins and their derivatives; methods of isolation and identification; Primary, secondary, tertiary and quaternary structures of proteins; determination and biochemical applications of the structures proteins; Nomenclature of nucleosides and nucleotides; Effects of acid and alkali on hydrolysis of nucleic acids; Structure of DNA and RNA ; prokaryotic versus eukaryotic organisms.

2. Enzymes :

Introduction and historical perspective, Chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fisher's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelismeten and Lineweaver-Burk Plots, reversible and irreversitble inhibition.

3. Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, rebonuclease, lysozyme and carboxypeptidase A.

4. Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates, intermediates in isomerization reactions, cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

5. Co-Enzyme Chemistry

Co-Factors as derived from vitamins, co-enzymes, prosthetic groups, apoenzymes. Structure and biological functions of co-enzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B12 Mechanisms of reactions catalyzed by the above co-factors.

6. Enzyme Models

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, crown ethers. Cyptates. Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzyme of synzymes.

7. Biotechnological Applications of Enzymes

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and chesse-making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy.enzymes and recombinant DNA technology. Application of enzymes in organic synthesis.

PAPER-IV BIOPHYSICAL CHEMISTRY ELECTIVE 1

1. Introduction:

Chemistry of amino acids proteins and their derivatives; methods of isolation and identification; Primary, secondary, tertiary and quaternary structures of proteins; determination and biochemical applications of the structures of proteins; Nomenclature of nucleosides and nucleotides; Effects of acid and alkali on hydrolysis of nucleic acids; Structure of DNA and RNA ; prokaryotic versus eukaryotic organisms.

2. Biological Cell and its' Constituents

Biological cell, Structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition.

3. Bioenergetics

Standard Free energy change in biochemical reactions, exergonic, endergonic Hydrolysis of ATP, synthesis of ATP from ADP.

4. Statistical Mechani in Biopolymers.

Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

5. Biopolymer interactions

Forces involved in biopolymer interactions. Electrostaic charges, and molecular expansion, hydrophobic forces. Dispersion force interactions. Multiple equlibria and various types of binding processes in biological systems. Hydrogen ion titration curves. DNA Protein Interaction.

6. Thermodynamics of Biopolymer Solutions

Thermodynamics of biopolymer soluctions, osmotic pressure, membrane equilibrium. muscular contraction and energy generation in mechnochemical system.

7. Cell Membrane and Transport of Ions

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

8. Biopolymers and their molecular Weights

Evaluation of size, shape molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion. Sedimentation velocity, viscosity, electrophoresis and rotational motions.

III SEMESTER ANALYTICAL PRACTICAL

1. To verify Lambert's Beer's Law with the help of U.V. visible spectrophotometer.
   a. To determine max of a given sample.
   b. To determine the concentration of unknown sample with the help of U.V. visible spectrophotometer.
2. To determine the concentration of Na^+, Ca^+, K^+ with the help of flame photometer.
3. To scan the U.V. visible spectra of unknown sample with the U.Vvisible double beam spectrophotometer.
4. To determine the calorific value of unknown sample.
5. To determine the degradation peak. Tg, Tm of unknown sample with the help of DSC.
6. To determine kinematic viscosity of plasticizer with the help of Redwood viscometer.
7. To determine the dynamic viscosity of polymeric plastcizer at different temperature with the help of Brook field viscometer.
8. To separate the chlorophyll pigments with the help of TLC.
9. Apply paper chromatography to separate.
   a. The chlorophyll pigments. b. Lead anions and cations.
10. To separate the amino acids with the help of TLC.
11. To determine formation constant of Fe SCN^{-2} compounds by conductometry.
12. To determine rate constants & formation constants of intermediate complex in the reaction of Cerium (IV) ammonium nitrate and hypo phosphoric acid in avid medium.

BIOCHEMISTRY PRACTICAL

1. To make a phosphate buffer of pH.
2. Qualitative test for carbohydrates. Molish's Iodine, Scliwanhoff, Benediet, Anthrone, Barfoed, Fehling, Bial's Test
3. Qualitative test for lipids.
   Acrolien test for presence of FA, Test for unsaturation of FA.
4. Determination of acid value of fats and oils.
5. Determination of saponification value of fats and oils.
6. Determination of Iodine no. of a fat sample.
7. Qualitative test for Amino acid and protein.
   Ninhydrin, Million's, Sakaguchi, Xanthoproteic, Biuret.
8. To detect Ketone bodies in urine sample.
9. Separation of plant pigmen by TLC.
10. Estimation of amylase activity in saliva.
11. To Know blood group in given sample of blood.
12. To have RBC and WBC count.
13. To estimate glucose in urine sample.
14. To estimate sugar in blood.
15. To prepare casein protein from milk and its estimation.

FOURTH SEMESTER

Contents:

1) **Compulsory Paper: Environmental Chemistry**
2) **Any 3 papers are two be selected out of the set of 5 papers of each branch:**
   a) **5 papers for Inorganic chemistry**
   b) **5 papers for Organic chemistry**
   c) **5 papers for Physical chemistry**

Compulsory Paper

CH-401 ENVIRONMENTAL CHEMISTRY

1. Environment

Introduction. Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C, N, P, S and O. Biodistribution of elements.

2. Hydrosphere

Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle.

Aquatic pollution - inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters - dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms. Water quality standards.

Analytical methods for measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.), residual chloride and chlorine demand.Purification and treatment of water.

3. Soils

Composition, micro and macro nutrients, Pollution - fertilizers, pesticides, plastics and metals. Waste treatment.

4. Atmosphere

Chemical composition of atmosphere - particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals, chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls and their chemistry.

Analytical methods for measuring air pollutants. Continuous monitoring instruments

5. Industrial Pollution

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy, Polymers, drugs etc. Radionuclide analysis. Disposal of wastes and their management.

6. Environmental Toxicology

Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes. Bhopal gas tragedy, Chernobyl, Three Mile Island, Sewal D and Minamata disasters.

5. SPECIAL PAPERS OF INORGANIC CHEMISTRY

(any 3 are to be selected)

INORGANIC CHEMISTRY SPECIAL-I

(Special topics in Inorganic Chemistry)

1. Advanced inorganic compunds:

Chemistry of inorganic rings, cages and metal cluster compounds, borazines,

phosphazenes, polyhedral boranes, carboranes, metalloboranes and metallocarboranes. Silicates and aluminosilicates

Classifications, structure, properties and applications of naturally occurring silicates and aluminosilicates. Syntheses of pillared clays, and zeolites. Characterization of clays, pillared clays and zeolites from measurement of surface area, surface activity pore size, distribution and interlayer spacing. Application of clays, pillared clays and zeolites with emphasis of catalyses.

2. Macrocyclic Complexes:

Types of macrocyclic ligands-design and synthesis of co-ordination template effect, di- and poly- nuclear macroscopic complexes.

3. Organotransition metal chemistry:

General introduction, Structure and bonding, Survey of organometallic complexes according to ligands. p bonded organometallic compounds including carbonyls, nitrosyls, tertiary phosphines, hydrides, alkene, alkyne, cyclobutadiene, cyclopentadiene, arene compounds and their M.O. diagrams. Metal-carbon multiple bonds. Fluxional organometallic compounds including p-allyl complexes and their characterization. Metallocycles, unsaturated nitrogen ligands including dinitrogen complexes. Futuristic aspects of organotransition metal chemistry.

4. Molecular Magnetic Materials:

Basic concepts of molecular magnetism, Types of magnetic interactions, inorganic and organic ferro-magnetic materials, low spin-high spin transitions, isotropic interactions in Cu(II) dinuclear compounds, magnetic chain compounds.

5. Metallomesogens:

Basic concepts, types of meso-phases synthetic strategies, characterization and applications

INORGANIC CHEMISTRY SPECIAL-II

1. Inorganic Materials

Introduction to the solid state, metallic bond, Band theory (Zone model, Brillouin Zones, Limitations of the Zone model); Defects in solids, p-type and n-type; Inorganic semiconductors (use in transistors, IC, etc.); Electrical, optical, magnetic and thermal properties of inorganic materials. Superconductors, with special emphasis on the synthesis and structure of high temperature superconductors. Solid State Lasers (Ruby, YAG and tunable lasers): Inorganic phosphor materials; Synthesis and advantages of optical fibres over conducting fibres. Diffusion in solids, catalysis and Zone refining of metals. Preparation of nanomaterials and their characteristic differences over bulk materials.

2. Inorganic Polymers:

Classification, types of inorganic polymerization, comparison with organic polymers, Boron-oxygen and boron-nitrogen polymers, Silicones.

3. Nuclear and Radiochemistry

Nuclear structure and nuclear stability, Nuclear Models, Radioactivity and nuclear reactions (including nuclear fission and fusion reactions). Hot atom Chemistry, Nuclear Fission and Fusion Reactors. The interaction of nuclear radiations with matter. Radiation hazards and therapeutics. Detectors and their principles. The direction of radioactivity. The counting errors and their corrections. Tracer techniques and their applications. Isotope dilution and radioactivation methods of analysis. Fission product analysis (e.g., the technique of isolating two or three different fission products of U or Th and determining the yields).

INORGANIC CHEMISTRY SPECIAL-III

(Advanced Inorganic Chemistry)

1. Introduction to the solution of multi-electron problems:

The central field approximation, angular momenta, step up and step down operators and their use in atomic spectra. Lande's interval rule. Evaluation of energy matrices using Slater's method. Wave functions forming basis for irreducible representations, direct product. Spherical harmonics and their linear combinations. Operator equivalent technique.

2. The octahedral potential:

Contribution of spherical harmonics to the octahedral potential Vxyz. Single electron in a cubic field, quantitative basis (r,?,f) for the splitting of d orbital to eg and t2g in terms of Dq, multielectron systems : the weak and strong field cases. Generation of a secular determinant for 3F term (d2) in weak field. Bethe's method of descending symmetry. Non octahedral fields, tetrahedral (including contribution of odd harmonics), trigonal and tetragonal (including Ds & Dt parameters). Spin orbit coupling and its magnitude in comparison to crystal field. Splitting of eg and t2g orbitals due to spin orbit coupling, for a d1 and d9 case. The use of double group D4' and O'. Effect of spin orbit coupling on A, E and T terms in octahedral fields.

3. Magnetism:

Types of magnetic behaviour, magnetic susceptibilities, Pascal's constants, paramagnetism in experimental simple systems where S = Ã‚Â½, van Vleck's equation, its derivation and its applications. Spin-orbit coupling and susceptibility of transition metal ions and rare earths; magnetic moments of metal complexes with crystal field terms of A, E and T symmetry, T.I.P., intramolecular effects, antiferromagnetism and ferromagnetism of metal complexes, super paramagnetism. High and low spin equilibria.

INORGANIC CHEMISTRY SPECIAL-IV

(Advanced Spectral Techniques in Inorganic Chemistry)

1. Electronic spectroscopy:

Vibrational and electronic energy levels in a diatomic molecule, potential energy level diagram. Symmetry requirements for n to p* transitions, oscillator strengths, transition moment integrals (electric dipole and magnetic dipole moment operator), selection rules, spin orbit and vibronic coupling contributions, mixing of d and p orbitals in certain symmetries. Polarized absorption spectra. Survey of the electronic spectra of tetragonal complexes. Calculation of Dq and Ã*f*Å¸ for Ni(II) Oh complexes, nephelauxetic effect, effect of s and p bonding on the energy of t2g orbitals and Dq, spectrochemical series, effect of distortion on the d orbital energy level (Td, D2d, D4h), cis and trans isomers and bonding parameters from spectra of tetragonal complexes, bonding parameters, calculation of Dq, Ds and Dt for tetragonal complexes, intervalence electronic transition, structural evidence from electronic spectra.

2. Nuclear magnetic resonance spectroscopy:

Nuclear spin quantum number and its calculation using the nuclear shell model, spin parity rules. Types of nuclei based on value of nuclear spin angular momentum quantum number, and its relation to classical magnetic moment. Behaviour of a bar magnet in a magnetic field. The NMR transition and NMR experiment, measuring chemical shifts, signal intensities and splitting. Application of chemical shifts, signal intensities and spin-spin coupling to structure determination of inorganic compounds carrying NMR active nuclei like 1H, 11B, 15N, 19F, 29Bi, 31P, 183W, 195Pt, etc. Effect of fast

chemical reactions, coupling to quadrupolar nuclei, NMR of paramagnetic substances in solution, nuclear and electron relaxation time, the expectation value of , contact shift, pseudo contact shift, factoring contact and pseudo contact shift for transition metal ions. Contact shift and spin density, p delocalization, simplified M.O. diagram for Co(II) and Ni(II). Application to planar tetrahedral equilibrium, Contrast agents.

3. Electronic paramagnetic resonance spectroscopy:

Electronic Zeeman effect, Zeeman Hamiltonian and EPR transition energy. EPR spectrometers, presentation of spectra. The effects of electron Zeeman, nuclear Zeeman and electron nuclear hyperfine terms in the Hamiltonian on the energy of the hydrogen atom. Shift operators and the second order effect. Hyperfine splittings in isotropic systems, spin polarization mechanism and McConnell's relations Anisotropy in g-value, EPR of triplet states, zero field splitting, Kramer's rule, survey of EPR spectra of first row transition metal ion complexes.

4. Nuclear Quadrupolar Resonance (NQR) Spectroscopy:

Quadrupolar moment, energy lends of a quadrupolar nuclease and effect of asymmetry parameters and energy lends. Effect of an external magnetic field, selected examples for elucidation of structural aspects of inorganic compounds using NQR spectroscopy.

INORGANIC CHEMISTRY SPECIAL-V

(Chemistry of Materials)

I. Multiphase of Materials

Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

II. Glasses, Ceramics, Composites and Nanomaterials

Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications. Microscopic composites; dispersion-strengthened and particle-reinforced, fibre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.

III. Thin Films and Langmuir-Blodgett Films

Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

IV. Liquid Crystals

Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic – nematic transition and clearing temperature-homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

V. Ionic Conductors

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors. examples and applications of ionic conductors.

VI. High Tc Materials

Defect perovskites, high Tc superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting

state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high Tc materials, applications of high Tc materials.

VII. Materials for Solid State Devices

Rectifiers, transistors, capacitors-IV-V compounds, low- dimensional quantum structures; optical properties.

INORGANIC CHEMISTRY PRACTICALS:

Note:

1. Duration of examination: Three days, six hours daily
2. One internal examiner from college and one external examiner from other university are to be appointed.
3. Total section = 05
   Total Practicals to conducted in exam. = 04
   One from section A, One from section B and any two from section C, D, E;
   But only one from one section.

Total marks	=	100
Mixture	=	40
Preparation	=	15
From C, D, E	=	20 (2x10)
Viva-voce	=	15
Record	=	10

A: Identifications/ Qualitative Determinations (all three experiments are to be performed in practice)

1. Qualitative analysis of mixtures of salts including rare element salts (soluble and insoluble) containing eight radicals including interfering.
2. Quantitative analysis of mixtures of metal ions by complexometric titrations (mixture of two metals) with the use of masking and demasking agents.
3. Determination of concentration of some metal ions, such as iron, nickel, etc. by colourimetric method.

B: Preparations (Any three are to be performed in practice) Preparation of selected inorganic compounds and their study by IF, electronic spectra, Mossbauer, ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines.

1. Sodium amide. Inorg. Synt h., 1946,2,128.
2. Synthesis and thermal analysis of group II metal oxalate hydrate. J. Chem. Ed. 1988, 65, 1024.
3. Trialkylboranes-Preparation, IR and NMR spectra.
4. $PhBCl_2$ Dichlorophenylborane-Synthesis in vacuum line.
5. Preparation of Tin(IV) iodide, Pb(IV). Preparation of ammonium hexachlorostannate $(NH_4)_2SnCl_6$, ammonium hexachloroplumbate $(NH_4)_2PbCl_6$.
6. Sodium tetra thionate $Na_2S_4O_6$.
7. Bromination of $Cr(acac)_3$. J. Chem. Edu., 1986, 63,90.
8. Separation of optical isomer of cis-$[Co(en)_2Cl_2]$ Cl. J. Chem. Soc. 1960, 4369.
9. Determination of Cr (III) complexes.
   $[Cr(H_2O)_6]NO_3$. $3H_2O$, $[Cr(H_2O)4Cl_2]$ $Cl_2.2H_2O$, $[Cr(en)_3]$ Cl_3, $Cr(ac\ ac)_3$. Inorg. Synth., 1972, 13, 184.

C: Spectrophotometric Determinations (Any two are to be performed in practice)

a) Manganese/Chromium/Vanadium in steel sample

b) Nickel/molybdenum/tungsten/vanadium/uranium by extractive spectrophotometric method.

c) Fluoride/nitrate/phosphate.

d) Iron-phenanthroline complex: Job's Method of continuous variations.

e) Zirconium-Alizarin Red-S complex: Mole-ratio method

f) Copper-Ethylene diammine complex: Slope-ratio method.

D: Flame Photometric Determinations (Any one is to be performed in practice)

a) Sodium and potassium when present together

b) Lithium/calcium/barium/strontioum

c) Cadmium and magnesium in tap water.

E: Chromatographic Separations (any two are to be performed in practice)

a) Cadmium and zinc

b) Zinc and magnesium

c) Thin-layer chromatography-separation of nickel, manganese, cobalt and zinc. Determination of R_f values.

d) Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

5 SPECIAL PAPERS OF ORGANIC CHEMISTRY

(Any 3 are to be selected)

CH-402 ORGANIC CHEMISTRY SPECIAL I

(Organic Synthesis)

1. Organometallic Reagents:

Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details:

Group I & II metal organic compounds

Li, Mg, Hg, Cd, Zn and Ce Compounds

Transition metals

Cu, Pd, Ni, Fe, Co, Rh, Cr and Ti Compounds.

Other elements

S, Si, B and I compounds.

2. Oxidation:

Introduction. Different oxidative processes.

Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated).

Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids.

Amines, Hydrazines and sulphides.

Oxidation with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate.

3. Reduction:

Introduction. Different reductive processes.

Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings.

Carbonyl Compounds- aldehydes, ketones, acids and their derivatives.

Epoxides, nitro, nitroso, azo and oxime groups.

4. Rearrangements:

General mechanistic considerations- nature of migration, migratory aptitude, memory effects.

A detailed study of the following rearrangements:Pinacol-Pinnacolone, Wagner-Meerwin, Demjanov, benzyl-Benzilic acid, Favorskii, Arndt-Eistern synthesis, Neber, Beckmann, Hoffman, Curtius, Schmidt, BaeyerVilliger, Shaprio reaction, Barton, Chichibaben, Hoffman-Lofler Freytag reaction, Wittig reaction.

5. METALLOCENES, NONBENZENOID AROMATIC AND POLYCYCLIC AROMATIC COMPOUNDS:

General considerations, synthesis and reactions of Ferrocene, Chrysene, Azulene.

CH-403 ORGANIC CHEMISTRY SPECIAL II

(Medicinal Chemistry)

1. Introduction to Medicinal Chemistry:

Introduction to important functional groups in medicinal chemistry, a century of drug research.

2. Drug design:

Strategies for drug research including various targets, lead generation/ sources for drugs, receptor and drug receptor interactions; enzymes and design of inhibitors; concept of Prodrugs, hard and soft drugs.

3. Combinatorial Chemistry:

Introduction; solid support and linkers; combinatorial synthesis of compounds on solid phase, split and mix method, premix method, spatially addressable parallel chemical synthesis, multiple synthesis; Identification of active compounds from combinatorial libraries; Analytical methods for characterization of combinatorial libraries;

Application of combinatorial libraries using solid phase chemistry.

4. Computational approaches:

Structure activity relationship, concept of QSAR, physicochemical parameters-lipopilicity, partition coefficient, electronic-ionization constants, H-bonding, steric parameters, Hammett equation, Isosterism, bioisosterism.

5. Biodisposition and implications:

Pharmacokinetics; concepts including absorption, distribution, metabolism and excretion of the drug, pharmacokinetic parameters; drug metabolism including phase I and phase II biotransformatins; mention of the uses of pharmacokinetics in drug development process. Molecular toxicology, avoidance of toxic intermediates.

6. Neuroactive agents:

The chemotherapy of the mind: Introduction, neurotransmitters, CNS depressant, General anaesthetics, mode of action of hypnotics, sedatives, antianxiety agents, bezodiazepines, buspirone, neurochemistry of mental diseases. Antipsychotic drugsthe neuroleptics, antidepressants, butyrophenone, serendipity and drug development, stereochemical aspects of neuroactive drugs. Synthesis of Diazepam, Oxazepam, Chlorazepam, barbiturates.

7. Cardiovascular agents:

Introduction , cardiovascular diseases, drug inhibitors of theperipheral sympathetic function, central intervention of the cardiovascular output, direct acting arteriolar dilators, synthesis of amyl nitrate, sorbitrate, diltiazam, quinidine, verapamil, methyldopa, atenolol, oxeprenolol.

8. Antineoplastic agents:

Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in the treatement of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors; synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, 6-mercaptopurine. Recent development in cancer chemotherapy, the hormones and natural products.

9. Local anti-infective drugs:

Introduction and general mode of action, synthesis of sulphonamide, furazolidone, naxilidic acid, eiprofloxacin, dapsone, aminosalicylic acid, isoniazid, ethionamide, ethambutol, fluconazole, econozole, gresiofulvin, chloroquin, primaquin.

CH-404 ORGANIC CHEMISTRY SPECIAL III

(Polymers)

1. Basics

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reaction. Polymerization in homogeneous and heterogeneous systems.

2. Polymer characterization

Polydispersion-average molecular weight concept. Number, Weight and Viscosity average molecular weight. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weight. End group, viscosity light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers and chemical analysis of polymers, spectroscopic methods, physical testing – tensile strength, fatigue, impact. Tear resistance. Hardness and abrasion resistance.

3. Structure and Properties

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tgrelationship between Tm & Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

4. Polymer Processing

Plastics, elastomers and fibers. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fiber spinning.

5. Properties of Commercial Polymers

Polyethylene, Polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicon polymers. Functional Polymers- Fire retarding polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney, skin and blood cells

ORGANIC CHEMISTRY SPECIAL IV

(Chemistry of Natural Products)

I. Terpenoids and Carotenoids : Classification, nomenclature, occurrence, isolation, general methods of structure, determination, isoprene rule, Structure determination, stereochemistry biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, termpeneol Menthol, Farnesol, Zingiberen.

II. Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods or structure elucidation, degradation, classification based on nitrogen heterocyclic rings, role of alkaloids in plants, Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+) Coniline, Nicoline, Atropine, Quinine and Morphine.

III. Steroids : Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholestrol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of steroids.

IV. Plant Pigments : Occurrence, nomenclature and general methods of structure determination, Isolation and synthesis of Apigenin, Luteolin, Quercetin, mytcelin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7- arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

V. Prophyrins : Structure and synthesis of Haemoglobin and Chlorophyll.

VI. Prostaglandins : Occurrence, biogenesis and physiological effects Synthesis of PGE_2 and PGF_{2a}.

ORGANIC CHEMISTRY SPECIAL V

(Heterocyclic Chemistry)

1. Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch-Sidman system) for monocyclic, fused and bridged heterocycles.

2. Aromatic Heterocycles

General chemical behaviour of aromatic heterocicles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^1H) NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

3. Non-aromatic Heterocycles

4. Heterocyclic Synthesis

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.

5. Small Rings Heterocycles

Three-membered and four membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and theitanes.

6. Benzo-Fused Five-Membered Heterocycles

.Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

7. Meso-ionic Heterocycles

General classification, chemistry of some important meso-ionic heterocycles of type-A and type-B and their applicatios.

8. Six-Membered heterocycles with One Heteroatom

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium and thiopyrylium salts and pyridines. Synthesis snd reactions of quinolizinium and benzopyrylium salts, cumarins and chromones.

9. Six-membered Heterocycles with two of More Heteroatoms

Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.

ORGANIC CHEMISTRY PRACTICALS

Note:

1. Duration of examination: Three days, six hours daily
2. One internal examiner from college and one external examiner from other university are to be appointed.
3. Total section-4

Total practicals to be conducted in the exam-4 (One from each section)

4. Marks distribution:

Total marks	=	**100**
Mixture	=	30 marks,
Preparation	=	15 marks,
Estimation of aniline	=	10 marks,
Estimation of sulphur	=	20 marks
Viva	=	15 marks,
Record	=	10 marks

Each section is to be covered in practice.

1. Analysis of ternary organic mixtures.
   - Separation with $NaHCO_3$ and water
   - Separation with NaOH and water.
   - Separation with HCl and water
   - Separation with organic solvents.
2. Three step organic preparations.
   - To prepare o-chlorobenzoic acid from phthalic anhydride.
   - To prepare benzilic acid from benzaldehyde.
   - To prepare dibenzil from benzaldehyde.
   - To prepare benzoic acid from benzophenone.
3. To determine the strength of the given aniline/phenol solution (estimation of Aniline/phenol).
4. To determine the percentage of sulphur in the given organic compound by messenger's method.

5 SPECIAL PAPERS OF PHYSICAL CHEMISTRY

(Any 3 are to be Selected)

PHYSICAL CHEMISTRY SPECIAL-I *(Solid State Chemistry)*

I. Solid State Reactions

General principles, experimental procedures, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

II. Crystal Defects and Non-Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of schottky and

III. Electronic Properties and Band Theory

Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors.

Optical Properties- Optical reflectance, photoconduction-photoelectric effects. Magnetic properties-Classification of materials : Quantum theory of paramagnetics-cooperative phenomena- magnetic domains, hysteresis

IV. Organic Solids

Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.

V. LASERS

Luminescence and lasers

VI. Recent trends in solid state chemistry

PHYSICAL CHEMISTRY SPECIAL-II *(Advanced Quantum Chemistry)*

I. Theoretical and Computational Treatment of Atoms, Molecules

Hartree-Fock Theory Review or the principles of quantum mechanics, Born-Oppenheimer approximation. Slater-Condon rules, Hartree-Fock equation, Koopmans and Brillouin theories, Roothan equation, Gaussian basis sets.

II. Configuration Interaction of MC-SCF

Introduction to CI, full and truncated CI theories, size consistency. Introductory treatment of couples cluster and MC-SCF methods

III. Semi-Empirical Theories

A review of Huckel, EHT and PPP treatments, ZDO approximations, detailed treatment of CNDO and INDO theories. A discussion of electronic energies and properties. An introduction to MOPAC and AMI with hands on experience on personal computers

IV. Density Functional theory

Derivation of Hohenberg-Kohn theorem, Kohn-Sham formulations, N- and V-representabilities; review of the performance of the existing local (e.g. Slater Xa and other methods) and non-local functional, treatment of chemical concepts with the density functional theory.

V. Computer Experiments

Computer experiments using quantum chemistry- software packages such as GAUSSIAN/GAMESS/MOPAC and modeling software e.g. MM2/AMBER/CHARM etc.

PHYSICAL CHEMISTRY SPECIAL-III *(Liquid State)*

I. General Properties of Liquids

(a) Liquids as dense gases, liquids as disordered solids, some thermodynamic relations, internal pressure and its significance in liquids, Equation of state, critical constants. Different types of intermolecular forces in liquids, different potential functions for liquids, additivity of pair potential approximation.

(b) A classical partition function for liquids, correspondence principle, configuration integral, configurational properties

II. Theory of Liquids

Theory of liquids, partition function method or model approach; single cell models, communal energy and entropy, LTD model, significant structure model.

III. Distribution Function and related Equations

Radial distribution function method, equation of state in terms of RDF. Molecular distribution functions, pair distribution function. Relationship between pair distribution function and pair potential function. The IBG equation, the HNC equation, the PY equation, cluster expansion.

IV. Methods for Structure Determination and Computational Techniques

Spectroscopic techniques for liquid dynamic structure studies, Neutron and X-ray scattering spectroscopy.

Computation Techniques- Monte Carlo and molecular dynamics methods

V. Supercooled and Ionic Liquids

Supercooled and ionic liquids, theories of transport properties; non Arrhenius behaviour of transport properties, Cohen-Turnbull free volume model, configurational entropy model, Macedo-Litovitz hybrid model, glass transition in supercooled liquids

PHYSICAL CHEMISTRY SPECIAL-IV

(Physical Chemistry in Organic reactions)

I. Concepts in Molecular Orbital (MO) and Valence Bond (VB) theories: Introduction to Huckel Molecular Orbital (MO) method as a means to explain modern theoretical methods. Advanced techniques and FMO theory. Molecular mechanics, semi empirical methods and ab initio and density functional methods. Scope and limitations of several computational programmes.

Quantitative MO theory – Huckel molecular orbital (HMO) method as applied to ethane, allyl and butadiene. Qualitative MO theory- ionization potential, Electron affinities. MO energy levels. Orbital symmetry. Orbital interaction diagrams. MO of simple organic systems such as ethane, allyl, butadiene, methane and methyl group.

Conjugation and hyperconjugation. Aromaticity.
Valence bond (VB) configuration mixing diagrams. Relationship between VB configuration mixing and resonance theory. Reaction profiles. Potential energy diagrams. Curve- crossing model- nature of activation barrier in chemical reactions.

II. Principles of Reactivity

Mechanistic significance of entropy, enthalpy and Gibb's free energy, Arrhenius equation. Transition state theory. Use of activation parameters, Hammond's postulate. Bell-Evens-polanyi principle. Potential energy surface model. Marcus theory of electron transfer. Reactivity and selectivity principles.

III. Kinetic Isotope effect

Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects.

IV. Structural Effects on Reactivity

Linear free energy relationships (LFER). The Hammet equation, substituent constants. theories of substituent effects. Interpretation of σ-values. Reaction constant ρ. Deviations from Hammet equation. Dual-parameter correlations, inductive substituent constant. The Taft model. σ_I- and σ_R scales.

V. Solvation and Solvent Effects

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of salvation. Effects of salvation on reaction rates and equilibrium. Various empirical indexes of salvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific solvation. Use of solvation scales in mechanistic studies. Solvent effects from the curve crossing model.

VI. Acids, Bases, Electrophiles, Nucleophiles and Catalysis

Acid-base dissociation. Electronic and structural effects, acidity and basicity. Acidity functions and their applications.Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The σ-effect. Ambivalent nucleophiles. Acid-base catalysis-specific and general catalysis. Bronsted catalysis. Nucleophilic and electrophilic catalysis. Catalysis by non-covalent binding-micellat catalyst.

VII. Steric and Conformational Properties

Various types of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFER. Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin-Hammet principle.

PHYSICAL CHEMISTRY SPECIAL-V *(Computational Chemistry)*

1. Fortran/C Programming and Numerical Methods

Advanced programming features of FORTRAN/C. Basic theory, discussion of algorithms and errors for the following numerical methods. Examples from chemistry should be selected for illustrating the methods. The teacher may select ANY THREE of the following subtopics considering the background of students available time etc.

a. Solutions of Equations

Bisection, regular falsi, Newton-Raphson and related methods for solving polynomial and transcendental equations. Convergence. Errors and illconditioning.

b. Linear Simultaneous Equations

Gaussian elimination, Gauss-Seidel method, Gauss-Jordan method. Pivoting strategy. Errors and ill conditioning.

c. Eigenvalues and Matrix Diagonalization

Jacobi and Householder methods, analysis of errors

d. Interpolation

Newton forward and backward difference, central differenced formulae. Lagrange and Hermite interpolation. Polynomial wiggle problem.

e. Numerical Differentiation

Solution of simple differential equations by Taylor series and Runge- Kutta methods.

f. Numerical Integration

Newton-Cotes formulae, Romberg integration, errors in integration formulae. The students should develop computer programs of the abovenumerical methods.

2. Running of Advanced Scientific Packages

The students are expected to get hands on experience of running a few selected advanced level scientific software packages after a brief introduction to the basic theory and methodology. ab *initio* quantum chemical packages such ad GAUSSIAN/GAMES with carefully designed exercises for illustrating various features of the packages. Semiempirical/ Dynamics/ Simulation packages such as MOPAC, CHARM, AMBER, QUANTA etc. Basic ideas on structure activity relation, drug and catalysis design etc.

3. Introduction to Networking and Search using Internet

4. Project

The students will develop utilities such as analysis of spectra, simulation programmes which will supplement laboratory or theory exercises in physical, organic, inorganic chemistry or biochemistry. This list is only indicative and a variety of small projects designed by the teacher based on the interest of the student ad capabilities should be worked out.

PHYSICAL CHEMISTRY PRACTICLS

Note:

1. Duration of examination: Three days, six hours daily
2. One internal examiner from college and one external examiner from other university are to be appointed.
3. One experiment each from any three sections, total three experiments are to be conducted.
4. Marks distribution

Total marks	=	100
Each experiment = 25 marks	=	75 (3x25)
Viva	=	15
Record	=	10

At least 10 experiments are to be performed in practice covering at least four sections.

A: Chemical Kinetics

1. Determine the specific rate constant for the acid catalyzed hydrolysis of methyl acetate by the Initial Rate Method. Study the reaction at two different temperatures and calculate the thermodynamic parameters.
2. Compare the strengths of hydrochloric acid and sulphuric acid by studying the rate of hydrolysis of methyl acetate.
3. Study the saponification of ethyl acetate with sodium hydroxide volumetrically.
4. Determine the specific reaction rate of the potassium persulphate-iodide reaction by the Initial Rate Method.
5. Study the kinetics of the iodination of acetone in the presence of acid by the Initial Rate Method.
6. (a) Determine the specific rotation constant for sucrose.
   (b) Study the acid catalyzed inversion of cane sugar, and find out
   (i) the order with respect to sucrose;
   (ii) the rate constant;
   (iii) Compare kinetically the strengths of two acids (HCl and H_2SO_4)

B: Conductometry

1. Determine the Cell Constant of the given conductivity cell at room temperature and

study the equivalent conductance versus square root of concentration relationship of a strong electrolyte (KCl or NaCl) and weak electrolyte (acetic acid).

2. Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law of independent migration of ions.
3. Determine the equivalent conductance, degree of dissociation and dissociation constant (Ka) of acetic acid.
4. Study the conductometric titration of hydrochloric acid with sodium carbonate and determine the concentration of sodium carbonate in a commercial sample of soda ash.
5. Study the conductometric titration of
   (i) Acetic acid vs. sodium hydroxide. (ii) Acetic acid vs. ammonium hydroxide.
   (iii) Sodium acetate vs. HCl,
   Comment on the nature of the graphs.
6. Study the stepwise neutralization of a polybasic acid e.g. oxalic acid, citric acid, succinic acid by conductometric titration and explain the variation in the plots.
7. Study the conductometric titration of a mixture of a strong and weak acid.
8. Study the estimation of potassium sulphate solution by conductometric titration.

C: Potentiometry

1. Prepare and test the Calomel Electrode.
2. Titrate hydrochloric acid and sodium hydroxide potentiometrically.
3. Determine the dissociation constant of acetic acid potentiometrically.
4. Titrate oxalic acid and sodium hydroxide potentiometrically.
5. Titrate a mixture of
   (i) strong and weak acids (Hydrochloric and acetic acids)
   (ii) weak acid (acetic acid) and dibasic acid (oxalic acid)
   (iii) strong acid (hydrochloric acid) and dibasic acid (oxalic acid) versus sodium hydroxide.
6. Titrate a solution of Mohr's salt against potassium permanganate potentiometrically.
7. Titrate a solution of Mohr's Salt and potassium dichromate potentiometrically.

D: Computational Methods

Familiarity with word processing, electronic spreadsheets, data processing, mathematical packages, chemical structure drawing and molecular modelling.

E: Thermodynamics

1. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
2. Determination of the dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

F: Spectroscopy

1. Determination of pKa of an indicator (e.g., methyl red) in (a) aqueous and (b) micellar media.
2. Determination of stoichiometry and stability constant of inorganic (e.g. ferric-salicylic acid) and organic (e.g amine-iodine) complexes.
3. Characterization of the complexes by electronic and IF spectral data.

नोट–पाठ्यक्रम बहुत ही सावधानी से प्रकाशित किया गया है। फिर भी किसी त्रुटि के लिए प्रकाशक, मुद्रक, विक्रेता उत्तरदायी नहीं है। कृपया विश्वविद्यालय द्वारा प्रकाशित पाठ्यक्रम से अवश्य चैक कर लें। 10-9-12

DEPARTMENT OF HORTICULTURE

List of Courses in M.Sc. (Ag) Horticulture

Semester	S.No.	SUBJECT CODE	TITLE OF COURSE	Max Marks Internal+External
I Semester	1.	J-1004	Fundamentals of Biostatistical Computer application	50+50
	2.	J-1061	Fundamentals of Vegetable Production	50+50
	3.	J-1062	Propagation and nursery management	50+50
	4.	J-1063	Fundamentals of Ornamental gardening	50+50
	5.	J-1065	Practical I (Based on above 4 theory courses 1-4)	200
II Sememster	6.	J-2004	Statistical methods in Agriculture	50+50
	7.	J-2061	Production technology of vegetable crops & spices	50+50
	8.	J-2062	Orchard management	50+50
	9.	J-2063	Production technology of ornamental crops	50+50
	10.	J-2065	Practical II (Based on above 4 theory courses 6+9)	200
III Semester	11.	J-3061	Fundamentals of fruit production	50+50
	12.	J-3062	Breeding of vegetables & ornamental crops	50+50
	13.	J-3063	Fundamentals of preservation of Horticultural Crops	50+50
	14.	J-3064	Post Harvest technology of Horticultural Crops	50+50
	15.	J-3065	Practical III (Based on above 4 theory courses 11-14)	200
IV Sememster	16.	J-4061	Production of fruit crops	50+50
	17.	J-4062	Breeding of fruit crops	50+50
	18.	J-4063	Processing of fruits & vegetables	50+50
	19.	J-4064	Seed Production technology of vegetables & flowers	50+50
	20.	J-4065	Practical IV (Based on above 4 theory Courses 16-19)	200

I Semester
S-104 : Fundamentals of Biostatistics & computer applications.

J-161 : Fundamentals of Vegetable Production

Unit - I
Importance, present position and future scope of olericulture in India. Food value of vegetables. Types of vegetable growing. Classification of vegetable.
Unit - II
Soil and climatic requirements of vegetables (Chilling requirement and heat unit). Irrigation and drainage management. Nutrient and fertilizer management.
Unit - III
Nursery management in vegetable growing, intercultural operations (hoeing, weeding, staking, earthing-up, inter cropping and mixed cropping).
Unit -IV
Role of plant growth regulators (PGR) in vegetable growing. Use of plastic in vegetable cultivation. Protected cultivation of vegetable crops.
Unit - V
Integrated Pest and Disease management. Integrated Nutrient management (INM). Hydroponics and Aeroponics

~~J-165 : Practical based~~

J-162 : Propagation and Nursery Management

Unit - I
Need for plant multiplication. Sexual and asexual method of propagation, their advantages and disadvantages. Seed : morphology, anatomy, maturity, seed dormancy, factors affecting dormancy and methods to overcome them. Apomixes – mono embryony, polyembryony.
Unit – II
Methods and techniques of cutting, layering, grafting and budding. Factors affecting rooting of cuttings and layering. Anatomical studies of bud union. *Stionic effects and* their influences.
Unit - III
Establishment of horticultural nursery. Selection and maintenance of mother plants, collection of scion wood, rootstock. Lifting and packing of seedling from nursery. Nursery tools and implements.
Unit - IV
Propagation structures (glasshouse, polyhouse, mist chamber, cold frames, hot beds, lath house, humidifier etc.). Role of polythene in propagation.
Unit - V
Use of plant growth regulators (PGR) in sexual and asexual propagation. Disease and insect pest management of nursery plants. Micro-propagation.

Fundamentals of Bio-statistics and Computer Applications (J-1004)

1. **Processing data:**
   Introduction to Statistics, Classification and tabulation of statistical data, frequency distribution, diagrammatic and graphical representation of data-bars, circles, rectangles, histogram, frequency polygon, frequency curve and cumulative frequency curves.
2. **Measures of central Tendency and Dispersion:**
   Mean, Median, Mode, Qualities and Calculation of median, mode and quartiles by graphs, range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation and standard error of mean
3. **Probability and Distribution:**
   Random experiment, events-exhaustive, mutually exclusive, equally likely, independent and favorable, definition of probability (with simple exercise), Law of addition and law of multiplication of probability (with simple ex.), random variable – discrete and continuous, definitions of Binomial, Poison and Normal distributions and simple properties of the above distributions (without derivation)
4. **Correlation and Regression:**
   Bivariate data, bivariate frequency distribution, simple correlation, Karl pearson's correlation coefficient, linear regression, regression lines, regression coefficients and their relation with correlation coefficient, multiple regression, multiple and partial correlation coefficients (for three variables only).

5. **Computer Application:**
   - **Introduction to Computer:** - Definition, History, Generation of development, Characteristics of computers, benefits and application of computers
   - **Organization of Computer- Hardware:** - Inputs devices, output devices, CPU, storage unit, Software, Types of software, application of software, system software, utility software, general purpose software. Binary number system and its conversion, Intermodulation to statistical packages (Excel, SPSS, SYSTAT, Sigma stat).

J-163 : Fundamentals of Ornamental Gardening

Unit - I

History, importance, present position and scope of landscape gardening in India. Principles of garden designs – initial approach, axis, focal point, mass effect, unity, space, divisional lines, proportion and scale, texture, mobility, light, tone and colour.

Unit - II

Style of gardening (Formal garden, Informal garden, Wild garden) with special reference to Mughal garden, Japanese garden, Persian garden, French garden, Italian garden, English garden. Garden features : pavements and steps, fences and gates, hedges and edges, arch, pergola, screens and borders, lawn, flowerbeds, shrubberies, rosery, rockery, water body and bridges. Garden adornments – stone lanterns and basins, statues, towers, sundial, topiary, bird bath, saddle stones and floral clock.

Unit - III

Specialized gardens : Indoor gardening, pots and containers, potting mixtures, Water garden, rock garden, roof garden, vertical garden, marsh or bog garden, sunken garden, gardening in the shade. Landscaping of highways, railway station and railway lines, along bank of rivers and canals, city, town and country-sides, public buildings, educational institutions, factories, places of historic importance, places of worship, small home ground, crematories and burning *ghats*.

Unit - IV

Flowering annuals – classification, colour scheme and grouping (monochromatic, analogous, complementary or contrasting).

Ornamental trees – ecological adaptation, plantation and after care of trees.

Ornamental shrubs – morphological characters and cultural practices.

Ornamental climbers – description of ornamental climbers and their planting.

Cacti and succulents, palm and cycads, ornamental grasses, bonsai.

Unit - V

Garden practices : planting and transplanting, stopping and pinching, deshooting and disbudding, defoliation, stalking, pricking, shading, training and pruning, wintering, clipping or culling of hedges and edges, mulching. Floral ornaments and flower arrangement.

J-165- Practical I : (based on above 4 theory courses 1-4)

II Semester

J-204: Statistical methods in Agriculture

J-261 : Production Technology of Vegetables and Spices

Improved production technology of vegetable crops with special reference to origin and distribution, soil and climate, land preparation, improved varieties, sowing and planting, irrigation, fertigation, intercultural operations, training, pruning and stalking, harvesting, major insect-pest and disease control measures, storage and marketing.

Unit - I

Solanaceous fruit vegetables - tomato, brinjal, chilli and capsicum, and potato and okra.

Unit - II

Cole crops - cauliflower, cabbage, knol khol and broccoli, and

Root crops - radish, carrot, beet root and turnip.

Unit - III

Unit - IV
Cucurbits – cucumber, muskmelon, watermelon, bottle gourd, bitter gourd, pumpkin and squashes, sponge gourd, ridge gourd, and
Tuber crops – colocasia (arvi and banda), elephant foot yam, sweet potato, cassava.
Unit - V
Spices – cumin, coriander, fenugreek, fennel, ginger, turmeric etc
Important physiological disorders of vegetable crops

J-262 : Orchard Management

Unit - I
Establishment of orchard – selection of site, planning, selection and procurement of quality planting material, soil preparation, layout, planting systems, digging of pits, planting, after care of young plants.
Unit - II
Irrigation management of fruit trees : water requirement and method and time of application. Abnormalities caused due to excess and deficiency of moisture. Manurial requirement of fruit trees, major and minor nutrients, nutrient deficiency and their remedies, foliar feeding.
Unit - III
Growing and fruiting habits of fruit trees. Training and pruning in fruit trees. Clean cultivation, sod culture, intercropping, cover crops, filler crop.
Unit - IV
Pollination and pollinizers. Unfruitfulness, factors affecting and remedial measures. Alternate bearing, factors affecting and remedial measures. Fruit thinning, fruit drop and fruit splitting
Unit - V
Rejuvenation of old and uneconomic orchards. Protection from insect-pest and diseases High density planting system in orchards. Dryland farming in fruit crops

J-263 : Production Technology of Ornamental Crops

Production technology of flower crops with special reference to origin, history and distribution, soil and climate, land preparation, improved varieties, sowing and planting, irrigation, fertigation, intercultural operations, training, pruning and stalking, harvesting/picking, major insect-pest and disease control measures, storage and marketing.
Unit - I
Rose, carnation, chrysanthemum and dahalia.
Unit – II
Gladiolus, tuberose, lilies, tulip and alstromeria.
Unit - III
Marigold, gerbera, aster, orchids and jasmine.
Unit - IV
Cultivation of cut flower crops, cultivation of loose flower crops, cultivation of cut foliage cut greens
Unit - V
Greenhouse cultivation of important flower and ornamental crops

J-265 : Practical II (Based on above 4 theory courses)

II - Semester

Course - **M.M. : 100**

Statistical Methods in Agriculture (J-204)

Teaching Hours : 50

1. Theory of Sampling :

Concept of sampling, sampling Vs complete enumeration, simple random sampling, stratified sampling, systematic sampling, cluster sampling and multi-stage sampling (methods, advantages and disadvantages only). 5

2. Testing of Hypothesis :

Null and alternative hypothesis, two types of error, level of significance, power of the test, one tailed and two tailed tests. 3

3. Test of Significance :

Z and t-tests for testing equality of two means, chi-square test for testing goodness of fit, independence of attributes (contingency table) with Yates correction and testing for the variance of population, F-test for testing the equality of two variances and homogeneity of means (analysis of variance). 15

4. Analysis of Variance :

Analysis of variance with one way and two way classification (one observation percell). 05

5. Design of Experiments :

Basic principles of design of experiments, uniformity trials, shape and size of the plots and blocks, completely randomized, randomized block and Latin square designs and their analysis, Missing plot technique in R.B.D., simple factorial experiments of the 2^2 and 2^3,

III Semester

J-361 : Fundamentals of Fruit Production

Unit - I
importance, present position and future scope of fruit culture in India. Classification of fruit crops.
Unit - II
Flowering and fruiting of fruit crops : inflorescence, forms of flower, blooming period, pollination and pollinizers, bearing habit, type of fruits, etc
Unit - III
Soil and climatic requirements of fruit crops. Irrigation requirements of fruit crops : irrigation methods, time and amount of water application. Nutritional requirement of fruit crops : deficiency symptoms, fertilizer dose, method and time of application.
Unit - IV
Insect-pest management in fruit crops. Disease management in fruit crops.
Unit - V
Marketing of fruit crops in India. Import and export of fruits and their products. Use of plant growth regulators (PGR) in fruit setting, fruit thinning, fruit drop, parthenocarpy, yield and quality of fruits.

J-362 : Breeding of Vegetable and Ornamental Crops

Unit - I
History of vegetable and ornamental breeding research and infrastructure in India. Centre of origin and genetic variability of vegetable crops. Mendels laws of inheritance. Qualitative and quantitative inheritance. Self incompatibility, male sterility. Heterosis and inbreeding depression. Mutation breeding. Hybridization techniques. Polyploidy in crop improvement. Biotechnology and genetic engineering

Unit – II
Self pollinated vegetable crops : mechanism of self pollination. Breeding procedures and techniques of self pollinated vegetable crops.

Unit – III
Cross pollinated vegetable crops, mechanism of cross pollination.Genetic composition of cross pollinated populations. Selection in cross pollinated populations. Hardy Weinberg Law. Breeding procedures and techniques of cross pollinated vegetable crops. Hybrid and synthetic varieties
Unit - IV
Breeding of major vegetable crops : tomato, brinjal, chilli and capsicum, cauliflower, cabbage, onion, radish, carrot, pea, French bean, cucumber, muskmelon, watermelon, bottle gourd, bitter gourd, pumpkin and squashes, pointed gourd, okra, potato, colocasia, elephant foot yam etc
Unit - V
Breeding of important flower crops : Rose, carnation, chrysanthemum, gladiolus, marigold, gerbera, aster, orchids, lilies, tulip, jasmine, dahalia, alstromeria.

J- 363 : Fundamentals of Preservation of Horticultural Crops

Unit - I

History, importance, present position, and scope of preservation. General principles of fruit and vegetable preservation.

Unit - II

Enzymatic and textural changes, respiration and transpiration of fruits and vegetables. Spoilage in fruit and vegetable preservation. Role of microorganisms in processing of fruits and vegetables.

Unit - III

Brief history of scientific bottling and canning. Principles and guidelines for location and layout of fruit and vegetable preservation unit. Equipments for home and commercial production

Unit - IV

Methods of preservation. Preservation by drying and dehydration. Preservation by freezing. Preservation with sugar and chemicals. Preservation with salt and vinegar.

Unit - V

Fermentation. Browning reactions. Food colours. Food flavours. Enzymes and other microorganisms in preservation of fruits and vegetables.

J-364 : Post Harvest Technology of Horticultural Crops

Unit - I

Importance of postharvest management in fruit, vegetable and ornamental crops. Components of quality, variability due to genetic, environment and cultural factors, stage and time of harvesting, water quality and relation. Pre and post harvest factors related to post harvest deterioration of horticultural crops. Physiological and biological changes during and after maturity in horticultural crops. Post harvest losses.

Unit - II

Maturity indices. Hardening and delaying in ripening process in fruit crops. Time and method of harvesting. Pre and post harvest treatments of horticultural crops. Methods of storage, types of storage - pre-cooling, controlled and modified atmospheric storage, low pressure storage. Grading, packing and transportation of horticultural crops

Unit - III

Postharvest management of important fruit crops : mango, banana, papaya, guava, litchi, grape, apple, etc.

Unit - IV

Post harvest management of important vegetable crops : solanaceous fruit vegetable, cole crops, peas and beans, root and bulb crops, tuber crops, green leafy vegetables, cucurbits, okra, potato, etc.

Unit - V

Factors affecting bud and flower development, senescence, carbohydrate and nitrogen metabolism. Role of applied sugars, growth regulators, metallic salts and other chemicals on delaying quality deterioration. Special features like bent neck, flower bud abscission, geotropic bending, foliage discolouration, pulsing, bud opening and holding solution, etc. Post harvest management of rose, carnation, chrysanthemum, gerbera, gladiolus, orchids, tulips, lilies, etc.

J365: Practical III (based on above 4 theory courses)

IV Semester

J-461 : Production of Fruit Crops

Unit - I

Improved production technology of fruit crops with special reference to origin, history and distribution, soil and climate, land preparation, improved varieties, sowing and planting, irrigation, fertigation, intercultural operations, training, pruning and staking, harvesting picking, major insect-pest and disease control measures, storage and marketing.

Tropical fruits : mango, guava, papaya, banana, jackfruit, pineapple, sapota, arecanut.

Unit - II

Subtropical fruits : citrus, litchi, loquat, phalsa, pomegranate, aonla, bael, ber and grapes.

Unit - III

Temperate fruits : apple, peach, pear, plum, almond and apricot, and other fruits of minor importance.

Unit - IV

Study of important physiological disorders of fruit crops : Aonla necrosis, bitter pit of apple, yellow spot, granulation of citrus, shot berry, pink berry, hen and chickens of grapes, fruit cracking of pomegranate and litchi, multiple crown of pineapple, black tip, taper tip, tip pulp, gridle necrosis, sunburn, jelly seed ,soft nose, stem end rot, internal fruit necroses of mango.

Unit - V

Major problems of fruit growing – mango malformation, alternate bearing, spongy tissue in mango, bunchy top of banana, guava wilt, citrus canker, root wilt of coconut, yellow leaf disease of areca nut, etc.

J-462 : Breeding of Fruit Crops

Unit - I

History and infrastructure of fruit breeding in India. Centre of origin of fruit crops. Objectives of fruit breeding.

Unit - II

Breeding of major fruit crops with special reference to origin and distribution, genetic diversity, germplasm resources, wild species, botany, floral biology, pollination, inheritance pattern, pre selection criteria, breeding objectives, breeding methods and achievements, improved varieties, and future research thrust.

Tropical fruits : mango, guava, papaya, banana, jackfruit, pineapple, sapota, arecanut.

Unit - III

Subtropical fruits : citrus, litchi, loquat, phalsa, pomegranate, aonla, bael, ber and grapes.

Unit - IV

Temperate fruits : apple, peach, pear, plum, almond and apricot.

Unit - V

Breeding for abiotic stress (salt tolerance, moisture stress, high and low temperature).

Breeding for insect-pest and disease resistance.

J-463 : Processing of Fruits and Vegetables

Unit - I

Treatment prior to processing the fruit and vegetables. Drying and dehydration of fruits and vegetables, smoking and sulphuring. Freezing of fruits and vegetables - freezing units, cold storage, etc.

Unit - II

Preservation with sugar - candy, preserve, crystallized fruit

Preservation with sugar, acid and chemicals - jam, jelly, marmalade.

Unit – III

Preservation with salt and vinegar – pickles, chutney, sauce/ketchup. Brine solution and brining.

Unit - IV

Unfermented and fermented fruit beverages, ready to serve (RTS) drinks. Some other products from fruit and vegetable (mushroom processing, etc).

Unit - V

Quality control of processed products – FPO and AGMARK specifications. Government policy on import and export of processed fruit and food law. Chemical preservatives, vinegar. Importance of by-products from processing plant. Food poisoning and their control measures

J-464 : Seed Production Technology of Vegetables and Flowers

Unit - I

History, importance, present position and future scope of vegetable and flower seed production in India. Seed, its morphology, anatomy and types.

Unit - II

Seed production techniques of major vegetable crops. Solaneceous fruit vegetables - tomato, brinjal, chilli and capsicum. Cole crops - cauliflower, cabbage, knol khol and broccoli. Root crops carrot, radish beet root and turnip. Peas and beans – pea, french bean, cowpea. Cucurbits - cucumber, muskmelon, watermelon, bottle gourd, bitter gourd, pumpkin and squashes, sponge gourd, ridge gourd. Onion, okra, spinach.

Unit - III

Seed production techniques of important flower crops Rose, carnation, chrysanthemum, gladiolus, marigold, gerbera, aster, orchids, lilies, tulip, jasmine, dahalia, alstromeria etc

Unit - IV

Land/field standards in seed production. Seed standards and evaluation, seed testing. Seed processing. Seed packaging and storage. Seed certification, seed production and certification agencies.

Unit - V

Indian seed industry. Quality control of vegetable and flower seed. Seed policy. Quarantine.

J465: Practical IV (based on above 4 theory courses)

CH. CHARAN SINGH UNIVERSITY, MEERUT

DEPARTMENT OF PHYSICS

SYLLABUS
FOR M.Sc. (PHYSICS)
ELECTRONICS SPECIALIZATION
(REGULAR)

w.e.f.
ACADEMIC SESSION 2016-2017 AND ONWARD

M.Sc. PHYSICS (I Semester): MATHEMATICAL PHYSICS

Unit 1. Polynomials- Legendre, Hermite and Laguerre polynomials and their generating functions. Recurrence relations and special properties of $P_n(x)$ as solution of Legendre
differential equation, Rodrigues formula, orthogonality of $P_n(x)$, associated Legendre polynomials (Introdution only).

Unit 2. Bessel function of first kind, generating function, recurrence relations, $J_n(x)$ as solution of Bessel differential equation, Expansion of $J_n(x)$ when n is half and odd integer, Integral representation.

Unit 3. Complex Variable: Function of a complex variable, Cauchy Riemann conditions, Cauchy's integral theorem (without proof), Cauchy's integral formula, Cauchy's Residue theorem, singular points and evaluation of definite integrals of the type
$\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)\,dx$, $\int_{-\infty}^{\infty} f(x)\,e^{iax}dx$

Unit 4. Integral Transforms: Laplace Transform, First and second shifting theorems, Inverse LT by partial fractions, LT of derivative and integral of a function, Solution of initial value problems by using LT,

Unit 5. Fourier Series and Fourier Transform: Fourier series, Half range expansion, Arbitrary period, Fourier integral and transforms, FT of delta and Gaussian function.

Text and References Books

Mathematical method for Physics by G. Arfken
Advanced Engineering Mathematics by E.Kreyszig
Special Functions by E.D Rainville
Special Functions by W.W Bell
Functions of complex variable by R.V.Churchill
Mathematical Method for Physicists and Engineers by K.F.Reily, M.P.Hobson and S.J.Bence
Mathematical Physics by H.K. Das

M.Sc. PHYSICS (I Semester): CLASSICAL MECHANICS

Unit 1. Preliminaries: Newtonian mechanics of a particle, Mechanics of a system of particles, Constraints; their classification, D'Alembert's principle, Virtual work, generalized coordinates and derivation of Lagrange's equations, Velocity-Dependent potentials and the Dissipation function, Applications of Lagrangian formulation: Simple Pendulum with rigid support, Two connected masses with string passing over a pulley.

Unit 2. Variational Principles and Lagrange's Equations: Hamilton's principle, Some techniques of the calculus of variations, Derivation of Lagrange's equation from Hamilton's principle, advantages of variational principle formulation, Principle of least action.

Unit 3. Two body central force problem: Reduction to the equivalent one-body problem, Motion in a central force field, The Virial theorem, The inverse square law of force, The motion in central force in the Kepler problem.

Unit 4. Hamiltonian equations of motion: Legendre transformations and Hamilton equations of motion, Cyclic coordinates and conservation theorems, Canonical transformation generating functions, Properties, Poisson bracket, Poisson theorem, Relation of Poisson brackets, Hamilton Jacobi method

Unit 5. Small oscillations: Concept of small oscillations, Expression of kinetic energy and potential energy for the problem of small oscillations, Frequencies of free vibration, and Normal coordinates.

Text and Reference Books

H. Goldstein : Classical Mechanics
N.C. Rana and P.S. Joag : Classical Mechanics
A. Sommerfiel : Mechanics
Perceival and D. Richards: Introdution to Dynamics

M.Sc. PHYSICS (I Semester): QUANTUM MECHANICS- I

Unit 1. Wave Mechanics: Dual nature of matter and radiation, Schrodinger equation, Principle of superposition, Motion of wave packets, Uncentainty principle, Fundamental postulates of wave mechanics, Eigenvalues and eigenvectors, Probabilistic interpretation, normalization of bound and continuum state wave functions,Expectation values of dynamical variables, Coordinate and momentum representation, Hermitian operator, Commutator algebra and uncertainty relation, Three dimensional potential well and Hydrogen atom.

Unit 2. Representation and Transformations: State vectors, Hilbert Space, Dirac notations, Dynamical and linear operators in matrix form, Linear harmonic oscillator in matrix formulation, Space and time displacements, Rotation generators, Transformations of dynamical variables, Symmetry and conservation laws. Symmetric and anti symmetric wave-functions and Pauli exclusion principle.

Unit 3. Approximate Methods: Time independent first and second order perturbation theory for non-degenerate and degenerate levels, Variational method and its application for Helium atom. Stark effect, Dipole polarizability of ground state Hydrogen atom, Zeeman Effect.

Unit 4. Angular momentum: Commutation relations involving angular momentum operators, the eigenvalue spectrum, Matrix representation of J , Addition of angular momentum, Clebsch- Gordon coefficients, Spin angular momentum, Spin wave functions, Addition of spin and orbital angular momentum.

Unit 5. Scattering Theory: Laboratory and centre-of-mass systems, scattering by potential field, scattering amplitude, differential and total cross sections, phase shift, Lippmann-Schwinger equation, First Born approximation.

Text and References Books

Modern Physics by S.P. Khare.
Quantum Mechanics and Atomic Physics by S.P. Khare.
Quantum Mechanics by S. Gasiorowicz.
A text book of Quantum Mechanics by P.M. Mathews and K. Venkatesan
Introduction to Quantum Mechanics by E. Merzbacher
Quantum Mechanics by L.I. Schiff

M.Sc. PHYSICS (I Semester): ELECTRONIC DEVICES

Unit 1. Conduction Mechanism in Semiconductors: Classification of semiconductors - Elemental and compound semiconductors, Direct band and indirect band gap semiconductors, Charge carriers in extrinsic semiconductors, Carrier concentrations; The Fermi Level, electron and hole concentrations at equilibrium, temperature dependence of carrier concentrations, drift of carriers in electric and magnetic fields; conductivity and mobility, drift and resistance, effect of temperature and doping on mobility, The Hall effect, Diffusion of carriers in semiconductors; diffusion processes, diffusion and drift of carriers, diffusion and recombination, The continuity equation.

Unit 2. Semiconductor-diode characteristics: Qualitative theory of P-N junction, The Contact Potential, Space charge at a junction, Capacitance of p-n junctions, Forward and reverse bias junctions, Reverse bias breakdown, Zener diode, Tunnel diode.

Unit 3 . Bipolar Junction Transistors: Transistor current components, The transistor as an Amplifier, CB, CE, CC configurations, Input output characteristics, Early Effect, Graphical analysis of the CE configuration, Transistor hybrid model, h parameters, Analysis of a Transistor amplifier circuit using h parameters, Hybrid π model, Ebers-Moll model, Transistor biasing and thermal stabilization.

Unit 4. Field Effect Transistors: Construction and characteristics of JFET, transfer characteristic, The FET small signal model, Measurement of gm and rd, JFET fixed bias, Self bias and voltage divider configurations, JFET source follower (common-Drain) configuration, JFET Common – Gate configuration, Depletion and enhancement type MOSFETs.

Unit-5. Feedback Amplifiers: Classification of Amplifiers, Feedback concept, Ways to introduce negative feedback in Amplifiers, Effect of negative feedback, Method of analysis of a feedback amplifier, Volatge-series feedback, Current-series feedback, Volatge-shunt feedback, Current-shunt feedback, Nyquist criterion for stability of feedback amplifiers.

Text and Reference Books

Solid State Electronic Devices by B.G. Streetman
Electronic Devices and Circuit Theory by R.L. Boylested and L. Nashelsky
Integrated Electronics by J. Millman and C.C. Halkias
Introduction to Semiconductor Devices by M. S. Tyagi
Electronic Devices and Circuits by Balbir Kumar and S.B. Jain

M.Sc. PHYSICS (II Semester): QUANTUM MECHANICS- II

Unit 1. Time dependent Perturbation Theory : First order perturbation, Interaction of an atom with electromagnetic field, Transition probabilities, Fermi Golden rule, Dipole approximation.

Unit 2. Induced and Spontaneous radiations: Einstein A and B coefficients, Induced and spontaneous emissions of radiations, their applications in the construction of gas and solid lasers.

Unit 3. Quantum Theory of Radiation: Classical radiation field, Fourier decomposition and radiation oscillators, Creation, annihilation and number operators, Photon states, Quantized radiation field, Basic matrix elements for emission and absorption, Spontaneous emission in the dipole approximation, Plank's radiation law.

Unit 4. Relativistic Equations: Klein-Gordon equation and its plane wave solution, Probability density in KG theory, Difficulties in KG equation, Dirac equation for a free electron, Dirac matrices and spinors, Plane wave solutions, Charge and current densities, Existence of spin and magnetic moment from Dirac equation of electron in an electromagnetic field.

Unit 5. Dirac Equation: Dirac equation for central field with spin orbit interaction, Energy levels of Hydrogen atom from the solution of Dirac equation, Covariant form of Dirac equation.

Text and Reference Books

Quantum Mechanics and Atomic Physics by S.P. Khare.
Quantum Mechanics by L.I. Schiff
Modern Quantum Mechanics by J.J. Sakurai
A Text Book of Quantum Mechanics by P.M. Mathews and K.Venkatesan
Quantum Mechanics by A. P. Messiah

M.Sc. PHYSICS (II Semester): STATISTICAL MECHANICS

Unit 1. Foundation of Statistical Mechanics & Ensembles: Phase space, concept of Ensemble, Ensemble average, Liouville's theorem, equation of motion and Liouville's theorem, Canonical Ensemble, Microcanonical Ensemble, Grand Canonical Ensemble, partition functions.

Unit 2. Statistical Quantities: Calculation of statistical quantities, Energy and density fluctuations, Entropy of an ideal gas using microcanonical Ensemble, Gibb's paradox, Sackur- Tetrode equation.

Unit 3. Postulates of quantum statistical mechanics, Density matrix, Statistics of indistinguishable particles, Maxwell-Boltzmann, Fermi- Dirac and Bose- Einstein Statistics, properties of ideal Bose and Fermi gases, Bose- Einstein condensation.

Unit 4. Cluster expansion for a classical gas, virial equation of state, ising model, mean-field theories of the ising model in three, two and one dimensions, Exact solutions in one-dimension.
Landau theory of phase transition, critical indices, scale transformation and dimensional analysis.

Unit 5. Fluctuations: Correlation of space-time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory, fluctuation dissipation theorem, The Fokker-Plank equation.

Text and Reference Books

Statistical and Thermal Physics by F. Reif
Statistical Mechanics by K. Huang
Statistical Mechanics by R. K. Pathria
Statistical Mechanics by R. Kubo
Statistical Physics by Landau and Lifshitz
Statistical Mechanics and properties of matter, theory and application by E.S.R. Gopal

M.Sc.PHYSICS (II Semester): ATOMIC AND MOLECULAR PHYSICS

Atomic Physics:

Unit 1 . Quantum Mechanical Treatment of one-electron Atom, Spin-Orbit interaction and fine structure of hydrogen atom, Spectra of alkali elements. Singlet and triplet States of Helium.

Unit 2 . Many electron atoms: Central field approximation, Thomas-Fermi field, Atomic wave function, Hartree and Hartree –Fock approximations, Spectroscopic Terms: L S and J J coupling schemes for many electron atoms, Introduction of Zeeman Effect, Paschen effect and Stark effect, Electric dipole and Electric Quadrupole.

Molecular Physics:

Unit 3. Born - Oppenheimer approximation, Heitler-London theory of H_2, LACO treatment of H_2^+ and H_2, Classification of Molecules, Types of Molecular Spectra and Molecular Energy States: Pure Rotational Spectra, Vibrational-Rotational Spectra, Raman Scattering, Selection rules, Isotope effect, Classification of electronic states, Coupling of rotational and electronic motions, Electronic spectra: Franck-Condon principle.

Unit 4. Infrared Spectroscopy, General description and working of infra-red Spectrophotometer, Raman spectroscopy, Raman Spectrometer.

Unit 5. Photoelectron Spectroscopy, Photoelectron Spectrometer, Nuclear Magnetic Resonace, Chemical Shift, NMR Spectrometer, Electron Spin Resonance (Introduction and their principles only), ESR Spectrometer.

Text and Reference Books

Introduction to atomic spectra by H.E. White
Spectra of diatomic molecules by Herzberg
Atoms and molecules by M. Weissbluth
Quantum theory of Atomic Structure Vol I by Slater
Quantum theory of molecules and Solids by Slater
Fundamentals of molecular spectroscopy by C.B.Banwell
Introduction to molecular spectroscopy by G.M.Barrow
Molecular spectroscopy by Jeanne L.McHale
Molecular spectroscopy by J.M.Brown
Spectra of atoms and molecules by P.F. Bemath
Modern spectroscopy by J.M. Holias

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M.Sc.PHYSICS (II Semester): ELECTRODYNAMICS & PLASMA PHYSICS

Unit 1. Electrostatics: Electrostatic fields in matter; Dielectrics, Polarization, Field inside a dielectric, Electric displacement, Linear dielectrics. Laplace's and Poisson Equations, Methods of images, point charge near an infinite conducting plane, Point charge in the presence of grounded conducting sphere, Point charge in presence of charged insulated sphere.

Unit 2. Magneticstatics: Magnetic vector potential, Magnetostatic fields in Matter: Magnetization, field of a magnetized object, magnetic field inside matter, linear and non linear magnetic media.

Unit 3. Time-Varying Fields: Maxwell's displacement current, Maxwell's equations, Maxwell's equations in terms of vector and scalar potentials, Poynting theorem, Lienard- Wiechert potentials due to a point charge, Fields of a point charge in motion, Power radiated by an accelerated charge, Larmor's formula and its relativistic generalization.

Unit 4. Plane Electromagnetic Wave: Reflection, Refraction of electromagnetic waves at an interface between dielectrics, Fresnel's relation polarization by reflection and total internal reflection, Plain electromagnetic waves in free space, dielectrics and conducting media.

Unit 5. Plasma: Definition of plasma ,Concept of temperature, Debye shielding, Criteria for plasma, Single-particle motions in E and B fields, Magnetic mirrors and plasma confinement, Plasma as fluid, the fluid equation of motion, Equation of continuity and equation of state, Waves in plasmas, Plasma oscillations, Plasma frequency ωp, Electron plasma waves, ion waves, Electron and ion oscillations perpendicular to **B** and parallel to **B,** Cutoffs and resonances.

Text and Reference Books;

Classical Electrodynamics by J.D. Jackson
Foundations of Electromagnetic theory by J.R. Reitz, F.J.Milford and R.W.Christy
Introduction to Electromagnetics by David J. Griffiths
Intriduction to Plasma Physics and Controlled Fusion, Vol-1: Plasma Physics by Francis F. Chen
Plasma Physics by S.N. Sen.**)**

M.Sc. PHYSICS (III Semester): CONDENSED MATTER PHYSICS

Unit 1. Crystal Physics and Defects in Crystals:
Crystalline solids, unit cell and direct lattice, Bravais lattice in two dimensions (plane lattice) and three-dimensional (space lattice), Closed packed structures.

Unit 2. Interaction of X-rays with matter, Absorption of X-rays, X-ray diffraction, The Laue, powder and rotating crystal methods, The reciprocal lattice and its important properties and applications, Diffraction intensity, Atomic scattering factor, Geometrical structure factor.

Unit 3. Crystal imperfections: Point defects, line defects and planer (stacking) faults. Estimation of dislocation density from X-ray diffraction measurements. The observation of imperfections in crystals: electron microscopic techniques.

Unit 4. Electronics Properties of Solids:
Electrons in a periodic lattice: Bloch theorem, The Kronig-Penny Model, Effective mass of an electron, Tight-binding approximation, Cellular and pseudopotential methods,
Fermi surface: Fermi surface and Brillouin zones, Anomalous skin effect, Cyclotron resonance, de Hass van Alphen effect, Magnetoresistance, Hall effect in semiconductors
Superconductivity: Elements of BCS theory, Flux quantization, Meissner effect, Critical temperature, Persistent current.

Unit 5. Ferromagnetism: Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, Ferromagnetic domains, The Bloch-wall, Spin waves and magnons, Curie- Weiss law for susceptibility, Ferri and antiferro-magnetic order.

Text and References Books
Verma and Srivastava: Crystallography for Solid State Physics
Azaroff: Introduction to Solids
Omar: Elementary Solid State Physics
Aschroff & Mermin: Solid State Physics
Kittel: Solid State Physics
Chaikin and Lubensky: Principles of Condenced Matter Physics

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M. Sc. PHYSICS (III Semester): SPECIAL PAPER- I: ELECTRONICS

Unit 1. Operational Amplifier Basic and Application: Review of Feedback, Linear Circuit, Op-Amp Basic, Inverting and Non-inverting amplifiers, Unity follower, Summing amplifiers, Integrator, Differentiator, Op- Amp Specifications- DC Off-set parameter, Frequency parameters, Imperfection in Op- Amplifier application- multiple stage gain, Voltage summing and subtraction, Current controlled voltage ource, Voltage controlled current source, Rectifiers and Limiters, Comparators and Schmitt Triggers, Active filters.

Unit 2. Digital Logic Gates: Symbols and truth tables, Classes of digital integrated circuits (Diode logic, DTL, TTL, ECL, MOSFET, CMOS), Transistor- Transistor Logic (TTL), Single Input TTL Inverter (transfer characteristic), Multi- collector transistors, Propagation delays, Diode Logic, DTL NAND Gate (transfer characteristic, noise immunity, fan out), Emitter Coupled Logic (transfer characteristic of OR/NOR gate, practical implementation, MOSFET Logic- Review of MOSFET, MOSFET Inverter with active load, MOSFET NOR and NAND gates, Complementary MOS (CMOS)- CMOS inverter, CMOS NOR and NAND, Power dissipation in CMOS, Advantages/Disadvantages of CMOS.

Unit 3. Digital Electronics and Logic Gate: Binary, Octal, Hexadecimal number system, Base conversion system, Bipolar junction and Field Effect transistor as switches, Basic digital logic gates (OR, AND and NOT, NOR, NAND and Exclusive OR), XOR gate, Boolean laws and theorem, Sum of Product (SOP) and Peroduct of Sum (POS) method, Karnaugh map, pair, quad and octave, POS simplification, min-term, max-term.

Unit 4. Application of Digital Logic Gate: Half adder and Full adder circuit, multiplexers, demultiplexer, **Flip- Flop and Registers-** RS Flip Flop, D- Flip Flop, T- Flip Flop, JK- Flip Flop, JK Master- Slave Flip Flop, Astable, Monostable and Bi-stable multivibrator, types of registers, serial-in-serial out, serial-in-parallel out, parallel-in-serial out, parallel-in parallel out, **Counters and Convertors-** asynchronous and synchronous counter, Mod-3 and Mod-5 counters, shift counters, Digital-to Analog Converters-D/A converter, ladder network, A/D converters.

Unit 5. Microprocessor-Intel 8085 microprocessor architecture, interfacing devices, BUS timing, instruction set, simple illustrative program.

Text and Reference Books

Electronic Device and Circuit: R. Boylested and L. Nashdsky
Analysis and Design of Digital Integrated Circuit: Hodges, Jackson and Saleh
Digital Principles and Implementation: A.P. Malvino and D.P. Leach
Op- Amp and Linear Integrated Circuit: Ramakant A. Gayakwad

M. Sc. PHYSICS (III Semester): SPECIAL PAPER II: ELECTRONICS

Unit 1. Microwave Devices: Klystrons amplifiers,velocity modulation, Basic principles of two cavity klystrons, Multicavity clystron amplifier and Reflex klystron oscillator, Magnetrons, principles of operation of magnetrons and Travelling wave tube (TWT).
Transferred electron devices, Gun effect, Principles of operations, modes of operation, Read diode, IMPATT diode, and TRAPATT diode.

Unit 2. Amplitude Modulated Systems: Frequency translation, method of frequency translation, recovery of the base band signal, Amplitude modulation, Maximum allowed modulation, The square law demodulation, Spectrum of an amplitude modulated signal, Modulators and Balanced modulators, Single side band modulation, Methods of generating as SSB signal, Vestigial side band modulation, Multiplexing.

Unit 3. Frequency Modulated Systems: Angle modulation, Phase and frequency modulation, Relationship between phase and frequency modulation, Phase and frequency deviation, Spectrum of an FM signal, Sinusoidal modulation, Bandwidth of a sinusoidally modulated FM signal, FM generation, Parameter variation method, Armstrog system.

Unit 4. Transmission and Radiation of signals: Primary line constants, phase velocity and line wavelength, Characteristic impedance, Propagation Coefficient, Phase and group velocities, Standing waves, Lossless line at radio frequencies, Voltage standing wave ratio, Slotted line measurements at radio frequencies, Transmission lines as circuit elements, Smith chart, Single and double Stub matching, Time domain reflectometry, Telephone lines and cables, Radio frequency lines.

Unit 5. Fiber optic communications: Principles of light transmission in a fiber, Propagation within a fiber, Effect of index profile on propagation, Modes of propagation, Single mode propagation, Losses in fibres, Dispersion, Fiber optic communication systems.

Text and Reference Books

Electronic Devices and circuit Theory by R. Boylested and L. Nashdsky
Principles of Communication Systems by H. Taub and Donald L. Schilling
Optoelectronics: Theory and Practice, Edited by Alien Chappal
Microwaves by K.L. Gupta
Electronic communications by Dennis Roddy and John Coolen

M. Sc. PHYSICS (III Semester): NUCLEAR AND PARTICLE PHYSICS

Unit 1. Introductory Concept of Nuclei: Binding energy and Binding energy per nucleon, Nuclear angular momentum, Nuclear magnetic dipole moment and Electric quadruple moment, Parity quantum number, Statistics of nuclear particles, Isobaric spin concept, Systematic of stable nuclei.

Unit 2. Nuclear Disintegration: Simple theories of decay, Properties of neutrino, Non-conservation of parity and Wu's experiment in beta decay, Electron capture, Internal conversion.

Unit 3. Inter Nucleon Forces: Properties and simple theory of the deuteron ground state, Spin dependence and tensor component of nuclear forces, Nucleon- nucleon scattering at low energy, Charge- independence of nuclear forces, Many – nucleon systems and saturation of nuclear forces, Exchange forces, Elements of meson theory.

Unit 4. Nuclear Structure and Models: Fermi gas model, Experimental evidence for shell structure in nuclei, Basic assumption for shell model, Single- particle energy levels in central potential, Spin-orbit potential and prediction of magic numbers, Extreme single- particle model, Prediction of angular momenta, Parities and magnetic moment of nuclear ground states, Liquid drop model, Semi- empirical mass formula, Nuclear fission, The unified model.

Unit 5.Particle Physics: Properties and origin, Elementary particles, Properties, classification, type of interactions and conservation laws, Properties of mesons, Resonance particles, Strange particles and Strangeness quantum number, Simple ideas of group theory, Symmetry and conservation laws, CP and CPT invariance, Special symmetry groups SU (2) and SU (3) classification of hadrons, Quarks, Gell- Mann- Okubu mass formula.

Text and Reference Books

Nuclear Physics by Roy & Nigam
Introduction to nuclear Physics by H. Enge
Theoretical Nuclear Physics by J.M. Blatt and V.F. Weisskopf
Theoretical nuclear and Subnuclear Physics by J.D. Walecka
Particle Physics An introduction by M.Leon
Group Theory in Subnuclear Physics by F.I. Stancu
Introduction to Particle Physics by R. Ones.
Fundamentals of Nuclear Physics by B.B. Srivastava
Nuclear Physics by D.C. Tayal

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M.Sc. PHYSICS (IV SEMESTER): PHYSICS OF NANOMATERIALS

Introduction to Nanostructure Materials: Nanoscience & nanotechnology, Size dependence of properties, Moor's law, Surface energy and Melting point depression of nanoparticles, Free electron theory (qualitative idea) and its features, Idea of band structure, insulators, semiconductors and conductors, Energy band gaps of semiconductors, Effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, variation of density of states with energy and size of crystal.

Quantum Size Effect: Quantum confinement, Nanomaterials structures, Quantum well, Quantum wire and Quantum dot, Fabrication techniques.

Characterization techniques of Nanomaterials: Determination of particle size, XRD (Scherrer's formula), Increase in width of XRD peaks of nanoparticles, Shift in absorption spectra peak of nanoparticles, shift in photoluminescence peaks, Electron microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe microscopy (SPM), Scanning Tunneling Electron Microscopy (STEM) and Atomic Force Microscopy (AFM).

Synthesis of Nanomaterials: Key issues in the synthesis of Nanomaterials, Different approaches of synthesis, Top down and Bottom up approaches, Cluster beam evaporation, Ball Milling, Chemical vapor deposition, capping agents, Carbon nanotubes (CNT)- Synthesis, Properties and Applications.

Text and References Books

Nanostructures & Nanomaterials, Synthesis, Properties & Applications by Guozhong Cao, Imperial College Press.

Introduction to Nanotechnology, by Charles P. Poole, Jr. Frank J. Owens, John Wiley & Sons Inc. Publication.

Quantum Wells, Wires and Dots by Paul Harrison, John Wiley & Sons Ltd.

Quantum Dot Hetrostructures, by D. Bimberg, M. Grundman, N.N. Ledenstov.

Introduction to Nanoscience and Nanotechnology by Hornyak G.L., Tibbals H.F., Dutta J., Moore J.J., CRC Press.

Carbon Nanotechnology by Liming Dai

Carbon Nanotubes: Properties and Applications by Michael J. O'. Connell.

M. Sc. PHYSICS (IV Semester): SPECIAL PAPER III ELECTRONICS

Unit 1: Digital communication: Elements of a digital communication system, sampling theorem – Low Pass and Band Pass signals, Pulse Amplitude Modulation, Natural sampling. Flat – top sampling, Other forms of Pulse Modulation, Pulse Code Modulation, uniform and non-uniform Quantization of signals, Quantization error, Differential PCM, Delta Modulation, Adaptive Delta Modulation.

Unit 2: Digital Modulation techniques: Principle of Binary Phase Shift Keying (BPSK), Generation and Reception of BPSK, Bandwidth of BPSK Signal , Differential Phase Shift Keying (DPSK); DPSK Transmitter and Receiver, Bandwidth of DPSK Signal, Quadrature Phase Shift Keying (QPSK); QPSK transmitter and Receiver, Bandwidth of QPSK Signal, Binary Frequency Shift Keying (BFSK), BFSK Transmitter and receiver, Amplitude Shift Keying (ASK).

Unit 3. Random Variables, Probability Distributions, Random Processes,
Mathematical representation of Noise: Sources of noise. Frequency domain representation of noise, effect of filtering on the probability density of Gaussian noise, Spectral components of noise, Response of a narrowband filter to Noise, effect of a filter on the power spectral density of noise, Superposition of noises, Mixing involving noise, Linear Filtering of Noise.

Unit 4. Data Transmission: Baseband signal receiver, probability of error Optimum filter probability of error for Optimum receiver, Matched filter, Impulse response of Matched filter, probability of error of a Matched filter Correlation.

Unit 5. Satellite Communication: Introduction to Satellite Systems**,** Types of Satellites, Frequency Allocations, Satellite orbits; orbit fundamentals, Orbit shape, Height of Geostationary orbit, Law governing satellite motion; Kepler's Laws, Antenna Look Angles determinations, Orbital Elements, Orbit Perturbations, Inclined Orbits, Global Positioning Systems, Satellite link power budget equation, system Noise, carrier to noise ratio for uplink and downlink, combined uplink and downlink carrier to noise ratio.

Text and Reference Books;

(1) Principles of Communication Systems, second Edition by Taub and Schilling
(2) Communication Systems, third edition, by Simon Haykin
(3) Digital Communications, second edition by J.S. Chitode

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M.Sc. Physics (IV- Semester):SPECIAL PAPER –IV- ELECTRONICS

Unit 1. Materials for Integrated Circuits

Classification of IC, CMOS Process Overview , Electronic grade silicon , Crystal growth ,Czeehralski and float zone crystal growing methods, Silicon shaping lapping , Polishing and wafer preparation,

Unit 2. Hot Processes-I: Oxidation and Diffusion

Oxidation of silicon, oxide deposition by thermal dry oxidation and wet oxidation method Diffusion Process, Diffusion Coefficient, Fick's 1^{st} and 2^{nd} Laws of Diffusion, Vacancy –Impurity interactions, Dopants and Dopant Sources , Doping by Diffusion, ion implantation, Diffusion Process Control, Diffusion Systems, Implantation Technology, Selective Implantation, Junction depth, Channeling, Lattice Damage, Annealing ,Dopant Diffusion and Related Operations: Equipment for Diffusion and Related Operations.

Unit 3. Thin Films: Metals and Nonmetals

Vacuum Science and Technology, Evaporation theory and electron beam evaporation, evaporation system, idea of DC and R.F. sputtering system, Physical vapor deposition methods, Design construction of vacuum coating units, Chemicals Vapor Deposition, Reactors for Chemical Vapor Deposition, CVD Applications, Epitaxy methods for thin film deposition, Vapor-Phase Epitaxy,

Unit 4. Photolithography, Photoresist Processing and Etching

Wafer Cleaning methods, Wafer Preparation method: Vapor HMDS Treatment for adhesion improvement of photoresist, photoresist coating methods, soft backing of photo resist, post exposure backing of photo resist, Negative photoresist, Positive photoresist, Contrast and sensitivity of photoresist, Chemical Modulus Transfer Function (CMTF) of Photoresist, Resist Exposure (single, bi-layer and multi level photoresist exposure) and Resist Development, Hard Baking and Resist curing, Photolithographic Process Control.

Photolithography: An Overview, lithography, Raleigh criterion for resolution, Photolithography source, Resolution and numerical aperture, Photolithographic methods: Contact, proximity and projection and their resolution limit, Photo mask and mask Alignment, Limitations of optical lithography, Concept of phase-shift mask, Idea of electron beam lithography, Electron optics, Idea of an X-ray lithography and x-ray mask, Wet chemical dry etching for material removal, Reactive plasma etching, Ion milling,

Unit 5. Interconnections and Contacts and Packaging and Yield

Ohmic Contact Formation, Contact Resistance, Electromigration, Diffused Interconnections, Polysilicon Interconnections, Buried Contacts, Butted Contacts, Silicides, Multilayer Contacts, Liftoff Process, Multilevel Metallization.

Testing, Die Sepration, Die Attachment, Wire Bonding, Packages, Flip-Chip Process, Tape-Automated-Bonding Process, Yield, Uniform and Nonuniform Defect Densities.

Text and Refernece Books:

Integrated Electronics- Milliman and Taub
Microelectronics –Milliman and Gros
Thin Film Phenomena- K.L. Chopra
Hand Book of Thin Film- Marshel and Glang
VLSI Technology- S.M. Sze.

M.Sc. PHYS. (IV SEM.) COMPUTATIONAL METHODS AND PROGRAMMING

Unit 1. Computational methods: Methods for determination of zeros of linear and nonlinear algebraic equations and transcendental equations, Bisection method, Muller's method, Quotient-difference method, Newton-Raphson method
Solution of simultaneous linear equations, consistency of a system of linear equation, Gaussian elimination, LU decomposition method, matrix inversion, Jacobi iterative method, Gauss-Seidel method, convergence of Gauss-Seidel method

Unit 2. Diagonalization of matrices, Eigen values and eigenvectors of matrices, Power and Jacobi method.
Finite differences, Newton's formula for interpolation, Gauss, Stirling, Bessel's, Everett's formulae, Divided differences, Newton's general interpolation formula, Lagrange's interpolation formula.

Unit 3. Numerical differentiation, Numerical integration, Trapezoidal rule, Simpson 1/3 and 3/8 rules, Boole's and waddles rules, Newton-Cote's formula, Euler- Maclaurin formula, Gauss quadrature formula.
Method of Least square curve fitting, straight line and quadratic equation fitting, curve fitting of curves $y = ax^b$, $y = ae^{bx}$, $xy^a = b$ and $y = ab^x$, curve fitting by sum of exponentials, data fitting with cubic splines.

Unit 4. Numerical solution of ordinary differential equations, Euler, Picard and Runge-Kutta methods, Predictor and corrector method, elementary ideas of solutions of partial differential equations, solution of Laplace equation

Unit 5. Programming: elementary information about digital computer principles, compilers, interpreters and operating systems, Fortran programming, flow charts, integer and floating point, arithmetic expressions, built in functions, executable and non executable statements, IF statements, GO TO statements, DO loop and implied DO loop, simple computer programmes.

Text and References Books

Introductory Methods of Numerical analysis by S.S. Shastri
Numerical Analysis by Rajaraman

Numerical Methods by E. Balagurusamy
Fortran Programming by Rajaraman
Numerical methods for scientific & Eng. Computatioans by Jain, Iyengar

18. इस पाठ्यक्रम के प्रश्न-पत्र निम्न प्रकार हो

स्नातक स्तर (बी०ए०, बी०एस-सी० एवं बी०कॉम)

Paper-code- 001

खेलकूद एवं शारीरिक शिक्षा

Minimum
3 Hrs

Maximum Marks
50

UNIT - I

(1) Education & Physical Education

- Meaning & Defination of Education & Physical Education.
- Aims & Objectives
- Scope of Physical Education
- Need & Importance of Physical Education.

UNIT - II (3)

(2) Health Education & Nutrition

- Meanning & Defination & Diamention of Health.
- Meaning, Definition Objectives and Principles of Health Education.
- Balance Diet, its elements & Sources.
- Mul Nutrition & Adultration.

UNIT - III

(3) Biological Basis of Physical Education

- Meanning of Growth & Development
- Factors Affecting Growth & Development
- Heridity & Environment.
- Effect of Heridity & Environment on Growth & Development.

UNIT - IV

(4.) Psychological Basis of Physical Education

- Meanning & Definition of Psychology
- Meanning & Definition of Sports Psychology
- Meanning & Definition of Personalily
- Psychological factors effecting Physical Performance.

UNIT - V

(5.) Olympic Games, Asian Games, AFro Asian Game and Common Wealth Games

- Ancient Olympic Games.
- Modern Olympic Games.
- Asian Games.
- Afro Asian Games.
- Common Wealth Games.

स्नातक स्तर (बी० ए०, बी० एस० सी०, बी०

Paper-code-002

द्वितीय वर्ष

खेलकूद एवं शारीरिक शिक्षा

UNIT – I

1. Anatomy & Physiology
   - Cell – Structure & Functions
   - Different System (Muscular, Skeletal, Circulatory, Respiratory, Digestive and Nervous System)
   - Effect of exercise on various systems

UNIT – II

2. Sociological Aspects
   - Introduction
   - Society & Sports
   - Social Institutions
   - Games & Sports as Men's Cultural Heritage
   - National Integration
   - International integration

UNIT – III

3. Yoga
   - Introduction
   - Asanas – Lying, Sitting, Standing
   - Pranayama

UNIT – IV

4. Physical Fitness
   - Introduction
   - Components of Physical Fitness
   - Development of Physical Fitness Components
   - Factors influencing Physical Fitness

UNIT – V

5. First Aid
   - Introduction
   - Types of First Aid
   - Prerequisite Qualities of First Aider
   - First Aid Box
   - Types of Sports Injuries & their First Aid Treatment

Reference: -

Bucher, C.A.: Foundation of Physical Education C.V. Mosby Coo St. Louis, 1979.

Loy, J.W. and Kenyon, G.S.: Sports Culture and Society; A reader on the sociology of Sports Mac Millon Co. London 1969

Singh Hardyal (1991) Science of Sports Framing New Delhi; DVS Publication http://www.ifafitness.com

The St. John Ambulance Association of India "First Aid" 1, Red Cross Road, New Delhi, 1963.

Mathew and Fox – Physiological bases of Sports

Paper-code-003

स्नातक स्तर (बी० ए०, बी० एस० सी०, बी० कॉम) (Code-25 ci)

तृतीय वर्ष

खेलकूद एवं शारीरिक शिक्षा

UNIT – I

1. Kinesiology & Biomechanics
   - Meaning & Defination of Kinesiology & Biomechanics
   - Importance in Physical Education & Sports
   - Axis & Planes, Fundamental Movements around various points
   - Newton's Law of motion
   - Centre of Gravity

UNIT – II

2. Sports Training
   - Strength – Meaning, Types & Methods of Development
   - Speed – " " " "
   - Endurance – " " " "
   - Flexibility – " " " "
   - Co–ordinative ability – " " "

UNIT – III

3. Sports Medicine
   - Meaning & importance in Physical Education & Sports
   - Ergogenic aids, Therapeutic Modalities
   - Rehabilitation of Athlete after injury or sickness

UNIT – IV

4. Recreation
   - Meaning, Definition
   - Role in Physical Education & Sports
   - Types of Recreation

UNIT – V

5. Test & Measurement
   - Meaning, Definition & Importance in the field of sports
   - Frequency Table
   - Measures of Central Tendency
   - Measures of Variability
   - Correlation (Product Moment Correlation only)

Reference: -