COURSE CATALOGUE

(Undergraduate Courses)

COLLEGE OF BASIC SCIENCES

CSK HIMACHAL PRADESH KRISHI VISHAVAVIDYALAYA, PALAMPUR (H.P.) 176 062

Foreword

In a formal system of teaching and education, a course catalogue has a pivotal role to play for the orderly and planned running of teaching courses. For, it is the through the course catalogue that basic and vital information on the courses can be obtained by the teacher, student or the administrator.

The course catalogue in existence in the College of Basic Sciences for some years now, merited a revisit to update and upgrade some of the courses. Moreover, with the introduction of PG programme in Biology and Environmental Sciences, re-structuring of the course catalogue had become necessary. It is indeed a matter of happiness and satisfaction for that the College of Basic Sciences has been able to bring out a revised edition of the Course Catalogue incorporating the necessary changes wherever required in the courses.

Compilation and updating of such a document is no easy task. It is through the labour and efforts of all those who are associated with the work that it has finally seen the light of the day.

My heart-felt thanks to the Heads of the departments, the faculty members, the supporting staff and all those associated with the work for their endeavour.

Lastly, I hope that this revised volume will serve its desired purpose and prove useful to all the users.

(R.G.Sud)
Dean

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Semester-wise List of Courses to be Studied During B.Sc. Three Year Programme

Botany, Zoology and Chemistry combination

Sem. I

CourseNo	CourseTitle	Credit Hours
Bot-111	Algae, Fungi and Microbes	2+1
Bot-112	Bryophyta and Pteridophyta	2+1
Chem-111	States of Matter	2+0
Chem-112	Basic Principles of Inorganic Chemistry	2+0
Chem-113	Physical Organic Chemistry	1+1
Comp-111	Principles of Computer-I	1+1
Eng-111	Prose, Poetry and Functional English	2+0
Zoo-111	Life and Diversity of Animals-I	3+1
Zoo-112	Cell and Developmental Biology-I	1+1
Ort-111	Orientation	1+0 (NC)
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. II

CourseNo	CourseTitle	Credit Hours
Bot-121	Cell Biology	2+1
Bot-122	Genetics and Evolution	2+1
Chem-121	Colloids and Chemical Kinetics	1+1
Chem-122	Representative Elements and Noble Gases	2+0
Chem-123	Hydrocarbons and Organic Halides	2+0
Comp-121	Principles of Computer-II	1+1
Eng-121	Comprehension, Translation and Composition	2+0
Zoo-121	Life and Diversity of Animals-II	3+1
Zoo-122	Cell and Developmental Biology-II	1+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. III

CourseNo	CourseTitle	Credit Hours
Bot-211	Diversity of Seed, Plants Gymnosperms	2+1
Bot-212	Diversty of Seed Plants Angiosperms	3+1
Chem-211	Thermodynamics	2+0
Chem-212	Transtition and Inner Trasition Elements	2+1
Chem-213	Chemistry of Functional Groups-I	2+0

Zoo-211	Genetics-I	1+1
Zoo-212	Animal Physiology-I	3+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. IV

CourseNo	CourseTitle	Credit Hours
Bot-221	Structure and Development of Flowering Plants	2+1
Bot-222	Reproduction in Flowering Plant	2+1
Chem-221	Electrochemistry and Phase Equilibrium	2+0
Chem-222	Coordination Chemistry and Non-Aqueous Solvents	2+0
Chem-223	Chemistry of Functional Groups - II	1+1
Comp-222	Applications in FoxPro and Programming in BASIC	2+1
Zoo-221	Genetics - II	2+1
Zoo-222	Animal Physiology - II	3+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. V

CourseNo	CourseTitle	Credit Hours
Bot-311	Plant Ecology	2+1
Bot-312	Biochemistry and Biotechnology	2+2
Chem-311	Quantum Mechanics and Photochemistry	2+0
Chem-312	Advanced Inorganic Chemistry-I	2+1
Chem-313	Heterocyclics, Pericyclics and Spectroscopy	2+0
Zoo-311	Applied Zoology-I	2+2
Zoo-312	Ecology	2+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. VI

CourseNo	CourseTitle	Credit Hours
Bot-321	Plant Physiology	3+1
Bot-322	Economic Botany and Utilization of Plants	2+1
Chem-321	Solutions and Spectroscopy	1+1
Chem-322	Advanced Inorganic Chemistry-II	2+0
Chem-323	Natural Products, Synthetic Polymers and Dyes	2+0
Chem-324	Analytical Techniques in Chemistry	0+1
Zoo-321	Applied Zoology-II	2+2
Zoo-322	Evolution	2+1
Env-321	Introduction to Environmental Sciences	2+0 (NC)
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Physics, Mathematics and Chemistry combination

Sem. I

CourseNo	CourseTitle	Credit Hours
Chem-111	States of Matter	2+0
Chem-112	Basic Principles of Inorganic Chemistry	2+0
Chem-113	Physical Organic Chemistry	1+1
Comp-111	Principles of Computer-I	1+1
Eng-111	Prose, Poetry and Functional English	2+0
Math-111	Matrices, Trigonometry and Vector Analysis	3+0
Math-112	Calculus	3+0
Phys-111	Mechanics and Theory of Relativity	3+0
Phys-112	Vector Analysis and Electrostatics	2+0
Phys-113	Physics Laboratory-I	0+1
Ort-111	Orientation	1+0 (NC)
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. II

CourseNo	CourseTitle	Credit Hours
Chem-121	Colloids and Chemical Kinetics	1+1
Chem-122	Representative Elements and Noble Gases	2+0
Chem-123	Hydrocarbons and Organic Halides	2+0
Comp-121	Principles of Computer-II	1+1
Eng-121	Comprehension, Translation and Composition	2+0
Math-121	Algebra and Ordinary Differential Eqations	3+0
Math-122	Geometry	3+0
Phys-121	Statistical Physics and Thermodynamics	3+0
Phys-122	Current Electricity and Magnetism	2+0
Phys-123	Physics Laboratory-II	0+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. III

CourseNo	CourseTitle	Credit Hours
Chem-211	Thermodynamics	2+0
Chem-212	Transtition and Inner Trasition Elements	2+1
Chem-213	Chemistry of Functional Groups-I	2+0
Math-211	Advanced Calculus	4+0
Math-212	Dynamics	3+0
Phys-211	Oscillations and Waves	3+0
Phys-212	Quantum Mechanics	3+0
Phys-213	Physics Laboratory-III	0+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. IV

CourseNo	CourseTitle	Credit Hours
Chem-221	Electrochemistry and Phase Equilibrium	2+0
Chem-222	Coordination Chemistry and Non-Aqueous Solvents	2+0
Chem-223	Chemistry of Functional Groups - II	1+1
Comp-221	Computer Programming in C	2+1
Math-221	Differential Equations	4+0
Math-222	Statics	2+0
Phys-221	Optics and Lasers	3+0
Phys-222	Atomic, Molecular and X-rays Spectra	2+0
Phys-223	Physics Laboratory-IV	0+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. V

CourseNo	CourseTitle	Credit Hours
Chem-311	Quantum Mechanics and Photochemistry	2+0
Chem-312	Advanced Inorganic Chemistry-I	2+1
Chem-313	Heterocyclics, Pericyclics and Spectroscopy	2+0
Math-311	Analysis	3+0
Math-312	Abstract Algebra	4+0
Phys-311	Solid State Physics-I	3+0
Phys-312	Nuclear Physics-I	3+0
Phys-313	Physics Laboratory-V	0+1
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Sem. VI

CourseNo	CourseTitle	Credit Hours
Chem-321	Solutions and Spectroscopy	1+1
Chem-322	Advanced Inorganic Chemistry-II	2+0
Chem-323	Natural Products, Synthetic Polymers and Dyes	2+0
Chem-324	Analytical Techniques in Chemistry	0+1
Math-321	Metric and Inner Product Spaces	3+0
Math-322	Numerical Analysis	3+1
Phys-321	Nuclear Physics-II	3+0
Phys-322	Electronics	3+0
Phys-323	Physics Laboratory-VI	0+1
Env-321	Introduction to Environmental Sciences	2+0 (NC)
NCC	NCC	0+2 (NC)
NSS	NSS	0+2 (NC)

Biology and Environmental Sciences

Botany

Bot.111 Algae , Fungi and Microbes 2+1 Sem.I

Viruses and Bacteria: General account of viruses and mycoplasma; Bacteria-structure, nutrition, reproduction and economic importance; General account of cyanobacteria.
Algae: General characters, classification and economic importance; Important features and life history of Chlorophyceae-Volvox, Oedogonium, Coleochaete; Xanthophyceae -Vaucheria ; Phaeophyceae – Ectocarpus, Sargaassum; Rhodohyceae-Polysiphonia.
Fungi: General characters, classification and economic importance; Iimportant features and life history of Mastigomycotina – Pythium, Phytophthora; Zygomycotina – Mucor, Ascomycotina –Saccharomyces, Eurotium, Chaetomium; Peziza;. Basidiomycotina - Puccinia, Agaricus; Deuteromycotina – Cercospora , Colletotrichum; general account of Lichens.
Practical:
1. Study of the genera included under algae and fungi.
2.Observation of disease symptoms in hosts infected by fungi,viruses and mycoplasma. Section cutting of diseased material and identification of the pathogens as per the theory syllabus.
3.Study of crustose, foliose and other types of lichen thalli.
4.Gram staining of Bacteria.

Bot.112 Bryophyta and Pteridophyta 2+1 Sem.I

Bryophyta : Amphibians of plant kingdom displaying alternation of generations; Structure, reproduction and classification of Hepaticopsida (e.g. Marchantia); Anthocerotopsida (e.g. Anthoceros), Bryopsida (e.g. Funaria).
Pteridophyta : The first vascular plants; Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in Rhynia, Lycopodium, Selaginella, Equisetum, Pteris and Marsilea.
Practical:
Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta.

Bot.121 Cell Biology 2+1 Sem.II

Structure and function of nucleus : Ultrastructure; nuclear membrane; nucleolus.
Chromosome organization : Morphology; centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions; variations in chromosome number, aneuploidy, polyploidy; sex chromosomes.
DNA the genetic material : DNA structure; replication; DNA-protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA.
Cell division : Mitosis; meiosis.

Structure and function of other organelles : Golgi bodies, ER, peroxisomes, vacuoles.
The cell envelopes: Plasma membrane; bilayer lipid structure; function; the cell wall.

Practical:

1. To study cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, Hydrilla and Spirogyra. Study of cyclosis in Tradescantia staminal cells.
3. Study of plastids to examine pigment distribution in plants (e.g.. Cassia, Lycopersicon and Capsicum.)
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
5. Study of electron micrographs of viruses, bacteria, cynobacteria and eukaryotic cells for comparative cellular organization.

Bot.122 Genetics and evolution 2+1 Sem.II

Genetic inheritance : Mendelism; laws of segregation and independent assortment; linkage analysis; allelic and non-allelic interactions.
Gene expression : Structure of gene; tranfer of genetic information; transcription, translation, protein synthesis; tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D 2D and 3D structure.
Genetic variations : Mutations, spontaneous and induced; transposable genetic elements; DNA damage and repair.
Extranuclear genome : Presence and function of mitochondrial and plastid DNA; plasmids.

Practical:

1. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
2. Preparation of karyotypes from dividing root tip cells and pollen grains.
3. Cytological examination of special types of chromosomes : Bar body , lampbrush and polytene chromosomes.
4. Working out the laws of inheritance using seed mixtures.
5. Working out the mode of inheritance of linked genes from test cross and/or F_2data.

Bot.211 Diversity of seed plants – Gymnosperms 2+1 Sem.I

Characteristics of seed plants; evolution of the seed habit; seed plants with (angiosperms) and without (gymnosperms) fruits; fossil and living seed plants.
General features of gymnosperms and their classification; evolution and diversity of gymnosperms; geological time scale, fossilization and fossil gymnosperms.
Morphology of vegetative and reproductive parts; anatomy of root, stem and leaf; reproduction and life cycle of Pinus, Cycas and Ephedra.

Practical:

Cycas

1. Habit, armour of leaf bases on the stem (if specimen is not available show photograph), very young leaf (circinate venation) and old foliage leaves, scale leaf, bulbils, male cone (specimen); microsporophyll, megasporophyll, mature seed.
2. Study through permanent slides- normal root (T.S.), stem (T.S.) (if sections are not available show photographs), ovule(L.S.).
3. Study through hand sections or dissections- coralloid root (T.S.), rachis (T.S.), leaflet (V.S.). microsporophyll (V.S.), pollen grains (W.M.).

Pinus

1. Habit, long and dwarf shoot showing cataphylls and scale leaves, T.S. wood showing growth rings, male cone, 1st year, 2nd year and 3rd year female cones, winged seeds.
2. Study through permanent slides-root (T.S.), female cone (L.S.), ovule (L.S.), embryo (W.M.) showing polycotyledonous condition.
3. Study through hand sections or dissections – young stem (T.S.), old stem (wood) (T.L.S. and R.L.S.), needle (T.S.), male cone (L.S.), male cone (T.S.) , pollen grains (W.M.).

Ephedra

1. Habit and structure of whole male and female cones.
2. Permanent slides- female cone (L.S.).
3. Hand sections/dissections-node(L.S.), internode (T.S.), macerated stem to see vessel structure;, epidermal peel mount of vegetative parts to study stomata, male cone (T.S. and L.S.), pollen grains.

Bot.212 Diversity of seed plants – Angiosperms 3+1 Sem.I

Angiosperms: origin and evolution. Some examples of primitive angiosperms.
Angiosperm, brief history, aims and fundamental components (taxonomy, holotaxonomy;) identification keys, taxonomic literature.
Botanical nomenclature: Principles and rules; taxonomic ranks; type concept; principle of priority.
Classification of angiosperms; salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.
Major contributions of cytology, phytochemistry and taximetrics to taxonomy.
Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaaceae, Euphorbiaceae, Liliaceae and Poaceae.

Practical:
To study the following species by selecting plants available in the locality.

1. Ranunculaceae : *Ranunculus, Delphinium*
2. Brassicaceae: *Brassica, Alyssum, lberis, Coronopus*
3. Malvaceae : *Hibiscus, Abtilon*
4. Rutaceae : *Murraya, Citrus*
5. Fabaceae : Faboideae : *Lathyrus, Cajanus, Melilotus, Trigonella; Caesalpinioideae: Cassia, Caesalpinia; Mimosoideae Prosopis, Mimosa, Acacia.*
6. Apiaceae: *Coriandrum, Foeniculum, Anethum*
7. Acanthaceae: *Adhatoda, Peristrophe*
8. Apocynaceae: *Vinca, Thevetia, Nerium*
9. Asclepiaeaceae: *Calotropis*

10. Solanaceae: *Solanum, Withania, Datura*
11. Euphorbiaceae: *Euphoriba, Phyllanthus*
12. Lamiaceae: *Ocimum, Salvia*
13. Chenopodiaceae: *Chenopodium, Beta*
14. Liliaceae: *Asphodelus, Asparagus*
15. Poaceae: *Avena, Triticum, Hordeum, Poe, Sorghum*

Bot.221 Structure and development of flowering plants 2+1 Sem.II

1. The basic body plan of a flowering plant- modular type of growth.
2. Diversity in plant form in annuals, biennials and perennials; convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons; trees-largest and longest-lived organisms.
3. **The shoot system:** the shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; formation of internodes, branching pattern; monopodial growth; canopy architecture; cambium and its functions; formation of secondary xylem; a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; role of woody skeleton; secondary phloem- structure-function relationships periderm.
4. **Leaf:** origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; scenescence and abscission.
5. **The root system:** the root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and interaction with microbes.

Practical:

1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or Kalanchoe) to understand the body plan and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden). Study of tree-like habit in cycads, bamboos, banana, traveller's tree (*Ravenala madagascariensis*) or vucca and comparison with true trees as exemplified by conifers and dicotyledons.
3. L.S. of shoot tip to study the cytohistological zonation and origin of leaf primordial.
4. Monopodial and sympodial types of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood. Microscopic study of wood in T.S., T.L.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of the root, primary and secondary structure.

Bot.222 Reproduction in flowering plant 2+1 Sem.II

1. **Flower :** a modified shoot; structure, development and varieties of flower; functions; structure of anther and pistil; the male and female gametophytes; types of pollination;

attraction and rewards for pollinators; pollen-pistil interaction, self incompatibility; double fertilization; formation of seed—endosperm and embryo; fruit development and maturation.

2. **Significance of seed :** suspended animation; ecological adaptation; unit of genetic recombination and replenishment; dispersal strategies.

3. **Vegetative reproduction:** vegetative propagation, grafting, economic aspects.

Practical:

1. Examination of a wide range of flowers available in the locality and methods of their pollination
2. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using *in vitro* pollen germination.
3. Structure of ovule and embryo sac development (using serial sections).
4. Test of self-incompatibility (using *Petunia axillaries, Brassica campestris, B. oleracea* or a suitable available material) using field pollinations.
5. Nuclear and cellular endosperm. Embryo development in monocots and dicots (using slides/dissections).
6. Simple experiments to show vegetative propagation (leaf cuttings in *Bryophyllum, Sansevieria, Begonia*; stem cuttings in rose, salix, money plant, sugarcane and Bougainvillea).
7. Germination of non-dormant and dormant seeds.

Bot.311 Plant Ecology 2+1 Sem.II

Plants and environment : Atmosphere (gaseous composition), water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

Population ecology : Growth curves; ecotypes; ecads.

Community ecology: Community characteristics, frequency, density, cover life forms, biological spectrum; ecological succession.

Ecosystems: Structure; abiotic and biotic components; food chain, food web, ecological pyramids, energy flow; biogeochemical cycles of carbon, nitrogen and phosphorus. Biogeographical regions of India.

Vegetation types of India : Forests and grasslands.

Practical:

To determine minimum number of quadrats required for reliable estimate of biomass in grasslands.

1. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkair's Standard Frequency Diagram.
2. To estimate lmportance Value lndex for grassland species on the basis of relative frequency, relative density and relative biomass in protected and grazed grassland.
3. To measure the vegetation cover of grassland through point frame method.
4. To measure the aboveground plant biomass in a grassland.
5. To determine Kemp's constant for dicot and monocot leaves and to estimate the leaf area index of a grassland community.

6. To determine diversity indices (richness, Simpson, Shannon-Wiener) in grazed and protected grassland.
7. To estimate bulk density and porosity of grassland and woodland soils.
8. To determine moisture content and water holding capacity of grassland and woodland soil.
9. To study the vegetation structure through profile diagram.
10. To estimate transparency, pH and temperature of different water bodies.
11. To measure dissolved oxygen content in polluted and unpolluted water samples.
12. To estimate salinity of different water samples.
13. To determine the percent leaf area injury of different leaf samples collected around polluted sites.
14. To estimate dust holding capacity of the leaves of different plant species.

Bot.312 Biochemistry and Biotechnology 2+2 Sem.I

Basics of enzymology : Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; regulation of enzyme activity; mechanism of action.

Nitrogen and lipid metabolism : Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation; structure and function of lipids; fatty acid biosynthesis; - oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Genetic engineering : Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene mapping and chromosome walking.

Biotechnology: Functional definition; basic aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*; vectors for gene delivery and marker genes; salient achievements in crop biotechnology

Practical:

1. To prepare the standard curve of protein and determine the protein content in unknown samples.
2. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
3. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
4. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material.
5. Demonstration of the technique of micropropagation by using different explants, e.g. axillary buds, shoot meristems.
6. Demonstration of the technique of anther culture.

Bot.321 Plant Physiology 3+1 Sem.I

Plant-water relations: Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata.

Mineral nutrition : Essential macro-and micro-elements and their role; mineral uptake; deficiency and toxicity symptoms.

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation.
Photosynthesis : Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C_4 pathway; CAM plants; photorespiration.
Respiration : ATP- the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism (chemi-osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway.
Growth and development: Definitions; phases of growth and development; kinetics of growth; seed dormancy, seed germination and factors of their regulation; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; biological clocks; physiology of senescence, fruit ripening; plant hormones –auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

Practical:
To study the permeability of plasma membrane using different concentrations of organic solvents.

1. To study the effect of temperature on permeability of plasma membrane.
2. Comparison of the rate of respiration of various plant parts.
3. Separation of chloroplast pigments by solvent method.
4. Determining the osmotic potential of vacuolar sap by plasmolytic method.
5. Determining the water potential of any tuber.
6. lsolation of protoplasts from different tissues using commercially available enzymes.
7. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.

Bot.322 Economic Botany and utilization of plants 2+1 Sem.II

Food plants : Rice, wheat, maize, potato, sugarcane.
Fibres : Cotton and jute.
Vegetable oils: Groundnut, mustard and coconut.
General account of sources of firewood, timber and bamboos.
Spices: General account.
Medicinal plants : General account.
Beverages: Tea and coffee.
Rubber. Morphology of the plant, tapping practices and history of rubber.

Practical:

1. **Food Plants :** Study of the morphology, structure and simple microchemical tests of the food storing tissues in rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (excepting sugarcane).
2. **Fibres :** Study of cotton flowers, sectioning of the cotton ovules/developing seeds to trace the origin and development of cotton fibers. Microscopic study of cotton and test for cellulose. sectioning and staining of jute stem to show the location and development of fibres. microscopic structure. Tests for lignocellulose.
3. **Vegetable oils :** Study of hand sections of groundnut, mustard and coconut and staining of oil droplets by Sudan III and Sudan Black.

4. **Field visits :** To study sources of firewood (10 plants), timber-yielding trees and bamboos. A list to be prepared mentioning special features.
5. **Spices :** Examine black pepper, cloves, cinnamon (hand sections) and opened fruits of cardamom and describe them briefly.
6. **Preparation of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy :** Write their botanical and common names, parts used and diseases/disorders for which they are prescribed.
7. **Beverages :** Section boiled coffee beans and tea leaves to study the characteristic structural features.
8. **Rubber :** Collect illustrative materials of *Hevea brasiliensis*; morphology of the plant and tapping practices, history of rubber. Uses of rubber.

B.Sc. (Ag.) CC:

Biol.001 Elementary Biology 2+1 Sem.I

Principals of classification and nomenclature of plants and animals; principal animal division with examples of important types; general organization of amoeba, sponge, hydra, liverfluke , ascaris, earthworm, cockroach , snail, starfish, shark, carp, frog, lizard, pigeon and rabbit, structure and germination of a dicot and monocot seed; external morphology of root , stem, leaf and flower; placentation; pollination; elementary study of fruit types; dispersal of seeds and fruits.

Practical: A general survey with reference to classification upto order , habitat and economic importance of the representatives of invertebrates, protochordates and chordates; study of the structure and germination of dicot and monocot seeds; types of roots, stems, leaves and flowers.

Biol.002 Zoology 2+1 Sem.I

Study of paramecium, hydra, earthworm and cockroach; classification, habit, habitat, external characters and economic importance of the representatives of protozoa, coelenterata, platyhelminthes, nemathelminthes, annelids, arthropoda, mollusca and echinodermata; a detailed study of rabbit; physiology of digestion, respiration and excretion; a general survey with reference to classification upto class, habitat and economic importance (if any) of the representatives of Protochordata, Fishes, Amphiba.

Reptilia, Aves and Mammalia, histology of the tissues of frog and mammals.

Practical: Study of paramecium, hydra, earthworm and cockroach, representatives of chordates and non-chordates; microscopic study of various tissues of frog and rabbit; dissection of rabbit to study various systems.

Biol.003 Botany 2+1 Sem.II

Morphology of representative groups of plant kingdom; structure and germination of seeds, modifications of root, stem and leaf; life history of an angiosperm; histology of root, stem and leaf; distinguishing characters and economic importance of the following families;

Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Rosaceae, Cucurbitaceae, Asteraceae, Solanaceae, Liliaceae and Poaceae.

Practical: Study of (i) representative groups of plant kingdom, (ii) seeds and their germination, (iii) modifications of root , stem and leaf, (iv) flowers and fruits, and (v) representative genera pertaining to above mentioned families; examination of prepared slides pertaining to life history and histology.

Biol.004 Modern Biology 2+0 Sem.II

Nucleic acids and their role in protein synthesis; enzymes-their importance in metabolism, operon model; origin of life; evolution of plants and animals; inheritance of characters, Mendelism; chromosomes and genes; mitosis and meiosis; sex determination; sex-linked and cytoplasmic inheritance; living world and environment; producers and consumers; ecosystem; pyramids of life; importance of plants and animals-our friends and foes.

Zoology

Zoo.111 Life and Diversity of Animals-I 3+1 Sem.I

Functional morphology of the types included with special emphasis on the adaptations to their modes of life and environment. General characters and classification of all phyla up to orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

1. Introduction to Animal Kingdom
2. Protozoa- type study- Plasmodium, parasitic protozoans
3. Porifera- type study –Sycon
4. Coelenterata- type study-Sea anemone, corals and coral reefs
5. Helminthes-type study- Liver fluke, Helminth parasites
6. Annelida- type study –Nereis, Metamerism, Trochophore larva
7. Arthropoda- type study- Prawn and Grasshopper
8. Mollusca –type study –Sepia
9. Echinodermata-type study-Sea star, Echinoderm larvae

Practical:

1.Study of museum specimens and slides relevant to the types studied in theory
2. Dissection of digestive, reproductive and nervous system of cockroach
3.Mounting of :
   a) Body setae of earthworm
   b) Mouthparts of any 4 insects (Mosquito, Housefly, Bedbug, Plant bug, Cockroach and Honeybee)
   c) Salivary glands of Cockroach
   d) Appendages of Prawn.

Zoo.112 Cell and Developmental Biology-I 1+1 Sem.I

1. Cell and cell theory
2. Methods in cell biology –light and electron microscopy, cell fractionation methods, chromatography, electrophoresis, radioisotope tracer technique and autoradiography
3. Organization of cell – Plasma membrane, nucleus-nuclear envelope, nucleolus, chromosomes; mitochondria, endoplasmic reticulum, lysosomes, ribosome. golgi body
4. Cell Reproduction –cell division (mitosis and meiosis) ,cell cycle
5. An elementary idea of cell transformation and cancer
6. An elementary idea of cellular basis of immunity
7. Historical perspective, aim and scope of developmental biology
8. Gametogenesis – spermatogenesis and oogenesis , types of eggs.

Practical:

1.Observation of live sperm in physiological saline using phase contrast optics.
2.Demonstration of use of florescence microscope (DNA, RNA fluorescence) and familiarity with Cytophotometry.
3.Familiarity with scanning and transmission electron microscope
4.Familiarity to tissue culture (visit to plant and animal tissue culture labs.)

5.Exposure to gel electrophoresis through photographs or in research laboratory.
6. Preparation of polytene chromosome in Drosophila larva
7. Use of colchicine in arresting anaphase movement (onion root tips).
8.Metaphase chromosome preparations from cornea of mouse
9. Meiosis in grasshopper testis
10.Study of permanent slides to understand the following:
10.1 Constitutive heterochromatin (C-bands)
10.2 Semi-conservative DNA replication (BrdU -labelling)
10.3 Estimation of S phase cells in a random population (Autoradiography)
Transcription in polytene chromosome puffs (Autoradiography)

Zoo.121 Life and Diversity of Animals-II 3+1 Sem.II

Functional morphology of the types included with special emphasis on the adaptations to their modes of life and environment. General characters and classification of all phyla up to orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

1. Hemichordata-type study-Balanoglossus
2. Chordates-Origin
3. Protochordates-type study-Amphioxus, Cephalochordata and Urochordata
4. Agnatha-type study-Petromyzon
5. Pisces-type study- Mullet, scales& fins. migration, parental care
6. Amphibia-origin, type study-frog, parental care
7. Reptilia-type study –calotes, origin, extinct reptiles, poisonous and non-poisonous snakes, poison apparatus.
8. Aves- type study-pigeon, flight adaptation, bird migration.
9. Mammals- type study-rat, adaptive radiation , dentition ,evolution of man.

Practical:

1.Dissection of digestive, arterial , venous and urinogenital systems of frog.
2.Mounting of :
a) Hyoid apparatus of frog
b) Brain of frog
3.Identification of prepared skeletal structures of shark, frog, calotes, pigeon and rat; palates of birds, skulls of dog and rabbit.
4. Demonstration of dissections of arterial, venous and urinogenital systems of rat.
5. Feathers, flight muscles and viscera of bird.
6. Field study report.

Zoo.122 Cell and Developmental Biology-II 1+1 Sem.II

1.. Fertilization
2. Types of patterns of cleavage
3. Process of blastulation and fate map construction in frog and chick
4. Gastrulation in frog and chick up to the formation of three germinal layers
5. Elementary knowledge of primary organizer –concepts and induction
6. Elementary knowledge of extra embryonic membranes
7. Concepts of competence, determination and differentiation

8. Embryonic adaptations and the development of mammals (placentation) – review of placenta in different groups of mammals, physiology of placenta
9. Metamorphosis-causes and role of hormones in insects and amphibian metamorphosis
10. Concept of regeneration

Practical:

1.Frog Embryology:

1.1.1 Collection of Spawn

1.1.2 Identification of stages and preservation

1.1.3 Preparation of permanent/temporary slides of representative developmental stages

2.Demonstration of early developmental stages of freshwater snail (Limnaea).

3.Permanent preparation of whole mounts of chick embryo of

13-18 hrs
24-33 hrs
36-48 hrs
48-72 hrs

4.Window preparation and identification of stages of development in chick egg.

5. Study of development of frog and chick embryo from permanent slides

5.1 Slides of cleavage and tadpole larva of frog

5.2 Slides of sections of chick embryo through

5.2.1. Pharynx
5.2.2. Heart
5.2.3. Trunk

Zoo.211 Genetics-I 1+1 Sem.I

1. Elements of heredity- Mendelian inheritance patterns and laws of heredity, co- and incomplete dominance, variations,
2. Varieties of gene expression –multiple alleles, lethal genes, pleiotropic genes, gene interaction and epistasis
3. Gene linkage and linkage maps
4. Sex chromosome systems and sex linkage
5. Structural and numerical alterations of chromosomes and meiotic consequences
6. Human genetics –chromosomal and single gene disorders, somatic cells genetics
7. Genetic code and Wobble's hypothesis.

Practical:

1.Study of the biology of Drosophila and medium preparation

2.Observation of common mutants of Drosophila

Zoo.212 Animal Physiology-I 3+1 Sem.I

1. Aim and scope of physiology, chemical foundation of physiology-osmotic pressure, diffusion, pK and pH; buffers, bio-molecules: carbohydrates, amino acids, peptides, lipids, proteins, nucleic acids and nucleotides.
2. Nutrition –nutritional requirements and diorders; digestion and absorption of dietary components.

3. Metabolism-concepts, selected examples, pathways (Embden-Mayerhoff pathway, Krebs cycle, Hexose monophosphate shunt, gluconeogenesis, energetics of glucose metabolism; oxidation of triacylglycerol : β-oxidation of fatty acids, metabolism of glycerol, ketone bodies-their formation, utilization, ketosis; mitochondrial and extra-mitochondrial synthesis of fatty acids); and regulatory mechanisms.
4. Enzymes –nomenclature, classification, chemical nature of enzymes, general properties of enzymes, mechanism of enzyme action, factors affecting enzyme activity, enzyme inhibition, allosteric enzymes, coenzymes.
5. Respiration – organs of respiration-properties and functions of respiratory pigments, physiology of respiration –dissociation curve of oxyhaemoglobin, respiratory quotient, control of respiration
6. Blood – composition and function of blood and lymph; blood groups, blood coagulation.
7. Heart – internal structure of mammalian heart; origin, conduction and regulation of heart beat, cardiac cycle and ECG.

Practical:

1. Survey of digestive enzymes in cockroach
2. Study of human salivary activity in relation to pH
3. Estimation of oxygen consumption in fishes with reference to body weight
4. Estimation of the blood cell (RBC and WBC) counts; haemoglobin and haematocrit value
5. Blood pressure and its measurement by ausculatory and pulsatory methods

Zoo.221 Genetics-II 2+1 Sem.II

1. Introduction to application of genetic engineering techniques
2. Cytoplasmic inheritance-maternal effect on Limnaea (shell coiling), male sterility (Rhode's experiment), carbon-dioxide sensitivity in Drosophila, kappa particles in paramecium, milk factor in mice
3. Nature and function of genetic material
4. Regulation of gene expression – Operon circuits in prokaryotes and eukaryotes
5. Mutation- molecular basis of mutation
6. Applied genetics.

Practical:

1. Preparation of mounts of the salivary gland chromosomes of Drosophila or Chironomous larva.
2. Human blood grouping.

Zoo.222 Animal Physiology-II 3+1 Sem.II

1. Excretion : Structure and function of kidney –physiology of urine formation.
2. Regulatory mechanisms: osmoregulation in aqueous and terrestrial animals, mechanism of cell volume regulation; thermoregulation – heat production and loss, physiological mechanisms of the regulation of body temperature.
3. Neuromuscular co-ordination –nerve physiology – functional architecture of a neuron, morphological classification of nerve cells, propagation of nerve impulse,

synaptic and neuromuscular transmission, physiology of mechanical and osmotic work –skeletal and smooth muscle function.

4. Endocrine system – Introduction to endocrinology and the pituitary hormones, thyroid, parathyroid, adrenal, islets of Langerhans, thymus, pineal body, gastrointestinal glands hormones; mechanism of hormone action – categories of hormones, role of cyclic AMP as second messenger in hormone action.
5. Reproductive and hormonal functions of the male and the role of pineal gland in controlling seasonal fertility; pre-pregnancy reproductive functions of the female and the female hormones, regulation of female monthly rhythms, pregnancy and lactation.

Practical:

1. Study of ciliary activity in freshwater mussel in relation to temperature.
2. Detection of nitrogenous waste products, in fish tank water, frog tank water, bird excreta and mammalian kidney.
3. Use of Kymograph unit, Respirometer.
4. Study of endocrine glands of rat.
5. Study of estrous cycle by vaginal smear preparations.
6. Histology of pituitary, ovary, testes, adrenal and uterus..

Zoo.311 Applied Zoology-I 2+2 Sem.I

1. Aquaculture
2. Sericulture
3. Apiculture
4. Pest management
6. Poultry keeping
7. Aquarium fish keeping
8. Pisciculture

Practical:

1.Aquaculture

i.Identification of cultivable:

a.Prawns, crabs and lobsters

b.clams, mussels and oysters

c.food fishes

d.ornamental and exotic fishes

ii. Analysis of gut contents of fishes to study their feeding habits.

2. Sericulture

i. Different stages of silkworm from egg to adult stage (egg sheet, different stages of the larva, pupa and adult)
ii. Dissection of the silkworm to study the internal anatomy and mounting of silk glands.
iii. Study of disease- causing pests of larva, pupa and adult.
iv. Equipment needed in silkworm rearing center.
v. Mulberry leaves and utilization.

3.Apiculture

i. Identification of members of bee colony
ii. Study of a bee hive.
iii. Study of different types of bees.

iv. Mounting of mouthparts and sting apparatus of honeybee.
v. Identification of different types of hives and equipments used in apiculture.

4.Pest management
i. Identification of major crop pests given in theory syllabus
ii. Identification of the common pest of stored products
iii. Identification of the common household pests
iv. Study of common plant protection appliances such as foliar spray, sprayers and dusters
v. Report of a visit to an agricultural institute or fields or factories.

5.Economic Entomology
i. Methods of collection and preservation of insects
ii. Identification of insects in general and major pests
iii. Study of life cycle of hemimetabolous, holometabolous and ametabolous insects (at least one example in each)
iv. Rearing of insects
v. Study of parasitic and predatory insects (one in each) in relation to their adaptations
vi. Insecticide and plant protection appliances
vii. Record.

6.Poultry keeping
i. Identification of common breeds of fowl; Rhode Island Red, Minorca, White Leghorn
ii. Grading, handling and candling of eggs
iii. Sexing of chicks
iv. Dissection of Fowl to understand the anatomy and identification of animal
v. Equipments used in Poultry
vi. Report of field trip to a model poultry farm.

7.Pisciculture
i. Morphometric measurements of fish
ii. Measurement of fish age using scales
iii. Examination of stomach contents of two (carnivorous and herbivorous) types of fishes in order to understand their feeding habits
iv. Identification of marine and fresh water fishes, based on museum specimens.

8.Aquarium and fish keeping
i. Identification of common aquarium fishes
ii. Identification of different live feed organisms
iii. Study of different types of formulated feeds
iv. Preparation of a formulated feed
v. Study of slides of parasites and diseases
vi. Different equipment used in aquarium maintenance
vii. Setting up of aquarium

Zoo.312 Ecology 2+1 Sem.I

1. Brief introduction to the major ecosystems of the world.
2. Biotic community
3. Conservation of natural resources
4. Ecology in relation to climate in India
5. Biogeochemical cycles

6. Morphological, physiological and behavioural adaptations to external factors such as temperature, moisture, salinity and light
7. Thermoregulatory mechanisms
8. Populations- growth and regulation
9. Competition, predation, parasitism, commensalism and mutualism
10. Communities and ecosystems
11. Environmental pollution
12. Wildlife management

Practical

1. Field work to understand basic ecological concepts
2. Laboratory experiments

Zoo.321 Applied Zoology-II 2+2 Sem.II

1. Medical laboratory technique
2. Endocrinology
3. Toxicology
4. Microbiology
5. Bioethics
6. Economic Entomology

Practical

1.Medical laboratory technique

i. Study of laboratory equipment such as: Autoclave, hot air oven, incubator, waterbath, centrifuge, refrigerator, colorimeter, pH meter, haemoglobinometer, microtome and balances.

ii. Preparation of various reagents and fixatives

iii. Histological techniques; preparation of biological materials, fixing, embedding, sectioning, staining and mounting.

iv. Study of blood pressure apparatus, stethoscope and such other medical apparatus.

v. Blood tests

vi. Urine analysis

2.Endocrinology

i. Histological observation of endocrine glands-thyroid, adrenal gland, testis and ovary (mammal)

ii. Dissection and localization of selected endocrine glands- thyroid, pituitary, pancreas, adrenal, testis and ovary (frog and rat)

3.Toxicology

i. Determination of LC_{50}/LD_{50}
ii. Dermal toxicity
iii. Haematological parameters-DLC, TLC, Hb, Ht.
iv. Pesticides residues in vegetables
v. Behavioral studies
vi. Identification of histopathological slides
vii. Biochemical examination-Estimation of AST,ALT,ACP,AIP and AChe

4.Microbiology

i. Preparation of media and cultivation of microorganisms:
   A. Broth
   B. Agar
   a. Slants

b. Stabs
c. Plating

ii. Observation of various microbial colonies on plates
iii. Observation of cell shape and arrangement under light microscope
iv. Staining the microbes
a. Gram stain
b. Simple stain
c. Negative stain
d. Acid fast stain
e. Spore stain
f. Capsule stain
v. Observation of bacteriophage plaques
vi. Bacterial motility under microscope
vii. Measurement of bacterial cell size
viii. Pure culture techniques
A. Spreading
B. Streaking
C. Serial dilution
ix. Microbial population enumeration
A. Cell counting
a. Spread plate
b. Pour plate
c. Turbidimetry
x. Routine biochemical tests for identification of Bacteria
A. Sugars-acid and gas production
B. IMVic tests- indole, Methyl red, citrate utilization, Voges, Proskauer test
C. Nitrate reduction
D. H_2S production

5.Bioethics
i. Spotters of microorganisms used in environmental degradation
ii. Identification of plants susceptible to pests
iii. Chromosome types and structure
iv. Whole mount of giant chromosomes
v. Preparation of charts of genetic diseases and their cure
vi. Visit to a Molecular Biology laboratory.
vii. Visit to AIDS awareness center

6.Preparation of reports on Human Genome Project and issues in population control

Zoo.322 Evolution 2+1 Sem.II

1. Concept and evidences of organic evolution
2. Theories of organic evolution –Theory of inheritance of acquired characters (Lamarckism), theory of natural selection (Darwinism); mutation theory and synthetic theory.
3. Origin of life
4. Concept of micro-and mega-evolution
5. Concept of species – speciation and isolating mechanisms
6. Fossils and evolutionary rate

7. Phylogeny of horse
8. Evolution of man
9. Zoogeographical realms and faunal distribution

Practical:

1. Adaptive modifications in the feet of birds.
2. Adaptive modifications in the mouth parts of insects.
3. Embryological evidences of evolution
4. Analogy and Homology
5. Serial homology

B.Sc. Home Science:

Zoo.111 Human Physiology and Hygiene 2+1 Sem.I

Systems and parts of the body; development of bone and its types- joints or articulation; muscles of body, their structure and action; blood; lymphatic system; respiratory system; digestive system; nutrition and metabolism; urinary system; reproductive system; nervous system; endocrine glands; sensory organs and personal hygiene.

Practical: Study of human skeleton; various organs with the aid of models and charts, heart beat, respiration and pulse , microscopic study of mammalian tissues.

Environmental Science

Inter-College Course:

Env.311/Env.321 Introduction to Environmental Science 2+0(NC)

Definition and concepts of environment; natural resources relating to forests, water, minerals, food, energy and land; ecosystems, food chains, ecological pyramids; biodiversity, its hotspots, erosion and conservation; environmental pollution, causes, effects, protection and control measure; solid waste management; disaster management; energy and water flow; their conservation and management; climate change, global warming, nuclear accidents and holocaust; human population, health, environment and information technology.

Field Work

Field excursions to familiarize students with local flora and fauna, simple ecosystem and environmental degradation/ pollution.

Plant Physiology

B.Sc. Agriculture:

Cr. Physiol.241 Crop Physiology 2+1 Sem.II

Introduction, Importance in Agriculture. Seed Physiology, Seed structures, Morphological, physiological and biochemical changes during seed development, Physiological maturity, Morphological and physiological changes associated with physiological maturity in crop, Harvestable maturity, Seed viability and vigour, Factors affecting seed viability and vigour,. Methods of testing seed viability and vigour, Germination, Utilization of seed reserves during seed germination, Morphological, physiological and biochemical changes during seed germination, Factors affecting seed germination. Growth and Development, Definition, Determinate and Indeterminate growth, Monocarpic and Polycarpic species with examples. Measurement of growth, Growth analysis, Growth characteristics, Definitions and mathematical formulae. Crop Water Relations, Physiological importance of water to plants, Water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water Use Efficiency, WUE in C_3, C_4 and CAM plants, Factors affecting WUE. Photosynthesis, Energy synthesis, Significance of C_3, C_4 and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting Photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops. Respiration and its significance, Brief account of Growth respiration and maintenance respiration, Alternate respiration – Salt respiration – wound respiration – measurement of respiration. Nutriophysiology – Definition – Mengel's classification of plant nutrients –Physiology and nutrient uptake- Functions of plant nutrients – Deficiency and toxicity symptoms of plant nutrients – Foliar nutrition, Hydroponics. Introduction of Photoperiodism and Vernalisation in relation to crop productivity – Photoperiodism. Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Senescence and abscission – Definition – Classification – Theories of mechanism and control of senescence Physiological and biochemical changes and their significance, Post Harvest Physiology. Seed dormancy – Definition – types of seed dormancy – Advantages and disadvantages of seed dormancy – Causes and remedial measures for breaking seed dormancy, Optimum conditions of seed storage – Factors influencing seed storage (ISTA standards). Fruit ripening – Metamorphic changes – Climateric and non-climateric fruits – Hormonal regulation of fruit ripening (with ethrel, CCC, Polaris, paclobuterozole).

Practical

Preparation of solutions; Growth analysis; Calculation of growth parameters; Methods of measuring water status in roots, stems and leaves; Measurement of water potential by Chardakov's method; Measurement of absorption spectrum of chloroplastic pigments and fluorescence; Measurement of leaf area by various methods; Stomatal frequency and index – Respirometer – Measurement of respirometer; Leaf anatomy of C_3 and C_4 plants; Measurement of Transpiration; Imbibition of seed; Optimum conditions for seed germination; Breaking seed dormancy; (a) Chemical method (b) Mechanical method, Yield analysis; Seed viability and vigour tests; Effect of ethylene on regulation of stomata.

Chemistry and Biochemistry

Chemistry

Chem.111 States of Matter 2+0 Sem.I

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.
Gaseous States
Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals' equation of state.
Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals' equation, relationship between critical constants and van der 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).
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 cell.
Solid State
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.

Chem.112 Basic Principles of Inorganic Chemistry 2+0 Sem.I

Atomic Structure
Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger 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.
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.

Chemical Bonding

(i) 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 shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_3 and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicentre bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

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

(iii) Weak Interactions – Hydrogen bonding, van der Waals forces.

Chem.113 Physical Organic Chemistry 1+1 Sem.I

Structure and Bonding

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals' interations, inclusion compounds, clatherates, change transfer complexes, resonance, hyper conjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. 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)

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, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemizastion.

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 monosubstitued cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation.

Electromagnetic Spectrum: Absorption Spectra

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer – Lambert law), molar absorptivity, presentation and analysis of UV spectra¸ types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Infrared ((IR) absorption spectroscopy – molecular vibrations, Hooke's law, selection rules, intensity

and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Practical

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, Salicylic 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, Toluene 110.6^0, Benzene 80^0
Mixed melting point determination
Urea Cinnmic 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 stem less funnel)
Acetanilide from boiling water
Naphthalene from ethanol
Benzoic acid from water.

Decolorisation and crystallization using charcoal

Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.
Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixed with 0.3 g of Congo Red using 1 g decolorizing carbon) from ethanol.

Sublimation (Simple and Vacuum)

Camphor, Naphthalene, Phthalic acid and Succinic acid.

Qualitative Analysis

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

Chem.121 Colloids and Chemical Kinetics 1+1 Sem.II

Colloidal State

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 applications of colloids.

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 first 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, Arrhenious 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, miscellaneous examples.

Practical

Chemical Kinetics

(i) To determinate constant of hydrolysis of methyl acetate/ethyl acetate in the presence of HCl.

(ii) To study the effect of acid strength on the hydrolysis of an ester.

(iii) To determine surface tension and viscosity of liquids. To determine the percentage composition of given mixtures.

Distribution Law

(i) To study the distribution of I_2 between CCl_4 and H_2O at room temperature.

(ii) To study the distribution of benzoic acid between C_6H_6 and H_2O at room temperature.

Colloids

(i) To prepare arsenious sulphide sol and compare the precipitating power of mono – bi – and trivalent anions.

Viscosity, Surface Tension

(i) To determine the percentage composition of a given mixture (non interacting systems) by viscosity methods

(ii) To determine the viscosity of amyl alcohol in water at different concentrations and calculate the excess viscosity of these solutions.

(iii) To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

Chem.122 Representative Elements and Noble Gases 2+0 Sem.II

s-Block Elements

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

p-Block Elements

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

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

Chem.123 Hydrocarbons and Organic Halides 2+0 Sem.II

Alkanes and Cycloalkanes
IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms 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 redical 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 strainless rings. The case of cyclopropane ring: banana bonds.
Alkenes, Cycloalkenes, Dienes and Alkynes
Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – mechanisms 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 reactions – 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.
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 Huckel rule, aromatic ions.
Aromatic electrophilic substitution – general pattern of the mechanism, role of σ- and π-complexes. Mechanism of nitration, halogenation, sulphonation, mercuratin 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 alkylbenzens, alkynylbenzenes and biphenyl.
Alkyl and Aryl Halides
Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution relations of alkyl halides, SN^2 and SN^1 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 nucleophilic aromatic substitution

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

Chem.211 Thermodynamics 2+0 Sem.I

Thermodynamics-I

Definition of thermodynamic terms: system, surroundings etc. types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. 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 isothermal 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.

Thermodynamics-II

Second law of thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency. Carnot 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, Clausious inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz 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.

Chemical Equilibrium

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

Reaction isotherm and reaction isochore- Clapeyron equation and Clausius – Clapeyron equation, applications.

Chem.212 Transition and Inner Transition Elements 2+1 Sem.I

Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements.

Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

Chemistry of Lanthanide Elements

Electronic structure, oxidation state and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Chemistry of Actinides
General features and chemistry of actinides. Chemistry of separation of Np. Pu and Am from U, similarities between the later actinides and the later lanthanides.

Practical
Semimicro Analysis – cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI. Anion analysis

Chem.213 Chemistry of Functional Groups-I 2+0 Sem.I

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 and methods of formation, chemical reactions of glycerol.
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 synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.
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.
Aldehydes and Ketones
Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3—dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.
Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation, 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.

Chem.221 Electrochemistry and Phase Equilibrium 2+0 Sem.II

Electrochemistry-I
Electrical transport – conduction in metals and in electrolyte solutions, specific conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch 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 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.

Electrochemistry-II

Type of reversible electrodes – gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, reference electrodes, 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), polarization, over potential and hydrogen over voltage.

Concentration cells, with and without transport, liquid junction potenial, application of concentration cell, 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. Hydrolysis of salts. Corrosion – types, theories and methods of combating it.

Phase Equilibrium

Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, 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 , ($NaCl-H_2O$), $FeCl_3-H_2O$) and $CuSO_4-H_2O$) system. Freezing mixtures, acetone – dry ice.

Liquid – liquid mixtures – Ideal liquid mixtures, Raolt'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. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law – thermodynamic derivation, applications.

Chem.222 Coordination Chemistry and Non-Aqueous Solvents 2+0 Sem.II

Coordination Compounds

Warner'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

Oxidation and Reduction

Use of redox potential data- analysis of redox cycle, redox stability in water – Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Acids and Bases
Arrhenious, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

Non-aqueous Solvents
Physical properties of solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

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

Chem.223 Chemistry of Functional Groups – II 1+1 Sem.II

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, tartaric 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.

Carboxylic Acid Derivatives
Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions, mechanisms of esterification and hydrolysis (acidic and basic).

Organic Compounds of Nitrogen
Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substituion 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 mixture of primary, secondary and tertiaryamines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.
Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

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

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

Practical

Qualitative Analysis

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

(i) Acetalylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.
(ii) Aliphatic electrophilic substitution: Preparation of iodoform from ethanol and acetone.
(iii) Aromatic electrophilic substitution: Preparation of m-dinitrobenzene, p-nitroacetanilide, p-bromoacetanilide and 2,4,6-tribromophenol.
(iv) Diazotization/coupling: Preparation of methyl orange and methyl red.
(v) Oxidation: Preparation of benzoic acid from toluene.
(vi) Reduction: Preparation of aniline from nitrobenzene and m-nitroaniline from m-dinitrobenzene.

Chem.311 Quantum Mechanics and Photochemistry 2+0 Sem.I

Elementary Quantum Mechanics

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

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

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 antibonding wave functions, concept of σ, σ^* , π, π^* orbitals and their characteristics. Hybrid orbitals – sp, sp^2, sp^3; calculation of coefficients of A.O..'s used in these hybrid orbitals. Introduction to valence bond model of H_2, comparison of M.O. and V.B. models.

Photochemistry

Interaction of radiation with mater, difference between thermal and photochemical processes. Laws of photochemistry: Grothus – Drapper law, Stark – Einsein 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).

Chem.312 Advanced Inorganic Chemistry – I 2+1 Sem.I

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Ag, Sn and Ti, a brief

account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Bioinorganic Chemistry

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

Silicones and Phosphazenes

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

Practical

Volumetric and Gravimetric Analysis

Volumetric Analysis

(i) Determination of acetic acid in commercial vinegar using NaOH.
(ii) Determination of alkali content – antacid tablet using HCl.
(iii) Estimation of calcium content in chalk as calcium oxalate by permanganometry.
(iv) Estimation of hardness of water by EDTA.
(v) Estimation of ferrous and ferric by dichromate method.
(vi) Estimation of copper using thiosulphate.

Gravimetric Analysis

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

Synthesis and Analysis

(i) Preparation of sodium trioxalato ferrae (III), $Na_3[Fe(C_2O_4)_3]$ and determinatioin of its composition by permaganometry.
(ii) Preparation of Ni-DMG complex, [Ni(DMG0_2].
(iii) Preparation of copper etraammine complex. [Cu9$NH_3)_4$]SO_4.
(iv) Preparation of cis- and trans- bisoxalato diaqua chromate (III) ion.

Chem.313 Heterocyclics, Pericyclics and Spectroscopy 2+0 Sem.I

Heterocyclic Compounds

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanisms of nucleophilic substitution reactions 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-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Pericyclics

Orbital Symmetry: Electrocyclic reactions, Woodward-Hoffmann rules, cycloaddition and Sigmatropic reactions.

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 PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Chem.321 Solutions and Spectroscopy 1+1 Sem.II

Solutions, Dilute Solutions and Colligative Properties

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

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

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

Spectroscopy

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diotomic 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 vibration 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 vibarational 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 orbials, qualitative description of selection rules and Franck-Condon principle.

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

Practical

Transition Temperature

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

Phase Equilibrium

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).

(i) To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method.

Thermochemistry

(i) To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.

(ii) To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.

(iii) 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.

Electrochemistry

(i) To determine the strength of the given acid conductometrically using standard alkali solution.
(ii) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
(iii) To study the saponification of ethyl acetate conductometrically.
(iv) To determine the ionization constant of weak acid conductometrically.
(v) 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.

Molecular Weight Determination

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

Chem.322 Advanced Inorganic Chemistry-II 2+0 Sem.II

Metal-ligand Bonding in Transition Meal Complexes

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

Magnetic Properties of Transition Metal Complexes

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

Electron Spectra of Transition Metal Complexes

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

Thermodynamic and Kinetic Aspects of Metal Complexes

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

Chem.323 Natural Products, Synthetic Polymers and Dyes 2+0 Sem.II

OrganicSynthesis 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.

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 into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation.

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

Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of 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 portions structure. Protein denaturation/renaturation.
Nucleic acids: introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Fats. Oils and Detergents

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

Synthetic Polymers

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerizatin and vinyl polymers.
Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

Synthetic Dyes

Colour and consitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphathalein, Fluorescein, Alizarin and Indigo.

Chem.324 Analytical Techniques in Chemistry 0+1 Sem.II

Instrumentation

Colorimetry

(i) Job's Method
(ii) Mole-ratio method Adulteration – Food stuffs. Effluent analysis, water analysis.
(iii) To verify Beer-Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

Solvent Extraction

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

Ion Exchange Method

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

Refractometry, Polarimetry

(i) To verify law of refraction of mixtures (e.g., of glycerol and water) using Abbe's refractometer.
(ii) To determine the specific rotation of a given optically active compound.

(a) Thin Layer Chromatography

Determination of R_f values and identification of organic compounds.
(i) Separation of green leaf pigments (spinach leaves may be used).
(ii) Preparation and separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2- and 3-one using toluene and light petroleum(40:60).
(iii) Separation of a mixture of dye 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.

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

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

(iii) Separation of monosaccharides – a mixture of D-fructose using n-butanol : acetone: water (4:5:1). Spray reagent – aniline hydrogen phthalate.

B.Sc. (Agri) CC:

Chem.001 General Chemistry 4+1 Sem.I

Definition of sciences and Chemistry, matter and its nature: symbols and formulae: concept of mole: atomic weight and molecular weight: empirical and molecular formulae: balancing of chemical equations: laws of chemical combination: Dalton's laws of partial pressure: electrolysis: theory of ionization: cathode rays: Rutherdord model of atom: nucleus-electron interaction: periodic table (classification of elements and study of their properties along groups and periods with special reference to ionization potential, electron affinity and electron negativity): chemical bonding: molecular and atomic weights and their determination oxidation and reduction study of water, hydrogen peroxide, halogens, sulphur, nitrogen and their acids, carbon, phosphorus, nitrogen and carbon dioxide cycles.

Practical: Survey of laboratory equipments, study of burners, qualitative analysis of single salt, volumetric analysis (acid-base titrations).

Chem.002 Physical and Inorganic Chemistry 3+1 Sem.II

Kinetic molecular theory of gases and critical phenomena: chemical kinetics: chemical equilibrium: elementary idea of the properties of liquids: dilute solutions and colligative properties: common effect of and solubility product, colloidal state and basic concept of adsorption: atomic structure, chemical bonding including hydrogen and metallic bonding: geometry and shape of molecules: acids and bases elementary idea about ligands, chelation and clatherates.

Practical: Volumetric analysis involving redox and iodometric titration, qualitative analysis of mixture containing four radicals.

Chem.003 Organic Chemistry 2+0 Sem.II

Nomenclature and classification of organic compound, study of aliphatic hydrocarbons, halogen compounds, alcohols, ethers aldehydes. ketones, carboxy acids, amines and amides: elementary chemistry of oils, fats and carbohydrates: aromatic and heterocyclic compounds.

UnderGraduate Courses (Biochemistry)

B.Sc. Home Science:

Biochem.111 Biochemistry 2+1 Sem.I

Introduction to biochemistry, its importance and relationship to food and nutrition; Carbohydrates, definition, classification, general reaction, and metabolism; Lipids, definition, classification, metabolism, digestion and absorption, saturated and unsaturated fatty acids, oxidation and rancidity; Proteins, definition, classification, molecular weight, colloidal nature of protein, amino acids classification, chemical properties, amino acids metabolism, digestion and absorption, protein quality estimation; Nucleic acids, RNA, DNA their biological functions, basic nucleosides and nucleotides, structure and function. Enzymes, chemical nature, mechanism of enzyme action, specificity of enzymes, condition for enzyme activities; coenzymes and prosthetic groups; Vitamins, classification, structure and functions of vitamins; Hormones involved in regulation of metabolism, water balance, acid base equilibrium.

Practical

Qualitative and quantitative tests for carbohydrates, lipids, proteins, amino acids and Vitamin C; Separation of amino acids by paper chromatography- ascending and descending; Determination of pH, use of pH meter; Determination of starch and sugar, Analysis of proximate constituents in food.

B.Sc. Agriculture:

Biochem.351 Biochemistry 2+1 Sem.I

Biochemistry – Introduction and importance. Plant cell, cell wall and its role in live stock, food and paper industries. Biomolecules – Structure, properties & applications: amino acids, peptides and proteins – Plant proteins and their quality. Enzymes - Factors affecting the activity, classification, immobilization and other industrial applications. Lipids – Acyl lipids and their industrial application (soaps, detergents, plants, varnishes, lubricants, adhesives, plastics, nylon, bio-diesel, biodegradable plastic). Carbohydrates; Nucleotides and Nucleic acids. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. General reactions of amino acid degradation. Biosynthesis – carbohydrates, lipids, proteins and nucleic acids, Metabolic regulation. Secondary metabolites, terpenoids, alkaloids, phenolics and their applications in food and pharmaceutical industries.

Practical

Amino acid models (atomic); pigments; Protein denaturation – heat, pH, precipitation of proteins with heavy metals, protein estimation by Lowry method; enzyme kinetics, competitive inhibition, enzyme immobilization; Extraction of nucleic acids, Characterization of lipids by T.L.C.; extraction of oil from oil seeds; models of sugars, sucrose & starch; quantitative determination of sugars; paper chromatography for the separation of sugars; determination of phenols.

Microbiology

B.Sc. Home Science:

Micro.121 Fundamentals of Microbiology 1+1 Sem.II

Discovery of microorganisms; scope of microbiology; major groups of prokaryotes and eukaryotes; methods in microbiology; cultivation of microorganisms, nutrition and growth; microorganisms associated with different types of foods and food products; microbiology of milk and milk products; food spoilage, food poisoning, and food intoxication; food preservation; microbiology of potable water; industrially important microorganisms and their cultivation; quality control aspects.

Practical

Study of microscope and other laboratory equipments; examination of bacteria, fungi, yeast, protozoa and algae; staining-negative, simple, Gram, capsule and spore; sterilization techniques; preparation of media; isolation of bacteria; demonstration of microorganisms in food and dairy products.

B.Sc Agriculture:

Ag. Micro.121 Agricultural Microbiology 2+1 Sem.II

History of Microbiology: Spontaneous generation theory, Role of microbes in fermentation, Germ theory of diseases, Protection against infections, Applied areas of Microbiology; **Major groups of prokaryotes and eukaryotes**: Prokaryotic and eukaryotic cells; **Bacteria**: Arrangement, shape, structure and bacterial spore; Bacterial genetics-transformation, conjugation, transduction and genetic engineering; Brief introduction to fungi and algae; **Microbial nutrition and Growth**: Culture media, Growth curve & measurement of growth; **Viruses**: General properties of viruses, Bacteriophage-structure and reproduction, viroids and prions; **Soil Microbiology**: Microbial groups in soil, microbial transformation of carbon, nitrogen, phosphorus and sulphur, Microflora of rhizosphere & phyllosphere; **Beneficial microorganisms in Agriculture**: Biofertilizer, microbial insecticides, composting and biogas, Biological nitrogen fixation, Mycorrhizae, biodegradation; **Food microbiology**: Microbial spoilage and principles of food preservation microbiology of water.

Practical

General instructions, familiarization with microscope and other important laboratory equipments, staining techniques, sterilization techniques, preparation of culture media, isolation & preservation techniques, demonstration of micro-organisms in soil, water, air and food, enumeration of bacteria by pour and spread plate techniques.

Physical Sciences and Languages

Computer Science

Comp.111 Principles of Computer-I 1+1 Sem.I

General introduction to computer: definition, classification, advantages and limitations of computers.
Components of computers: input-output unit, central processing unit, software and hardware; types of memory.
Binary system: binary number system, coding information of storage.
Languages: machine, assembly and high level languages.
Data structure: simple data, arrays, lists, stacks, queues and trees.
Practical
Working with operating systems like WINDOWS, handling of Word processors.

Comp.121 Principles of Computer-II 1+1 Sem.II

Operating System- evolution, components, functions (processor, memory and file management).
Network: concept, advantages and limitations, topologies.
Algorithms: concept, representation.
File structure: sequential, indexed and hashed files.
Practical
Working with spreadsheets and presentations.

Comp.221 Computer programming in C 2+1 Sem.II
For B.Sc. non-medical

Getting started; character set; constant, variables and keywords; type declaration instruction; input-output instructions; arithmetic instruction; integer and float conversion; type conversion in assignment; hierarchy of operators.
Data types: integers (long and short); integers (signed and unsigned); characters (signed and unsigned); float and double.
Control statement: decision control structure; logical operators; hierarchy of logical operators; conditional operators; loop control structure; case control structure; go to statement.
Puppetting on strings: introduction to strings; standard library string functions.
Arrays: one dimentional and multi dimentional arrays; array initialization, input and output.
Subprogrammes: introduction, use, scope, role and advanced features of functions.
Practical
Development of different programmes in context to above given contents:

To print out all natural even/odd numbers between given limits
To find maximum, minimum and range of a given set of numbers
To compile a frequency distribution and evaluate moments such a mean; standard deviation etc.
To evaluate sum of finite series
To find the product of two matrices
To find a set of prime numbers and Fibonacci series
To find the roots of a quadratic equation
To check if triangle exists and the type of the triangle Inverse of a matrix
String manipulations
Find roots of f(x) = 0 by using Newton- Raphson method
Find root of f(x) = 0 by using secant method

Comp.222 Applications in FoxPro and Programming in BASIC 2+1 Sem.II
For B.Sc. (Medical)

FoxPro: creation of data files, type of data files; introduction to other files; adding and editing of data and records; locating and query commands; sorting and indexing databases; reports
BASIC: Data types; input – output statements; assignment statements; decision making statements; logical and relational operators; looping statements;

Practical

Creation and query of database using FoxPro; simple programmes using BASIC, such as, to find sum given numbers, etc.

B.Sc. Home Sciences:

Comp.111 Computer Sciences 1+2 Sem.I

Introduction to computer; components of computer; types of computers; hardware, software, humanware and firmware; types of memories; control unit; input and output unit; execution of a programme; data types; constants, variables, expressions, operators, function commands; simple commands; simple programme, flow charts, storage of data, filing, retrieving and reproduction; computer languages-their scope and limitation; use of computer for statistical analysis, agriculture and graphics; geographic information system; national information centre, libraries on Computer disc/floppies.

Practical

Use of computer and its operating systems; solving of simple problems using WINDOWS, MS WORD AND MS EXCEL.

B.Sc. Agriculture:

Comp.241 Introduction to Computer Applications 1+1 Sem.II

Introduction to Computers, Anatomy of Computers, Input and Output Devices. Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Types

of Processors, booting of computer, warm and cold booting. Computer Viruses, Worms and Vaccines. Operating System - DOS and WINDOWS. Disk Operating System (DOS): Some fundamental DOS Commands, FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE, Rules for naming files in DOS and Types of files. WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders; setting time and date, starting and shutting down of WINDOWS. Anatomy of a WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. Applications - MSWORD: Word, processing and units of document, features of word-processing packages. Creating, Editing, Formatting and Saving a document in MSWORD; MSEXCEL: Electronic Spreadsheets, concept, packages. Creating, Editing and Saving a spreadsheet with MSEXCEL. Use of in-built Statistical and other functions and writing expressions. Creating Graphs. MS Power Point: Features of Power Point Package. Internet: World Wide Web (WWW), Concepts, Web Browsing and Electronic Mail.

Practical

Study of Computer Components; Booting of Computer and its Shut Down; Practice of some fundamental DOS Commands, TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PATH; Practicing WINDOWS Operating System, Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars; WINDOWS Explorer, Creating Folders, COPY and PASTE functions; MSWORD: Creating a Document, Saving and Editing; Use of options from Tool Bars, Format, Insert and Tools (Spelling & Grammar) Alignment of text; Creating a Table, Merging of Cells, Column and Row width; MSEXCEL: Creating a Spreadsheet, Alignment of rows, columns and cells using Format tool bar; Entering Expressions through the formula tool bar and use of inbuilt functions, SUM, AVERAGE, STDEV; Creating Graphs and Saving with & without data; MS Power Point: Preparation of slides on Power Point; Transforming the data of WORD, EXCEL and ACCESS to other formats; Internet Browsing: Browsing a Web Page and Creating of E-Mail ID.

English

Eng.111 Prose, Poetry and Functional English 2+0 Sem.I

Selections of poetry and prose from the book prescribed; Vocabulary building; exercises in comprehension based on the text; phrase, clause, sentence; Verb (tenses); parts of speech; Modals; punctuation; Synonyms and antonyms; Use of Dictionary.

Eng.121 Comprehension, Translation and Composition 2+0 Sem.II

Selections of poetry and stories from the book prescribed; exercises in Comprehension based on text; translation from Hindi to English; comprehension (unseen passages); Personal letter and application; telegram, notice and invitation.

B.Sc. Agriculture:

Eng.111 Comprehension and communication Skills in English 1+1(NC) Sem.I

Comprehension: Text for comprehension, Current English for Colleges, By N. Krishnaswamy & T. Sriraman, Macmillan India Limited, Madras, 1995; War Minus shooting- The sporting spirit George Orwell (a) Reading Comprehension (b) Vocabulary Synonyms- Antonyms- Often confused words and (c) Two exercises to help the students in the enrichment of vocabulary based on TOEEL and GRE and other comp0etitive examinations. A Dilemma- A layman looks at science Raymond B. Fosdick (a) Reading Comprehension (b) Vocabulary – Homonyms and Homophones (c) Exercises on Figurative Language & Idiomatic Language (E.g.: dust and ashes, doorstep of doom, boundaries of knowledge, Apple of one's eye, in a fix etc.) 5&6 You and Your English – Spoken English and Broken English G.B. Shaw (a) Reading Comprehension (b) Language study, Functional Grammar, Agreement of verb with subject. Written Skills: Mechanics of good letter, Effective business correspondence, Personal Correspondence, Preparation of Curriculum vitae and Job applications. The Style, Importance of professional writing. Choice of words and Phrases, precision, conciseness clichés, redundancy, jargon, foreign words, Precis writing and synopsis writing.. Interviews, Types of interviews, purpose, different settings, as interviewer, interviewee, physical makeup and manners, appearance, poise, speech, self reliance, Evaluation process, Review or feedback.

Practical

Listening Comprehension, Listening to short talks, lectures, speeches (scientific, commercial and general in nature) Practical: listening to at least two tape, recorded conversations aimed at testing the listening comprehension of students; Communication: Spoken English, oral communication, importance stress and intonation. Practical: Spoken English practice by using audiovisual aids, the essentials of good conversations, oral exercises in conversation practice (At the Doctor, at the Restaurant, at the Market Yard); Oral Presentation of Reports:

Seminars and conferences, features of oral presentation, regulating speech, physical appearance, body language posture, eye contact, voice, audience, preparation of visual aids. Practical: One presentation by individual on the given topic related to agriculture like W.T.O., Developing new technologies in Agriculture, Bio fertilizers etc.; Evaluation of a Presentation: evaluation sheet, other strategies to be considered for evaluating a presentation, Practical: Mock evaluation of a presentation; Dyadic communication, face to face conversation, Telephonic conversation, rate of speech, clarity of voice, speaking and listening politeness, telephone etiquette, Practical: Practice of Telephonic conversation; Reading skills, using Dictionary, reading dialogues, rapid reading, intensive reading, improving reading skills; Meetings; purpose, procedure participation, chairmanship, physical arrangements, recording minutes of meeting; Practice of Presentation by using power point and LCD projector; Conducting Mock interviews – testing initiative, team spirit, leadership, intellectual ability – potential for development, memory, motivation, objectives, aptitude etc., Group Discussions and Debates on current topics; Review or Feed Back; Practical examination.

B.Sc. Home Sciences:

Eng.121 English and Technical writing 1+1 Sem.II

Grammar; Advanced exercises on prepositions; Tense usage and passive voice.
Comprehension; Text book: Language through literature 11 chapters prescribed; Prankster of the sea; the power of women; A scramble among the tagins; the night the ghoist got in.
Composition; Writing of personal letters; writing of technical reports on subjects connected with Home Sciences.

Practical

Spoken English; phonetics, Vowels, Diphthongs and Consonants; Word stress; Writing and presentation of technical reports; Group discussion and debates on current topics and on Home Science subjects to develop oral communication skills.

Mathematics

Math.111 Matrices, Trigonometry and Vector Analysis 3+0 Sem.I

Symmetric. Skew symmetric. Hermitian and skew Hermitian matrices. Elementary operations on matrices. Inverse of a matrix. Linear independence of row and column matrices. Row rank, column rank and rank of a matrix. Equivalence of column and row ranks. Eigen values, eigen vectors and the characteristic equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of a matrix. Applications of matrices to a system of linear (both homogenous and non-homogeneous) equations. Theorems on consistency of a system of linear equations.

De Moivere's theorem and its applications. Direct and inverse circular and hyperbolic functions. Logarithm of a complex quantity. Expansion of trigonometrical functions. Gregory's series. Summation of series.

Scalar and vector product of three vectors. Product of four vectors. Reciprocal Vectors. Vector differentiation. Gradient, divergence and curl. Vector integration. Theorems of Gauss, Green, Stokes and problems based on these.

Math.112 Calculus 3+0 Sem.I

Differential calculus:

ε-δ definition of the limit of a function. Basic properties of limits. Continuous functions and classification of discontinuities. Differentiability. Successive differentiation. Rolle's theorem, Taylor's theorem. Leibnitz theorem. Maclaurin and Taylor series expansions. Asymptotes. Curvature. Tests for concavity and convexity. Points of inflexion. Multiple points. Tracing of curves in Cartesian and polar coordinates.

Integral Calculus:

Integration of irrational algebraic functions and transcendental functions. Reduction formulae. Definite integrals. Quadrature. Rectification. Volumes and surfaces of solids of revolution.

Math.121 Algebra and Ordinary Differential Equations 3+0 Sem.II

Relations between the roots and coefficients of general polynomial equation in one variable . Transformation of equations. Descarte's rule of signs. Solution of cubic equations (Cardon's method). Biquadratic equation (Ferrari's method).

Mappings. Equivalence relations and partitions. Congruence modulo n.

Definition of group with examples and simple and properties. Subgroups. Generation of groups. Cyclic groups. Coset decomposition. Lagrange's theorem and its consequences. Fermat's and Euler's theorems. Homomorphism and Isomorphism. Normal subgroups. Quotient groups. The fundamental theorem of homomorphism. Permutation groups. Even and odd permutations. The alternating groups. Cayley's theorem. Introduction to rings, subrings, integral domains and fields. Characteristic of a ring.

Exact differential equations. First order higher degree equation solvable for x, y, p. Clairaut's form and singular solution. Geometrical meaning of a differential equation. Orthogonal

trajectories. Linear differential equation with constant coefficients. Homogeneous linear ordinary differential equation

Linear differential equations of second order. Transformation of the equation by changing the dependent variable / the independent variable. Method of variation of parameters. Ordinary simultaneous differential equations.

Math.122 Geometry 3+0 Sem.II

General equation of second degree. Tracing of conics. System of conics. Confocal conics. Polar equation of a conic. Plane. The Straight line and the plan. Sphere. Cone. Cylinder. Central conicoids. Paraboloids. Plane Sections of Conicoids. Generating lines. Confocal Connicoids. Reduction of Second degree equations.

Math.211 Advanced Calculus 4+0 Sem.I

Continuity. Sequential continuity. Properties of continuous functions. Uniform continuity. Chain rule of differentiability. Mean value theorems and their geometrical interpretations. Darboux's intermediate value theorem for derivatives. Taylor's theorem with various forms of remainders.

Limit and continuity of functions of two variables. Partial derivatives for functions of two variables. Jacobians.

Envelopes. Evolutes. Maxima, minima, and saddle points of functions of two variables. Lagrange's multiplier method. Indeterminate forms.

Beta and Gamma functions. Double and triple integrals. Dirichlet's integrals. Change of order of integration in double integrals.

Definition of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Cauchy's convergence criterion. Series of non- negative terms. Comparison tests. Cauchy's integral test. Ratio tests. Raabe's test, de Morgan and Bertrand's tests. Alternating series. Leibnitz's theorem. Absolute and conditional convergence.

Math.212 Dynamics 3+0 Sem.I

Velocities and accelerations along radial and transverse directions, and along tangential and normal directions. Simple harmonic motion. Elastic strings.

Motion on smooth and rough plane curves. Motion in a resisting medium. Motion of particles of varying mass.

Central orbits. Kepler's laws of motion.

Motion of a particle in three dimensions. Acceleration in terms of different coordinate systems.

Math.221 Differential Equations 4+0 Sem.II

Series solutions of differential equations- power series method, Bessel, Legendre and Hypergeometric equations. Bessel, Legendre and Hypergeometric functions and their properties, convergence, recurrence and generating relations. Orthogonality of functions.

Sturm-Liouville problem. Orthogonality of eigen- functions. Reality of eigen values. Orthogonality of Bessel functions and Legendre polynomials.
Laplace transformation- Linearity of the Laplace transformation. Existence theorem for Laplace transforms. Laplace transforms of derivatives and integrals. Shifting Theorems. Differentiation and integration of transforms. Convolution theorem. Solution of integral equations and systems of differential equations using the Laplace transformation.
Partial differential equations of the first order. Lagrange's solution. Some special types of equations which can be solved easily by methods other than the general method. Charpit's general method of solution.
Partial differential equation of second and higher orders. Classification of linear partial differential equations of second order. Homogeneous and non-homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients. Monge's methods.
Calculus of variation- variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable. Extremals. Functionals dependence on higher order derivatives. Functionals dependent on more than one independent variable. Variational problems in parametric form. Invariance of Euler's equation under coordinates transformation.
Variational Problems with moving boundaries- Functionals dependent on one and two functions. One sided variations.
Sufficient conditions for an Extremum- Jacobi and Legendre conditions. Second variation. Variational principle of least action.

Math.222 Statics 2+0 Sem.II

Analytical condition of equilibrium of coplanar forces. Virtual work. Catenary. Forces in three dimensions. Poinsot's central axis. Wrenches. Null lines and planes. Stable and unstable equilibrium.

Math.311 Analysis 3+0 Sem.I

Riemann integral. Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus.
Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests. Frullani's integral. Integral as a function of a parameter. Continuity, derivability and integrability of an integral of a function of a parameter.
Series of arbitrary terms. Convergence, divergence and Oscillation. Abel's and Dirichlet's tests. Multiplication of series. Double series.
Partial derivation and differentiability of real- valued functions of two variables. Schwarz and young's theorem. Implicit function theorem.
Fourier series. Fourier expansion of piecewise monotonic functions.
Complex numbers as ordered pairs. Geometric representation of Complex numbers. Stereographic projection.
Continuity and differentiability of Complex function. Analytic functions. Cauchy- Riemann equations. Harmonic functions.
Elementary functions. Mapping by elementary functions.
Mobius transformations. Fixed points. Cross ratio. Inverse points and critical mappings. Conformal mappings.

Math.312 Abstract Algebra 4+0 Sem.I

Group - Automorphisms, inner automorphism. Automophism groups and their computations. Conjugacy relation. Normaliser. Counting principle and the class equation of a finite group. Center for group of prime- order. Abelianizing of a group and its universal property. Sylow's theorems. P-sylow subgroup. Structure theorem for finite Abelian group.
Ring theory- Ring homomorphism. Ideals and Quotient rings. Field of Quotients of an Integral Domain. Eucidean Rings. Polynomial Rings. Polynomials over the Rational field. The Einstein Criterion. Polynomial Rings over Commutative rings. Unique factorization domain. R unique factorization domain implies so is R $[x_1, x_2\text{-----}x_n]$
Inner product Spaces- Cauchy- Schwarz inequality. Orthogonal vectors. Orthogonal complements. Orthogonal sets and bases. Bessel's inequality for finite dimensional spaces. Gram- Schmidt Orthogonalization process.
Modules, Submodules. Quotient modules. Homomorphism and Isomorphism theorems
Definition and examples of vector spaces. Subspaces. Sum and direct sum of sunspaces. Linear span. Linear dependence, independence and their basic properties. Basis. Finite dimensional vector spaces. Existence of complementary subspace of a subspace of a finite dimensional vector space. Dimension of sums of subspaces. Quotient space and its dimension. Linear transformations and their representation as matrices. The Algebra of linear transformations. The rank nullity theorem. Change of basis. Dual space. Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigen values and eigen vectors of a linear transformation. Diagonalisation. Annihilator of a subspace. Bilinear, Quadratic and Hermitian forms.

Math.321 Metric and Inner Product Spaces 3+0 Sem.II

Definition and examples of metric spaces . Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure and interiror. Boundary points. Sub-space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Contraction principle. Construction of real numbers as the completion of the incomplete metric space of rationals. Real numbers as a complete ordered field. Dense subsets. Baire category theorem. Separable, second countable and first countable spaces. Continuous functions. Extension theorem . Uniform continuity Isometry and homeomorphism. Equivalent metrics. Compactness. Sequential compactness. Totally bounded spaces. Finite intersection property. Continuous functions. and compact sets. Connectedness. Components. Continuous and connected sets. Inner product Spaces-Cauchy-Schwarz inequality. Orthogonal vectors. Orthogonal complements. Orthogonal sets bases. Bessel's inequality for finite dimensional spaces. Gram-Schmidt Orthogonalization process.
Modules, submodules. Quotient modules. Homomorphism and Isomorphism theorems.

Math.322 Numerical Analysis 3+1 Sem.II

Solution of Equations: Bisection, Secant, Regula Falsi, Newton's method, roots of polynomials.
Interpolation: Lagrange and Newton interpolation, Divided Differences, Difference schemes, Interpolation formula using Difference schemes.
Numerical Quadrature: Newton- Cote's formulas, Gauss Quadrature formulas, Chebychev's formulas.

Linear Equations: Direct methods for solving systems of linear Equations (Gauss Elimination), Iterative methods (Jacobi, Gauss- Seidel, Relaxation method).
Numerical Differentiation: Derivatives using Forward Difference Formula, Backward Difference Formula, Divided Difference formula, Central Difference Formula and Bessel's Formula.
Numerical Integration: Newton-Cote's formulas, Simpson's 1/3 rule, Simpson's 2/8 rule, Gauss Quadrature formulas.
Ordinary Differential Equations; Euler method, Single-step method, Runge-Kutta's method, multi-step methods, Milne-Simpson method, Boundary value problems, Eigen value problems.
Approximation: Different types of Approximation, Least Square polynomial Approximation, polynomial Approximation using Orthogonal polynomials, Approximation with Trigonometric functions, Exponential functions, Chebychev polynomials.
Practical (to be developed in C language)
Bisection method, Regula Falsi method, Newton Raphson method, Secant method, Gauss elimination method, Gauss Seidal method, Jacobi method, Difference table generation, Trapezoidal rule, 1/3 Simpson rule, Newton – forward methods of interpolation, Least square method of curve fitting, Eigen method of solving differential equation, 4^{th} order Runge-Kutta method of solving differential equation.

B.Sc. (Ag.) CC:

Math.001 Algebra and Trignometry 5+0 Sem.I

Number system: Complex Numbers with operation of addition, subtraction, multiplication and division: quadratoic equation: Elementary introduction of A.P. and G.P.: Permutations and combinations: Binomial theorem.
Angle and its measurements: t-ration and simple relations connecting them: t-rations of some standard angles: t-rations of certain allied angles: Addition and subtraction formula: Sum and product formula.

Math.002 Co- ordinate Geometry and Calculus 5+0 Sem.II

Rectangular system of co-ordination of a point, distance formula, section formula: equation of a st.Line, parallel lines, perpendicular lines: perpendicular distance of a point from a st. lines: Angle between two lines: Point of intersection of two lines.
Variables, functions and limits, simple techniques of differentiation: integration as inverse operation of differentiation: Simple techniques of integration.

Physics

Phys.111 Mechanics & Theory of Relativity 3+0 Sem.I

Co-ordinate Systems and Motion of a Particle: Cartesian and Spherical co-ordinate systems; volume, velocity and acceleration in these systems; solid angle.
Space Time Symmetry and Conservation Laws: Relationship of conservation laws and symmetries of space and time.
Elasticity: small deformations, Hooke's law, elastic constants for isotropic solid, beams supported at both the ends; cantilever, torsion of cylinder, bending moments and scaring forces.
Inverse Square Force Law: Various forces in nature (qualitative), central forces, centre of mass, equivalent one body problem; equation of orbit and turning points, Kepler's laws, potential because of a spherical body; Gauss and Poisson equations for gravitational energy.
Kinematics of Elastic and Inelastic Collisions: Elastic collisions in laboratory and C.M. systems, velocity, angle, and energies in elastic collisions in C.M. and lab. systems; cross-section for elastic scattering, Rutherford scattering (with derivation).
Frame of References: Inertial frames of reference. Galilean transformation and Galilean invariance, Non-inertial frames, Coriolis force and its applications. Focault's pendulum.
Special Theory of Relativity: Concept of stationary universal frame of reference and search for ether. Michelson- Morley experiment, Postulates of special theory of relativity, Lorentz transformation, observer in relativity of simultaneity, length contraction, time dilation, relativistic addition of velocities; relativistic Doppler effect, variation of mass with velocity and mass energy equivalence; Increase of mass in an inelastic collision, relativistic momentum and energies. Transformation of momentum and energy, Minkowsky space.

Phys.112 Vector Analysis and Electrostatics 2+0 Sem.I

Vector Algebra: Scalar and vector products, polar and axial vectors, their examples from physics, triple and quadruple products, sphere.
Vector Calculus: Scalar and vector fields, differentiation of vector with respect to scalars, gradient, divergence, curl operations and their meaning; Idea of line, surface and volume integrals; Gauss's, Stoke's and Green's theorems, General orthogonal coordinates, expression for gradient, divergence and curl in cartesian, spherical and cylindrical co-ordinates (no derivation).
Coulomb's law and Gauss's Law: Coulomb's law in vector notation for point charges and continuous distribution of charges; electric field due to a dipole and linear distribution of charge (line charge) and sheet of charges; electric flux, Gauss's law and its applications; Gauss's divergence theorem and differential form of Gauss's law.
Electric Potential: Work and potential difference, potential difference as line integral of field; conservative nature of electric field; electric potential due to point charge, a group of point charges, dipole and quadrupole, long uniformly charged wire, charged disc; electric potential energy; curl of a vector field, Stoke's theorem (with proof) and its applications to electrostatic field (Curl $\vec{E}$ = zero); Electric field as gradient of a scalar potential, calculation of electric field due to a point charge and a dipole from potential; potential due to charge

distribution and multipole moments; methods of Electrical images, calculation of electric potential and field due to point charge placed near an infinite conducting sheet; Poisson's and Laplace's equations (derivation only).
Electrostatic Field in Dielectrics: Polarization of matter. atomic and molecular dipoles, induced dipole moment and atomic polarizability; electric susceptibility and polarization vector, capacity of a capacitor filled with dielectrics; establishment of relation $\varepsilon_r = 1 + \chi$, Dielectrics and Gauss's law; Displacement vector - establishment of relation $\vec{\nabla} \cdot \vec{D} = \rho$, energy stored in a dielectric medium.

Phys.113 Physics Laboratory-I 0+1 Sem.I

Study of laws of parallel and perpendicular axes for moment of inertia.
Study of conservation of momentum in two dimensional collision
Study of a compound pendulum.
Study of damping of a bar pendulum under various mechanics.
Study of oscillation under a bifilar suspension.
Potential energy curves of a 1-D system and oscillations in it for various amplitudes.
Study of oscillations of a mass under different combinations of springs.
Study of bending of a cantilever or a beam.
Study of torsion of a wire (static and dynamic methods).
Study of flow of liquids through capillaries.
Determination of surface tension of a liquid by different methods.
Study of viscosity of a fluid by different methods.
Elementary Fortran programs, flowcharts and their interpretation.
To print out all natural even/odd numbers between given limits.
To find maximum, minimum and range of a given set of numbers.
To compile a frequency distribution and evaluate moments such as mean; standard deviation etc.
To evaluate sum of finite series and the area under a curve.

Phys.121 Statistical Physics and Thermodynamics 3+0 Sem.II

Basic Ideas of Statistical Physics: Scope of statistical physics, basic ideas about probability, distribution of four distinguishable particles in two compartments of equal sizes; concept of macro-states, micro-states, thermodynamic probability, effect of constraints on the system; distribution of n particles in two compartments, deviation from the state of maximum probability; equilibrium state of a dynamic system, distribution of n distinguishable particle in k compartments of unequal sizes.
Maxwell-Boltzmann Statistics: Phase space and division into elementary cells; three kinds of statistics, basic approach in the three statistics; M-B. statistics applied to an ideal gas in equilibrium, experimental verification of the Maxwell Boltzmann's law of distribution of molecular speeds.
Bose-Einstein and Fermi-Dirac Statistics: Need for quantum statistics, h as a natural constant and its implications; indistinguishability of particles and its implications; B.E. statistics, derivation of Planck's law of radiation, deduction of Wien's distribution law and Stefan's law

from Planck's law; Fermi-Dirac statistics; comparison of M-B, B-F and F-D statistics, Applications to liquid helium, free electrons (Fermi level and Fermi Energy), and photons in black body chamber.

Statistical Interpretation of Entropy: Statistical definition of entropy, change of entropy of system, additive nature of entropy, law of increase of entropy; reversible and irreversible processes, example of reversible and irreversible processes; work done in a reversible process; example of entropy in natural process; entropy and disorder.

Entropy and Carnot's Cycle: Brief review of the terms and laws of thermodynamics and of Carnot's cycle, entropy changes in Carnot's cycle, efficiency of reversible heat engine, the thermodynamic temperature scale; ideal refrigerator and heat pump; Application of thermodynamics to the thermoelectric effect, change of entropy along a reversible path in a p-v diagram, entropy of a perfect gas, equation of state of ideal gas from simple statistical considerations, heat death of the universe.

Maxwell's Thermodynamic Relations and their applications: Derivation of Maxwell's thermodynamic relations, applications of thermodynamic relations, cooling produced by adiabatic stretching, adiabatic compression, adiabatic stretching of wire, stretching of thin films, change of internal energy with volume, thermodynamical treatment of Joule-Thomson effect for liquification of Helium; Production of very low temperatures by adiabatic demagnetization.

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Phys.122 Current Electricity and Magnetism 2+0 Sem.II

Electric Current and Field of Moving Charges: Current and current density. Continuity equation ($\vec{\nabla} \cdot \vec{J} + \frac{\partial \vec{\rho}}{\partial t} = 0$), microscopic form of Ohm's law ($\vec{J} \alpha \vec{E}$) and conductivity, failure of Ohm's law and its explanation, invariance of charge; $\vec{E}$ in different frames of reference, Field of a point charge moving with constant velocity, field of a charge that starts or stops (qualitative), interaction between moving charges and force between parallel currents.

Magnetic Field: Definition of $\vec{B}$; Biot Savart's Law (statement) and its applications to long straight wire, circular current loop and solenoid; Ampere- circuital law and its applications; Divergence and curl of magnetic field $\vec{B}$; Hall Effect, expression for Hall constant and its significance; Vector potential: Definition of vector potential $\vec{A}$ and derivation of its expression; Surface current density: Definition and its use in calculation of change in magnetic field due to a current sheet; transformation equations of $\vec{E}$ and $\vec{B}$ from one frame of reference to another. Dielectrics, parallel plate capacitor with a dielectric, dielectric constant, polarization and polarization vector, displacement vector $\vec{D}$, molecular interpretation of Claussius Mossitti equation, boundary conditions satisfied by $\vec{E}$ and $\vec{D}$ at the interface between two homogeneous dielectrics, illustration through a simple example.

Magnetic Field in Matter: Behaviour of various substances in magnetic fields, definition of $\vec{M}$ and $\vec{H}$ and their relation to free and bound currents; magnetic permeability and susceptibility and their interrelation; orbital motion of electrons and diamagnetism. Electron spin and para magnetism; ferromagnetism; domain theory of ferromagnetism, magnetization curve, hysterisis loss; ferrites.

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, integral and differential forms of Faraday's law, mutual and self inductance, transformers; energy in a

static magnetic field; Maxwell's displacement current, Maxwell's equations, electromagnetic field energy density.

Phys.123 Physics Laboratory-II 0+1 Sem.II

Characteristics of a ballistic galvanometer.
Setting up and using an electroscope or electrometer.
Use of a vibration magnetometer to study a B field.
Study of B field due to a current.
Measurement of low resistance by Carey-Foster bridge or otherwise.
Measurement of inductance using impedance at different frequencies.
Measurement of capacitance using impedance at different frequencies.
Study of decay of currents in LR and LC and CR circuits.
Response curve for LCR circuit and resonance frequency and quality factor.
Sensitivity of a cathode-ray oscilloscope.
Characteristics of a choke.
Measurement of inductance.
Study of Lorentz force.
Study of discrete and continuous LC transmission lines.

Phys.211 Oscillations and Waves 3+0 Sem.I

Fourier Series: Fourier series. Dirichlet conditions (statement only), sine and cosine series and their orthogonality and distinctive features of Fourier expansions, applications of Fourier series, analysis of square and triangular wave; Dirac-delta function.
Simple and damped harmonic motion: Potential well and periodic oscillations, S.H.M. of mechanical and electrical systems. Damped S.H.M. Logarithmic decrement, relaxation time; the quality factor, Q-value of a simple harmonic oscillator; superposition of two simple harmonic motions of the same frequency along the same line, interference; superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies
The Forced Oscillator: Transient and steady behavior of forced oscillator, displacement and velocity variation with driving force frequency, variation of phase with frequency, power supplied to an oscillator and its variation with frequency; Q-value and band width, Q-value as an amplification (phasor treatment to be followed).
Coupled Oscillator: Stiffness coupled pendulums, normal co-ordinates and normal modes of vibration, inductance coupling of electrical oscillators.
Wave Motion: Types of waves, wave equation and its solution, characteristic impedance of a string, Impedance matching, reflection and transmission of energy, reflected and transmitted energy coefficients; standing waves on a string of fixed length, Energy of vibrating string, wave and group velocity and their measurements.
Acoustics: Reflection, refraction and diffraction of sound; acoustic impedance of medium, percentage reflection and refraction at a boundary; impedance matching for transducers; diffraction of sound, principle of a sonar system, sound ranging.
Applied acoustics: Transducers and their characteristics, recording and reproduction of sounds, various systems; measurements of frequency, waveform, intensity and velocity; acoustics of halls; reverberation time, Sabine's formula.

Electromagnetic Waves: Maxwell's equations, electromagnetic waves in a medium having finite permeability and permittivity but with conductivity 0, Wave equation for electromagnetic waves; Poynting vector; Impedance of a dielectric to electromagnetic waves, properties of electromagnetic waves in a medium, Skin depth, E.M. waves in a conductor and anomalous dispersion, response of conducting medium to E.M. waves; reflection and transmission of wave at a boundary for normal incidence, reflection and refraction by the ionosphere.

Phys.212 Quantum Mechanics 3+0 Sem.I

Introductory Quantum Mechanics: Einstein photoelectric equation, Compton effect: theory and experiment; wave nature of particle, de Broglie wave equation and its applications; the uncertainty principle and its application; postulatory basis of quantum mechanics, Schrodinger's theory; need for differential wave equation; time dependent and time independent forms of Schrodinger's wave equation, Born's interpretation of wave function, properties of wave function; expectation values, particle in a box; particle incident on an infinite potential step and a finite potential barrier, reflection and transmission by a barrier, the tunnel effect; harmonic oscillator.

Quantum Theory of Hydrogen Atom: Schrodinger's equation of hydrogen atom, separation of variables; solution of equation, physical significance of 'n', 'l' and 'm' quantum numbers, probability densities of electrons and shapes of H-atom orbital's, qualitative discussion of transition probabilities and selection rules.

Atoms with one electron: Hydrogen atom and its spectrum, Frank-Hertz experiment; quantization of angular momentum, vector atom model; L-S and J-J coupling; Zeeman effect (normal and anomalous); fine structure of hydrogen spectrum; electron spin, the Stern-Gerlach experiment, spin-orbit coupling.

Phys.213 Physics Laboratory-III 0+1 Sem.I

Study of Brownian motion.
Study of adiabatic expansion of a gas.
Study of conversion of mechanical energy into heat.
Heating efficiency of electrical kettle with varying voltage.
Study of temperature dependence of total radiation.
Study of temperature dependence of spectral density of radiation.
Resistance thermometry.
Thermo-emf thermometry.
Conduction of heat through poor conductors of different geometries.
Experimental study of probability distribution for a two-option system using a colored dice.
Study of statistical distributions on nuclear disintegration data (GM Counter used as a black box).
Calculation of days between two dates of a year.
To check if triangle exists and the type of the triangle.
To find the sum of the sine and cosine series and print out the curve.
To solve simultaneous equations by elimination method.
To prepare a mark-list of polynomials.

Phys.221 Optics and Lasers 3+0 Sem.II

Geometrical Optics: Format's principle: principle of extreme path, the aplanatic points of sphere and other applications.
General theory of image formation: Matrix methods in optics, translation, reflection and refraction matrix, the system matrix, cardinal points of an optical system, general relationship, thick lens combinations, Lagrange's equation of magnification, telescopic combinations, telephoto lenses and Ramsden's and Huygen's eye pieces.
Aberration in images: Chromatic aberrations, achromatic combination of lenses in contact and separated lenses, monochromatic aberrations and their reduction; Aspherical mirrors and Schmidt corrector plates, aplanatic points, oil immersion objectives, meniscus lens.
Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, common types of eyepieces (qualitative).
Polarization: Unpolarised light, plane and elliptical polarization, wire and grid polariser, double refraction, crystal polarizer, sheet polariser; Double refraction, crystal polariser; Malus law, polarization by reflection and scattering, production and analysis of polarized light.
Interference: Interference of a light: The principle of superposition, two slit interference, coherence requirement for the sources, optical path retardation, lateral shift of fringes, Rayleigh refractometer and other applications, Localized 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, intensity distribution in multiple beam interference, Febry-Perot interferometer and etalon.
Diffraction: Huygen's principle: Huygen's-Fresnel theory, Kirchhoff's diffraction integral, Fresnel and Fraunhaufer diffraction, Fraunhoffer diffraction at single slit, rectangular and circular apertures, Fraunhaufer diffraction at 'n' slits, diffraction grating, concept of resolving power of optical instruments.
Fresnel diffraction: Fresnel half-period zones, plates, straight edge, rectilinear propagation.
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 Febry-Perot etalon.
Double refraction and optical rotation: Refraction in uniaxial crystals, its electromagnetic theory, phase retardation plates, double image prism, rotation of plane of polarization, origin of optical rotation in liquids and in crystals.
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 and tunable lasers, spatial coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density.

Phys.222 Atomic, Molecular and X-rays Spectra 2+0 Sem.II

Atoms with many electron: Helium atom, symmetric and anti-symmetric wave functions, the exclusion principle, electronic structure of atoms, L-S coupling, spectroscopic terms for S^2,P, P^2 ,P^3,D, D^2, D^4, D^5, electron configurations, spectra of alkali and alkaline earth atoms (qualitative discussion).

Molecules: The H-molecule ion, molecular orbital of diatomic molecules, molecular rotation and vibrations; rotational, vibrational and electronic spectra of diatomic molecules; Raman effect, Stokes and anti-stokes lines, complimentary character of Raman and Infrared spectra, experimental arrangements for Raman spectroscopy, Spectroscopic techniques: Sources of excitation, prism and grating spectrographs for visible, UV and IR (qualitative), absorption spectroscopy, double beam instruments, different recording systems.
X-rays: Production, properties and diffraction of x-rays, diffraction formula, X-ray spectrometer, X-ray spectrum and mechanism for production of X-rays; K, L, M X-rays; Fine structure of X-ray transitions; Mosley law, Auger effect.

Phys.223 Physics Laboratory-IV 0+1 Sem.II

Speed of waves on a stretched string.
Studies on torsional waves in a lumped system.
Study of interference with two coherent sources of sound.
Chladni's figures with varying excitation and loading points.
Measurement of sound intensities with different situation.
Characteristics of a microphone + loudspeaker system.
Designing an optical viewing system.
Study of monochromatic defects of images.
Determining the principal points of a combination of lenses.
Study of interference of light (biprism or wedge film).
Study of F-P etalon fringes.
Study of diffraction at a straight edge or a single slit.
Use of Diffraction grating and its resolving limit.
Resolving limit of a telescope system.
Polarization of light by reflection; also cos-square law.
Study of optical rotation for any system.
Study of laser as a monochromatic coherent source.
Study of divergence of a laser beam.

Phys.311 Solid State Physics 3+0 Sem.I

Crystal Structure: Periodicity, lattice and basis, fundamental translation vectors, translational symmetry, unit cell, primitive cell, Wigner Seitz cell, allowed rotations, lattice types, packing fraction, Miller indices and lattice planes, simple structure NaCl, diamond.
Diffraction Methods: Bragg's law, experimental arrangements, Laue pattern, Laue equation, reciprocal lattice, atomic scattering factor, geometrical structure factors.
Crystal Bonding: Potential between a pair of atoms, Lennard-Jones potential, ionic, covalent, Van der Waal's bonding, calculation of cohesive energy for ionic and inert gas system.
Lattice Vibration: Vibrations of one dimensional monatomic chain under harmonic and nearest neighbour interaction approximation, concept of phonons, density of modes(1-D), specific heat-Einstein and Debye's models, low temperature limit, extension (conceptual) to 3-D.
Free Electrons Theory of Metals: Density of states, Fermi energy, and Fermi velocity, electronic contribution to specific heat of metals.

Band Theory of Metals: Kronig-Penny model, Brillouin zones, electrons in periodic structure, energy bands, energy gaps, effective mass of electrons and holes, metals, insulators, semiconductors.

Phys.312 Nuclear Physics-I 3+0 Sem.I

General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge, binding energy, angular momentum, magnetic moment and electric quadrupole moment of nucleus, wave mechanical properties of nucleus, parity and statistics. Average binding energy and its variation with mass numbers, main features of binding energy versus mass number curve. Qualitative discussion of main properties of nuclear forces; reasons for non-existence of electrons in nucleus and acceptability of neutron-proton model.
Nuclear Models: Assumptions of liquid drop model of nucleus, semi-empirical mass formula and significance of various terms, condition of nuclear stability, experimental evidence for nuclear magic numbers, elementary accounts of nuclear shell model, nuclear energy level scheme and explanation of magic numbers, predictions of shell model.
Radioactivity: Modes of Decay, description of the process of alpha emission, electron emission, positron emission, electron capture, gamma ray emission and internal conversion, law of decay, disintegration constant, half life and mean life, unit of radioactivity, radioactive dating, radioactive tracers, qualitative discussion of alpha, beta and gamma rays spectra, Geiger-Nuttal law, alpha decay qualitative account of the theory of alpha decay; neutrino hypothesis of beta decay, evidence for the existence of neutrino, qualitative discussion of the theory of beta decay.

Phys.313 Physics Laboratory-V 0+1 Sem.I

Determination of Planck's constant.
Determination of e/m using Thomson's tube.
Determination of e by Millikan's method.
Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton).
Absorption spectrum of iodine vapour.
Study of alkali or alkaline earth spectra using a concave grating.
Study of Zeeman effect for determination of Lande g-factor.
Analysis of a given band spectrum.
Study of Raman spectrum using laser as an excitation source.
Study of absorption of alpha and beta rays.
Study of statistics in radioactive measurement.
Find roots of f(x)= 0 by using Newton-Raphson method.
Find roots of f(x)= 0 by using secant method.
Integration by Simpson rule.
To find the value of y at a given value of x by Runga-Kutta method.
Eight Queens Problem.

Phys.321 Nuclear Physics-II 3+0 Sem.II

Interaction of Nuclear Radiations with Matter: Energy loss due to ionization (Bethe-Bloch formula), energy loss of electrons, Cerenkov radiation, Rutherford scattering, multiple Coulomb scattering, passage of gamma rays through matter, Compton scattering, pair production, radiation loss by fast electrons, radiation length and electron-gamma showers, positron annihilation, relativistic kinematics.
Particles Accelerators and Detector: Cockroft Walton machine, Van de-Graff generator (quantitative), cyclotron, synchrotron, synchro-cyclotron, betatron, linear accelerators.
Detectors: Ionization chamber, proportional counter, G.M. counter, scintillation counter, nuclear emulsions, bubble chamber.
Cosmic Rays and Elementary particles: Nature of cosmic rays, primary and secondary cosmic rays, discovery of elementary particles in cosmic ray studies, masses, life times, decay modes and classification of particle states (factual information only), types of interactions, quantum numbers, conservation laws, isospin, parity, parity violation in beta decay, charge conjugation, discovery of antiproton, discovery of strange particles and their decay modes, associated production, Gell-Mann-Nishijima scheme, introduction to leptonic, semileptonic and non-leptonic weak interaction and their selection rules, Introduction to quarks and qualitative description of quark model.

Phys.322 Electronics 3+0 Sem.II

Junction Diodes: p-n junctions, biased junction, V-A characteristics, Zener diode, tunnel diode, LED and LCD, solar cell; Diode as circuit element, load line concept, half wave and full wave rectifiers, efficiency and ripple factor; filter circuits; voltage regulation (Zener and IC).
Transistors: Characteristics of a transistor in CB, CE and CC mode, graphical analysis of the CE configuration, low frequency equivalent circuits, h-parameters, bias stability, thermal run-away.
BJT, FET and MOSFETS: Structure and Working, α and β of BJT, characteristics, common emitter amplifier, field effect transistor, JFET volt-ampere curves, biasing JFET, operation of JFET, source follower, depletion and enhancement mode, MOSFET, biasing a MOSFET, FET as variable voltage register, digital MOSFET circuits, FET amplifier.
Amplifiers: Small signal amplifiers: General principle of operation, classification, distortion, RC coupled amplifier, gain, frequency response, input and output impedance, multistage amplifiers, transformer coupled amplifier, Equivalent circuits at low, medium and high frequencies; emitter follower, low frequency common-source and common-drain amplifier; noise in electronic circuits, Feed back in amplifiers; negative feed back and stability, Barkhusen Criteria for oscillation, tuned collector, Hartley and Colpitts oscillators, phase shift oscillator.
Modulation and detection: AM and FM (Mathematical treatment included), power in AM and generation of AM; Detector; radio transmitter, radiowave propagation, ionosphere; radio receivers.
Television: Camera, the image orthicon, scanning and synchronization, picture tube, channel width, colour TV.

Phys.323 Physics Laboratory-VI 0+1 Sem.II

Goniometric study of crystal faces
Determination of dielectric constant
Hysteresis curve of transformer core
Hall-probe method for measurement of magnetic field
Specific resistance and energy gap of a semiconductor
Characteristics of a transistor
Characteristics of a tunnel diode
Study of voltage regulation system
Study of a regulated power supply
Study of Lissajous figures using a CRO
Study of VTVM
Study of RC and TC coupled amplifiers
Study AF and RF oscillators
Magic Squares
String manipulations
Towers of Hanoi (Non-recursive)
Finding first four perfect numbers
Quadratic interpolation using Newton's forward-difference formula of degree two.

B.Sc. (Ag.) CC:

Phys.001 General Physics – I 2+1 Sem.I

Units and dimensions; scalars and vectors; equations of motion; motion of falling bodies, laws of motion; uniform circular motion; simple harmonic motion; gravitation and acceleration due to gravity; work, power and energy; friction; elasticity; surface tension; viscosity.

Practical: Use of vernier caliper, screw gauge and spherometer; verification of parallelogram and triangle law of addition of forces; determination of 'g', density of liquids and solids, surface tension of liquid by capillary tube method; coefficient of viscosity by Poiseuille's method.

Phys.002 General Physics – II 2+1 Sem.I

Concept of heat and temperature; mechanical equivalent of heat; change of state; transmission of heat; radiation; ideal and real gases, equation of state, Van der Waal's equation; hygrometry; laws of thermodynamics, heat engines.

Practical: Determination of latent heat of steam and ice; thermal conductivity by Searle's method; coefficient of linear and apparent expansion; determination of dew point and relative humidity.

Phys.003 General Phyiscs-III 2+1 Sem.II

Lens formula, thin lenses in contact; optical instruments, simple and compound microscopes, eye; illumination and photometry; dispersion of light, spectra, nature of light, velocity of sound, Laplace's correction; musical sound determination of pitch, beats; laws of vibrating

strings; resonance of air columns; x-rays; photoelectricity; radio activity, apha, beta and gamma rays.

Practical Determination of velocity of sound using resonance column apparatus; determination of frequency of a tuning fork by sonometer; determination of focal length of mirrors and lenses; refractive index of a liquid by convex lens and spherometer; traveling microscope and spectrometer; determination of optical activity of a liquid by polarimeter.

Phys.004 General Physics – IV 2+1 Sem.II

Electric charge, Coulomb's Laws, electrostatic potential and potential energy; conductors and insulators; capacity; Ohm's Law and its applications; Kirchhoff's laws and their applications; heating, chemical and magnetic effects of current; electromagnetic induction; electrical machines and measuring instruments; thermo-electricity.

Practical Verification of laws of combination of resistances; determination of specific resistance of a wire by slide wire bridge; unknown resistance by post office box; E.C.E. of copper by copper voltameter; comparison of e.m.f. of cells by Lumsden method and by potentiometer; use of thermocouple; verification of laws of reflection and refraction.

Statistics

B.Sc. Agriculture:

Stat.351 Statistics 1+1 Sem.I

Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves; Measures of Central Tendency: Characteristics of Ideal Average, Arithmetic Mean, Median, Mode, Merits and Demerits of Arithmetic Mean; Measures of Dispersion: Standard Deviation, Variance and Coefficient of Variation; Probability: Definition and concept of probability; Normal Distribution and its properties; Introduction to Sampling: Random Sampling, the concept of Standard Error; Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples (all types); Small Sample Test for Means, Student's t-test for Single Sample, Two Samples and Paired t test. F test; Correlation: Types of Correlation and identification through Scatter Diagram, Computation of Correlation Coefficient 'r'; Linear Regression of Y on X and X on Y, Inter-relation between 'r' and the regression coefficients, fitting of regression equations; Basic Experimental Designs: Layout and Analysis of Completely Randomized Design (CRD) and Randomized Block Design (RBD).

Practical: Construction of Frequency Distribution Tables and Frequency Curves; Computation of Arithmetic Mean for Un-Grouped and Grouped data; Computation of Median for Un-Grouped and Grouped data; Computation of Mode for Un-Grouped and Grouped data; Computation of Standard Deviation, Variance and Coefficient of Variation for Un-Grouped and Grouped data; SND test for Means, Single Sample; SND test for Means, Two Samples; Student's t-test for Single Sample; Fisher's t-test for Two Samples; Paired t test and F test; Computation of Correlation Coefficient 'r'; Fitting of regression equations- Y on X and X on Y; Analysis of CRD and RBD.

B.Sc. Home Science:

Stat.231 Elementary Statistics (1+1) Sem.I

Definition and scope of statistics; Presentation and summarization of statistical data; Frequency distribution; Diagrammatic and graphical representation of data; Measures of central tenancy; Measures of dispersion; Standard normal deviation tests; Student’s t-test; Correlation and regression; Chi-square test; Analysis of variance (one way & two way classification); Sample and sampling.

Practical: Problems based on theory.