JECRC™
UNIVERSITY
BUILD YOUR WORLD

School of Pure and Applied Sciences

Course Structure and Syllabi

B. Sc. Courses

Academic Programmes

July, 2013

Syllabus for Under-Graduate Courses and Schemes of Examination

Details of the courses for Under Graduate (B.Sc.) degree:

A student is free to offer any of the following combinations of core subjects-

Chemistry, Botany, Zoology

Chemistry, Botany, Biotechnology

Chemistry, Zoology, Biotechnology

Chemistry, Botany, Microbiology

Chemistry, Zoology, Microbiology

Chemistry, Physics, Mathematics

Chemistry, Statistics, Mathematics

Physics, Statistics, Mathematics

B.Sc. Biotechnology

B.Sc. Microbiology

Following will be compulsory subjects:

Environmental Studies

Computer Applications

Current Affairs

Value Education

English/Communication skills

One elective paper/subject of the student's choice.

Codes for various courses follow criteria as under:

Codes beginning with S1 denote courses of first semester.

Codes beginning with S2 denote courses of second semester.

Codes beginning with S3 denote courses of third semester.

Codes beginning with S4 denote courses of fourth semester.

Codes beginning with S5 denote courses of fifth semester.

Codes beginning with S6 denote courses of sixth semester.

Similarly, codes G1 to G6 denote courses common to all disciplines.

Details of various subjects and their credits with contact hours are given below:

Semester I

S. No.	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G1001	Current Affairs	3			3		**3**
G1002	Computer Applications	3		2	3	1	**4**
G1003	Computer Lab-I			2		1	**1**
G1004	Communication Skills	2	1		3		**3**
							26

Semester II

Code	Subject	Lecture (Hr.)	Tutorials (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G2001	Current Affairs	3			3		**3**
G2002	Computer Applications	3		2	3	1	**4**
G2003	Computer Lab-II			2		1	**1**
G2004	Communication Skills	2	1		3		**3**
							26

Semester III

Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G3001	Current Affairs	3			3		**3**
G3002	Computer Applications	3		2	3	1	**4**
G3003	Computer Lab-III			2		1	**1**
G3004	Environment Studies	2	1		3		**3**
							26

Semester IV

Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G4001	Current Affairs	3			3		**3**
G4002	Computer Applications	3		2	3	1	**4**
G4003	Computer Lab-I			2		1	**1**
G4004	Value Education	2	1		3		**3**
							26

Semester V

Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G5001	Current Affairs	3			3		**3**
G5004	Communication Skills	3			3		**3**
	Seminar	1			1		**1**
							22

Semester VI

Code	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
	Core 1	4		2	4	1	**5**
	Core 2	4		2	4	1	**5**
	Core 3	4		2	4	1	**5**
G6001	Current Affairs	3			3		**3**
G6004	Personality Development	3			3		**3**
	Project	3					**3**
							24

Biotechnology

Course Objective

1) To familiarize students with fundamental concept of basic techniques and their applications.

2) It is expected that the knowledge gained through this course will make student competent to meet the challenges of academic and professional courses and entrepreneurship development.

3.) To train the student in various aspects related to agricultural biotechnology and medical biotechnology.

Biotechnology

Semester –I		
Course Code	**Title**	**Credits**
S1001	**Microbes in our lives**	4
S1002	Practical Lab	1
	Total	**5**
Semester –II		
S2001	**Instrumentation and Virology**	4
S2002	Practical Lab	1
	Total	**5**
Semester –III		
S3001	**Principles of Immunology**	4
S3002	Practical Lab	1
	Total	**5**
Semester –IV		
S4001	**Industrial Biotechnology**	4
S4002	Practical Lab	1
	Total	**5**
Semester -V		
S5001	**Genetic Engineering**	4
S5002	Practical Lab	1
	Total	**5**
Semester -VI		
S6001	**Plant and Animal Tissue Culture**	4
S6002	Practical Lab	1
	Total	5

SEMESTER-I

S1001: Microbes in our lives **Credit(s): 4**

Brief history of microbiology. Scope of Microbiology.
Bacterial Morphology and subcellular structures: Morphology of bacteria, Slime layer, Capsule, Cell wall, Ribosome, Cytoplasmic membrane (Fluid mosaic model of Singer - Nicholson); Cytoplasmic inclusion bodies - (inorganic, organic); Spores, Flagella, Pilus, Fimbriae. Plasmids and episomes, Bacterial Chromosome. Microbial Reproduction: Different modes of microbial DNA replication, Mechanism of DNA replication– rolling circle model. Sexuality and bacterial recombination – Conjugation, Transformation and Transduction.

Bacterial Growth: Growth phases- Generation time. Kinetics of growth, Batch culture. Continuous culture. Synchronous culture (definition and brief description). Physical factors influencing growth Temperature. pH, osmotic pressure, salt concentration.
Microbial Nutrition: Nutritional types (definition and example)
Control of growth of Microbes: Sterilization, disinfection, antimicrobial agent (definition, application & examples); physical method of disinfection and sterilization; Chemical control. Assessment of chemical disinfectant; phenol coefficient-definition and method of determination

Carbohydrates: Introduction, biological importance. Definition, Classification, {glyceraldehydes, Simple Aldose, Simple Ketose, D-glucose, Conformation of D glucose], Monosaccharides other than glucose, glyocosidic, bond, disaccharides, polysaccharides [starch, glycogen, peptidoglycan, proteoglycan matrix
Lipids: Chemical properties and characterization of fats. Waxes, cerebrosides, gangliosides, phospholipids and proteolipids. Steroids and bile salts. Prostaglandins

Proteins: Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, conformation and structure of proteins-primary, secondary, tertiary and quaternary structure of proteins.
Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides. Structure, types and biological role of RNA and DNA.

Suggested Books

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffory Zubey
3. Biochemistry: Stryer
4. Stanier, RY., et al., General Microbiology, 5th ed., 2000, Tata-McGraw Hill
5. Atlas, RM., Principles of Microbiology, 2nd ed., 1997, McGraw-Hill

S1002: Practical Lab **Credit(s): 1**

1. Instrumentation (Autoclave, LAF, pH meter, Incubator, Oven, Weighing balance)
2. Qualitative estimation of sugars
3. Qualitative estimation of lipids
4. Qualitative estimation of proteins
5. Qualitative estimation of starch
6. Gram staining
7. Spore staining
8. Preparation of nutrient agar for bacteria isolation from soil, water and air.
9. Preparation of potato dextrose agar for fungi isolation from soil, water and air.
10. Isolation of fungi from soil, water and air.
11. Isolation of bacteria from soil, water and air.
12. Serial dilution

Semester II

S2001: Instrumentation and Virology **Credit(s): 4**

Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, HPLC. Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

Spectroscopy: Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption. Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems.
Microscopy – Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM. History and principles of virology, virus taxonomy, introduction to replication strategies. Virus structures, animal and plant viruses. Virus structure and morphology, viruses of veterinary importance and plant viruses.
Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli PhageT4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, filamentous DNA phages, Single stranded RNA phages, The lysogenic Cycle.

S2002: Practical Lab **Credit(s): 1**

Principles & operations of Incubators & Shakers
Principle & operation of Centrifuge
Principle & operation of pH meter

Principle & operation of Colorimeter
Principle & operation of Spectrophotometer
Principle & operation of Electrophoresis techniques
Estimation of protein by Folin Lowry method
TLC separation of Amino acids
Estimation of RNA by Orcinol method
Estimation of DNA by diphenyl amine method

Suggested Books

1. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
2. Nuclear physics an introduction – S.B. Patel (New Age International)
3. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
4. Textbook of optics and atomic physics – P.P. Khandelwal (Himlaya Publishing House.
5. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
6. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
7. Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub. House, Delhi)

Semester III

S3001: Principles of Immunology **Credit(s): 4**

Principles of Immunology

Immune Response - an overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity, alternate pathways of transcript splicing, variable joining sites & somatic mutation, role of antibody (alone, in complement activation & with effector cells), monoclonal antibodies.

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing.

Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms. Immuno-techniques - Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA.

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of

vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs.

Auto-immune diseases – autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, diagnosis & treatment of auto-immune diseases, replacement therapy, suppression of auto-immune processes, nature of auto-antigens, immunodeficiency, AIDS

S3002: Practical Lab **Credit(s): 1**

1. Antigen-Antibody reactions – Agglutination (Blood grouping testing).
2. Antibody titration (Ouchterlony Double Diffusion).
3. Antigen-Antibody reactions – Immuno-electrophoresis
4. Rocket immuno-electrophoresis.
5. Antigen-Antibody reactions –Sandwich ELISA.
6. WBC counting
7. RBC counting
8. Haemoglobin estimation
9. DOT ELISA
10. Total leukocyte counting

Suggested Books

1. Abbas AK & AH Lichtman (2006): Basic Immunology: Functions and Disorders of the Immune System. With Student Consult Online Access. Edn. 3. WB Saunders Co.
2. Delves PJ, SJ Martin, DR Burton & IM Roitt (2006): Roitt's Essential Immunology. Edn. 11. Blackwell Publishing.
3. Kindt TJ, RA Goldsby & BA Osborne (2007): Kuby Immunology. Edn. 6. WH Freeman & Co.
4. Mak TW, M Saunders & W Tamminen (2008): Primer to the Immune Response. Elsevier.
5. Male D, J Brostoff, D Roth & I Roitt (2007): Immunology: With Veterinary Consult Access. Edn. 7. CV Mosby & Co.
6. Roitt I, J Brostoff, D Male & D Roth (2006): Immunology. With Student Consult Online Access. Edn. 7. CVMosby & Co.
7. Sompayrac L (2008): How the Immune System Works. Wiley- Blackwell.
8. Wood P (2006): Understanding Immunology. Edn. 2. Prentice Hall/ Pearson Education, Harlow, England.

Semester IV

S4001: Industrial Biotechnology **Credit(s): 4**

Industrial Biotechnology

Bioreactor / Fermenter – types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations.

Technology of Microbial cell maintenance – steps to maintain microbial culture in an aseptic & sterile environment (how to inoculate, preserve & maintain), Strain preservation, maintenance and strain improvement by mutation of gene transfer processes

Products from Microorganisms – Metabolites, Enzymes, Single-cell Protein.
Bioremediation – Petroleum prospecting and formation of oil spills,, Wastewater treatment, chemical degradation, heavy Metals.
Microorganisms & Agriculture – Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides.

Downstream processing – extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites), Industrial production of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid, α-amylase, protease penicillin, tetracycline and vitamin B12, with reference to easily available raw materials, Production of herbal drugs.

Enzyme technology – nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, technology of enzyme production, use of immobilized cells and enzymes (Ca-alginate beads, polyacrylamide), industrial applications of immobilized enzymes.

Biological fuel generation –Sources of biomass, ethanol from biomass, methane from biomass, hydrogen, microbial recovery of petroleum. Biotechnology in specific medical & industrial applications - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants

S4002: Practical Lab **Credit(s): 1**

1. Preparation of Antibiotics from Fungi
2. Test antibacterial activity of antibiotic
3. Production of citric acid
4. Estimation of citric acid
5. Sauerkraut production

6. Wine production from ginger
7. Wine production from grapes
8. Estimation of alcohol in produced wine.
9. Demonstration of bioreactor

Suggested Books

1. Microbiology – Pelczar
2. General Microbiology – Stanier
3. Food Microbiology –Frazier
4. Principles of Fermentation Technology - Whitaker, A. 2 edition

Semester V

S5001: Genetic Engineering **Credit(s): 4**

How to clone a gene- What is clone, Overview of the procedure, Gene library, Hybridization. Purification and Separation of nucleic acids – Extraction and Purification of nucleic acids, Cutting and Joining DNA – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules.

Vectors – Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors: YACs and BACs.
Amplifying DNA : PCR and Cell based DNA Cloning – The importance of DNA Cloning, PCR: basic features and application, Principles of Cell-based DNA Cloning.

Nucleic Acid Hybridization: Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays, and microarrays.
DNA Typing: DNA polymorphisms: the basis of DNA typing, Minisatellite analysis, Polymerase chain reaction based analysis, Short tandem repeat analysis, Mitochondrial DNA analysis, Y chromosome analysis, Randomly amplified polymorphic DNA (RAPD) analysis.
High-throughput analysis of gene function- DNA microarrays, Protein arrays, Mass spectrometry. Single Nucleotide Polymorphisms- The nucleolar proteome, Mapping disease-associated SNPs: Alzheimer's disease**.**

S5002: Practical Lab **Credit(s): 1**

1. Isolation of plasmid DNA & Gel electrophoresis
2. Genomic DNA- Isolation
3. Quantitation of isolated genome
4. DNA Ligation
5. Preparation of Component Cells

6. Transformation of E. coil and selection of recombinants.
7. Colony PCR of recombinant and analysis
8. Restriction mapping of recombinant DNA
9. Southern blotting techniques
10. Searching for gene and protein sequences and accessing information from web, and databases Information from genomes, BLAST, FASTA

Suggested Books

1. Molecular Biology of the Gene: Waston J. D.
2. Molecular Biotechnology: Glick
3. Milestones in Biotechnology : Classic papers in Genetic Engineering: J. A. Davis, W. S. Resnikoff
4. DNA Cloning – A Practical approach: D. M. Glover and B. D. Hames
5. Principles of Gene Manipulation & Genomics – Primrose and Twyman (2006, 7th Edition)
6. Molecular cloning – a laboratory manual – Sambrook and Russell (Vol. 1-3)

Semester VI

S6001: Plant and Animal Tissue Culture **Credit(s): 4**

Plant Tissue Culture: Introductory History– Concepts of Cell theory & Cellular totipotency, Milestones in plant tissue culture. Infrastructure & Organization of plant tissue culture laboratory – General & aseptic laboratory, different work areas, equipments & instruments required, other requirements.

Aseptic techniques– Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions. Culture Medium – Nutritional requirements of the explants, PGR‘s & their in vitro roles, media preparation.

‘Explant’ for plant tissue culture– histological and/or cellular characteristics Response of explants in vitro– Dedifferentiation and redifferentiation: a) callus formation, b) organogenesis (direct and indirect), c) embryogenesis (direct and indirect) Callus culture technique – Introduction, principle, protocol, factors affecting, Morphology & internal structure, genetic variation Suspension culture technique – Introduction, principle, protocol, types, growth & growth measurement, synchronization

Organ culture technique – Introduction, principle, protocol factors affecting w.r.t. root tip culture, leaf culture, shoot tip & meristem culture, Anther & pollen culture technique – Introduction, principle, protocol, factors affecting, ovary, ovule, embryo and endosperm culture.

Protoplast – protoplast isolation, protoplast culture. Somatic hybridization – Protoplast fusion techniques, selection of hybrids, production of symmetric & asymmetric hybrids & cybrid production.

Genetic transformations – Agrobacterium mediated transformations, direct DNA transfer methods electroporation, microprojectile bombardment, microinjection, use of marker genes, integration & expression of foreign DNA. Production of artificial seeds – techniques.

Animal Tissue Culture : Animal Tissue culture – Principles & practice, cleanliness, precautions, care to be taken. Nutrition & Physiology media components – Serum, balanced salt solutions, washing, packing, sterilization practices, instruments. Primary cell culture, establishing & maintenance of lymphocyte culture. Cell lines – Insects & Animals cells, subculture. Karyotyping, biochemical & genetic characterization of cell lines. Application of Animal cell cultures

S6002: Practical Lab **Credit(s): 1**

1. PTC Laboratory organization of facility and equipment
2. Aseptic manipulation – washing, capping, packing & sterilization, laminar flow operation & general precautions
3. Stock solutions & media preparation
4. Callus culture technique – Initiation of culture, callus morphology & internal structure
5. Suspension culture technique – Initiation of culture, sub culture and growth measurement
6. Effect of plant growth regulators on in vitro response of anther culture.
7. Initiation of shoot tip & axillary bud culture and sub culture.
8. Ovary / ovule / anther / embryo culture
9. Animal cell culture media preparation, sterilization, washing, packing

Suggested Books

1. Animal Tissue culture: J. Paul
2. Introduction to Plant Tissue culture: M.K. Razdan
3. Plant Tissue Culture: Theory & Practice : S. S. Bhojwani & M. K. Razdan
4. Micropropagation: Debergh & Zimmermann
5. Plant tissue culture: Kalyan Kumar Dey

Botany

Course Objectives

The Curriculum for Undergraduate Programme of Botany envisages Undergraduate Education as a combination of general and specialized education, simultaneously introducing the concepts of breadth and depth learning. It also stresses learning to learn rather than learning of specific lessons. The attempt is to prepare the students for lifelong learning and drawing attention to the vast world of knowledge of plants and introducing him/her to the methodology of systematic academic enquiry. With this in mind, we aim to provide a firm foundation in every aspect of Botany and to explain a broad spectrum of modern trends in Botany and to develop experimental, observational, computational skills also which lead him/her as an ambassador of sustainable development of our country.

Botany

Semester –I		
Course Code	**Title**	**Credits**
S1004	**Cell Biology and Thallophytes**	4
S1005	**Practical Lab**	1
	Total	**5**
Semester –II		
S2004	**Bryophyta, Pteridophyta and Lichens**	4
S2005	**Practical Lab**	1
	Total	**5**
Semester –III		
S3004	**Genetics and Plant Breeding**	4
S3005	**Practical Lab**	1
	Total	**5**
Semester –IV		
S4004	**Morphology, Anatomy and Plant Physiology**	4
S4005	**Practical Lab**	1
	Total	**5**
Semester -V		
S5004	**Gymnosperm, Angiosperm and Paleobatany**	4
S5005	**Practical Lab**	1
	Total	**5**
Semester -VI		
S6004	**Environmental Management and Economic Botany**	4
S6005	**Practical Lab**	1
	Total	5

I semester

S1004: Cell Biology and Thallophytes **Credit(s): 4**

Evolutionary history of biological diversity: early earth and its origin of life. Major events in the history of life, phylogeny and the tree of life. General structure of Bacteria. Cell membrane and cell wall: the function of membrane, models of membrane structure, membrane protein and their function, carbohydrate in the membrane and cell wall.

Cell theory, cell size and shape, eukaryotic cell components. Nucleus- nuclear envelop, structure of nuclear pore complex, chromatin structure, DNA packaging in eukaryotes, euchromatin, heterochromatin, nucleolus and ribosome structure, mitosis, meiosis.
Cell organelles: Mitochondria structure, composition, semiautonomous nature, symbiont hypothesis mitochondrial nature.
Chloroplast- structure, composition, semiautonomous nature and chloroplast DNA. ER, Golgi body and lysosome structure and role. Peroxysome and glyoxisome: structure.

Algae- General characteristics; Ecology and distribution, Range of thallus organization and reproduction; Basic criteria used in classification (Fritsch, and Smith)
Important classes in relation to applied Phycology listed below
Cyanophyceae- *Nostoc*
Chlorophyceae- *Volvox,Chara*
Xanthophyceae – *Vaucheria*
Phaeophyceae- *Ectocarpus*
Rhodophyceae – *Polysiphonia*

Fungi- General characteristics; Ecology and distribution; Range of thallus organization; Cell structure; Wall composition; Nutrition; Growth; Reproduction and spores; Heterokaryosis and parasexuality; Basic criteria used in classification.
Life cycle of *Sclerospora, Aspergillus Claviceps,Ustilago and Alternaria.*

S1005: Practical Lab **Credit(s): 1**

1. Study of different morphological forms of bacteria, Cocci, Bacilli.
2. Gram staining of Bacteria.
3. Study of specimen. Citrus Canker, Little Leaf of Brinjal, Crown Gall.
4. Instrumentation : Microscope, Various parts.
5. Study of cell structure from onion

6. Study of electron microphotographs of eukaryotic cell for various cell organelles.

7. Study of different stages of mitosis in root tips of onion.

8. Study of different stages of Meiosis in flower bud on Onion.

9. Study of classwork material by making suitable temporary slides and *Nostoc, Volvox, Vaucheria, Ectocarpus, Polysiphonia.*

10. Study of classwork material by making suitable temporary slides of *Sclerospora, Aspergillus*

11. Study of material by making slides of vegetative and sexual stages of *Ustilago* and *Alternaria*.

Suggested Books

1. Rastogi V.B. Organic Evolution. Rastogi Publication.

2. Clifton A., Introduction of Bacteria, McGrawHill Co. Ltd. New York 1985.

3. Kaushik P. Microbiology, Emkay Publication, 2001.

4. Pelczer, Chan and Kruig. Microbiology. McGraw Hill Co., London, 1995.

5. De Robertis & De Robertis Cell and Molecular Biology.Lippincott Williams and Wilkins.

6. P.K. Gupta, Cell and Molecular Biology.Rastogi Publication.

7. C.B. Powar – Cell Biology,Himalaya Publishing House.

8. V.B. Rastogi – Cell Biology.Rastogi Publications.

9. Gilbart, M. Smith Cryptogamic Botany Vol I and II, IInd Ed. Tata McGraw Hill Publishing Company Ltd. N.Delhi. 1985.

10. Ghemawat M.S., Kapoor, J.N. and Narayan H.S. : A text book of Algae. Ramesh Book Depot. Jaipur 1976.

11. Kumar. H.D. Introductory Phycology. Affiliated East-West Press Ltd., Newyork 1988.

12. Singh V., Pande P.C. and Jain D.K. A Text Book of Botany Rastogi and Co. Merrut, 2001.

13. Alexopolous, C.J. and Mims : Introductory Mycology, John Wiley and Sons, New York, 2000.

14. Dube, H.C. Fungi, Rastogi Publication, Merrut, 1989.

15. Sharma O.P. Fungi Today and Tomorrow Publication, 2000.

II semester

S2004: Bryophyta, Pteridophyta and Lichens **Credit(s): 4**

Bryophyta: general characters, origin, affinities and classification.Marchantiales- Life cycle of *Riccia, Marchantia.* Jungermanniales- Pellia. Anthocerotopsida- *Anthoceros*, Bryopsida- *Sphagnum*

Evolution of sporophyte in bryophytes**,** Economic Importance of Bryophyta. General character of pteridophyta, classification by Smith and Sporne, Stelar system in pteridophyta, Alteration of generation.

Distribution, Structure and life history of *Rhynia* and *Psilotum*. Distribution, Structure and life history of *Lycopodium* ,*Equisetum* and *Selaginella.* Distribution, Structure and life history of *Adiantum* and Marsilea.

Lichens- distribution, nature of association of phycobiont and mycobiont, classification of lichens, structure and reproduction of lichens. Ecological Indicators of pollution and economic importance of lichens. Mycorrhiza – General account and its significance

S2005: Practical Lab **Credit(s): 1**

1. Study of external morphology and preparation of suitable sections of vegetative / reproductive parts *Riccia, Marchantia, Pellia.*
2. Study of external morphology and preparation of suitable sections of *Anthoceros* and *Sphagnum.*
3. Morphological study of various type of lichens.
4. Study of extend morphology, anatomy of vegetative and reproductive parts of –

   Rhynia, Psilotum, Lycopodium, Equisetum, Selaginella, Adiantum, Marsilea

Suggested Books

1. Puri P. Bryophytes Atma Ram and Sons, Delhi, Lucknow 1985.
2. Sarabhai R.C. and Saxena R.C. Text Book of Botany Vol. I and II, Ratan Prakashan Mandir, Merrut, 1980.

3. Singh, Pandey and Jain. A text book of Botany, Rastogi and Co. Merrut 2001.

4. Vashishta B.R. : Botany for degree students (Bryophyta.) S. Chand & Co. New Delhi 2002.

5. Kumar H.D. Introductory Phycology Affiliated East-West Press Ltd., NewYork 1988.

6. Sarabhai & Saxena, Text Book of Botany, Rastogi Publications. Merrut 1990.

7. Sporne, K.R. Morphology of Pteridophytes B.I. Publication Pvt. Mumbai (2002).

8. Vashishta P.C. Pteridophyta. S. Chand and Co. New Delhi

III semester

S3004: Genetics and Plant Breeding **Credit(s): 4**

Mendel work, (Terminologies, Laws of inheritance, Modified Mendelian Ratios, Chi square, Pedigree analysis, Cytoplasmic Inheritance, Multiple allelism, Pleiotropism,)

Sex determination in human, Drosophila and plants, Sex linked inheritance.

Linkage: concept & history, complete & incomplete linkage, Bridges experiment, Crossing over : concept and significance, cytological proof of crossing over.

Numerical chromosomal changes, euploidy, polyploidy and aneuploidy.

Structural chromosomal changes : deletions, duplications, inversions and translocations.

Types of mutations, effects of physical and chemical mutagens.

Introduction and objectives of plant breeding, general methods of plant breeding,Conventional and non conventional methods of plant breeding, hybrid vigour, inbreeding depression, role of mutation and polyploidy in plant breeding. Introduction to the concept of Recombinant DNA Technology, Cloning vectors, Restriction and modifying enzymes, Transformation techniques (brief introduction).

Suggested books

1. Rastogi V.B. Genetics. Rastogi Publications.

2. Gupta P.K. Classical to Modern Genetics. Rastogi Publications.

3. Sandu and Arora, Genetics.Himalaya Publishing House

4. Miglani G.S. Advanced Genetics, Narosa Publishing House, New Delhi (2000).

5. Gardner,Principles of Genetics. Wiley India

6. Choudhary H.K. Elementary Principles of Plant Breeding, Oxford and IBH Publishing Co. N.D. 1989.

7. Shukla R.S. and Chandel P.S. Cytogenetics, Evolution and Plant Breedings S Chand and Co. Ltd. New Delhi (2000).

8. Singh R.B. Text Book of Plant Breeding Kalyani Publishers. Ludhiana.

S3005: Practical Lab **Credit(s): 1**

1. To solve genetic problems based upon mendel's law of inheritance.

2. Bar body study.

3. Emasculation of anther in a cross pollinated flower.

4. Vegetative propogation parts of plants.

5. To study hand cut section of t.s of anther.

IV semester

S4004: Morphology, Anatomy and Plant Physiology **Credit(s): 4**

Different types of tissues, their organization into root, stem and leaf (monocot & dicot),Concept of stele and its evolution, meristematic, simple and complex secretary tissue.

Basic Body plan of flowering plants, modular type of growth, diversity of plant forms: annual, biennials and perennials.

Shoot and root system: shoot and root apical meristem and its histological organization, vascularisation of primary shoot and root in monocot and dicots, monopodial and sympodial growth .

Morphology and anatomy of seed (monocot and dicot), significance of seed, seed dispersal, vegetative reproduction: vegetative propagation, grafting.

Plant water relationship: Significance of water, water potential, water absorption and transport, transpiration, mechanism of opening and closing to stomata.

Mineral Nutrition: Essential elements, micro and macro nutrients, soil factors affecting their availability, Physiological basis of deficiency, symptoms, ion update. Transport of inorganic and organic component, transport pathway Xylem and Phloem.

Role of physical factors in growth of plants:Response to light, photomorphogenesis, Role of growth regulators**:**Auxin, Gibberelins, Cytokinins, ABA, Ethylene

Photosynthesis:Brief history, pigments, mechanism of light, absorption and energy transfer PSI

and PSII e-transport, ATP synthesis C3, C4 and CAM photorespiration.

Suggested books

1. Cutter E.G. 1969. Part I Cells and Tissues ,Edward Arnold, London.
2. Cutter E.G. 1971. Plant Anatomy: Experiment and Interpretation Part-II, Organs, Educated Arnold. London.
3. Esau. K. 1977. Anatomy of seed Plants 2nd Eds. John Wiley & Sons, New York.
4. Fahn A. 1985. Plant Anatomy, Pergamon Press, Oxford.
5. Salisburry and Ross. Plant Physiology.
6. Teiz and Zeiger Plant Physiology.
7. V. Verma. Plant Physiology.

S4005: Laboratory Exercises **Credit(s): 1**

1. Study of any commonly occurring dicotyledonous plant to understand the body plan and modular type of growth.

2 .L.S. of shoot tip to study the organization of meristem.

3. Monopodial and sympodial types of branching.

4. Anatomy of primary and secondary growth in monocot and dicot using hand cut sections of sunflower, nerium, maize, cucurbit stem and roots.

5. Examination of seed (monocot and dicot) structure.

6. Specimen study for modifications of plant parts for vegetative reproduction.

7. To study the permeability of plasma membrane using different concentration of solvent.

8. To separate chlorophyll pigment by solvent method.

9. Measurement of growth using Auxanometer.

10. Photosynthesis by inverted funnel method and Moll's half leaf method.

V semester

S5004: Gymnosperm, Angiosperm and Paleobatany **Credit(s): 4**

Classification and characteristic features of different groups of Gymnosperm. Distribution, morphology, vegetative and reproductive parts, anatomy and life cycle of *Cycas.*

Distribution, Morphology of vegetative and reproductive parts, anatomy, reproduction and life cycle of *Pinus* and *Ephedra*, Economic Importance of Gymnosperm.

Angiosperm – origin and evolution. Some examples of primitive angiosperm.

Introduction, Principles of taxonomy, units of classification, Concept of Genus and species, Binomial nomenclature, ICBN, Botanical gardens and Herbaria.

Classification of angiosperm Linnaeus, Bentham and Hooker's system, Engler and Prantle system of classification.

Diversity of flowering plants as illustrated by members of the families, Brassicaceae, Malvaceae, Fabaceae, Solanaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Liliaceae and Poaceae, Asteraceae.
Fossilization, types of fossils, technique to study fossils, geological time scale, Applied aspect of Paleobotany (use in coal and petroleum exploration).

Fossil Pteridophyta – *Lepidodendron, Calamites*

Fossil Gymnosperms – *Williamsonia*

Suggested boos

1. Vashishtha P.C. Gymnosperm, S. Chand Company.
2. Singh Pandey Jain, A text Book of Botany, Rastogi Publication.
3. Biswas C and Johari B M .The Gymnosperm.Narosa Publishing house.
4. Wilson N.S., Rothwell G.W. Paleobotany and Evolution of Plants. IInd Ed. Cambridge. Univ. Press, U.K. (1990).
5. Willis K.J and McElwain J.C. The Evolution of Land Plants.Oxford University Press.
6. V.V. Shivrajan, Introduction to Principles to the Plant Taxonomy, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Angiosperm Taxonomy, Singh, Pandey, Jain Rastogi Publishers, Meerut.

8. Gurucharan Singh, Plant Systematics (2001). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

S5005: Laboratory Exercises **Credit(s): 1**

1. Following genera are suitable for the study of families.

Brassicaceae	–	*Brassica campestris*
Malvaceae	–	*Hibiscus rosasinensis, Abutilon*
Fabaceae	–	*Pisum sativum, Cassia, Acaccia*
Solavaceae	–	Datura, Withania
Apocyneceae	–	Vinca rosea, Thevetia
Asclepeideaceae	–	Calotropis
Euphorbiaceae	–	*Euphorbia, Ricinus*
Liliaceae	–	*Onion, Asphodelus*
Poaceae	–	*Triticum*
Esteraceae	–	*Heliahthus, Tridax*

2. Study of fossils and slides of fossils.

3. Study of External Morphology, anatomy of vegetative and reproductive part of

(i) *Cycas* (ii) *Pinus* and (iii) *Ephedra*

Semester VI

S6004: Environmental Management and Economic Botany **Credit(s): 4**

Introduction to Ecology, Community and Ecosystem Inter-relationships between living world and environment, Biosphere, biomes, ecosystem and its components (abiotic and biotic|)Bioenergetics. Biogeochemical cycles, Hydrologic cycle. Concept of habitat and niche.

Population and Community Ecology (Part Population attributes, density, natality, mortality, age ratio, sex ratio, dispersal and dispersion of population, exponential and logistic growth, life history strategies, population interactions

Biodiversity and regional conservation strategies success stories with reference to India and sustainable utilization. Principles of wildlife management, wildlife sanctuaries, parks and biosphere reserves in India, endangered and threatened species of plants and animals in India, germplasm banks.

Basic concept of center of origin of cultivated plants . Food plants – rice, wheat , maize , potato and sugarcane . Vegetable oils: coconut , groundnut and mustard . Spices: General account with an emphasize on those cultivated in Rajasthan (cumin , capsicum , coriander .) Beverages: tea and coffee. Fibers: cotton and jute.

Medicinal plants: General account with an emphasize on those cultivated in Rajasthan (senna, isabgol, safed musli). Wood: General account of sources of firewood, timber and bamboos; Rubber. Legumes or pulses, starch or sugar yielding plants. Ethnobotany: a general account.

Suggested Books:

1. P.D. Sharma, Ecology and utilization of plants.Rastogi publication.
2. Odum E P., and Barrett G.W., Fundamentals of Ecology. Thomson Asia Pvt. Ltd.
3. Rajagopalan R, Environmental Studies Oxford University Press.
4. P.D. Sharma. Ecology and utilization of plants.Rastogi Publication.
5. S.L. Kochar., Economic Botany in Tropics.McMillan Publishing House.
6. B.P. Pandey Economic Botany in Tropics.
7. Sambhamurthy. Economy Botany.

S6005: Laboratory Exercises **Credit(s): 1**

1. Study the frequency and density of plant sp. by quadrate method.
2. Estimate bulk density of grassland soil.
3. Estimate the porosity of grassland and wood land soil sample.
4. Determine moisture content of grassland.
5. To measure dissolved oxygen (D.O.) in given water sample.
6. To measure water holding capacity of soil.
7. Visit to any national park or sanctuary.

Chemistry

Objectives of the course

Chemistry is a subject which complements other various subjects including Biology, Physics and Environmental Science to give a holistic approach as well as a broad thinking to the students to excel in their field of competence. The basic objective of Chemistry is to educate the young generation of chemists with the capacity to solve real problems and provide opportunities for scientific study and creativity within a global context which will stimulates and challenges them.

It gives knowledge to synthesize, separate and characterize various compounds using published reactions, protocols, standard laboratory equipments, and modern instrumentation. Molecular designing is the result of comprehensive knowledge of chemistry. Sustainability of the environment is another great concern which may be addressed well by a true chemist only.

Chemistry at Undergraduate and Post-graduate level both will surely equip a student for various future challenges related to economic and industrial growth.

Chemistry

Semester – I		
Course Code	**Paper**	**Credits**
S1007	**Chemistry-I**	**4**
S1008	**Chemistry Lab-I**	**1**
	Total	**5**
SEMESTER – II		
S2007	**Chemistry-II**	**4**
S2008	**Chemistry Lab-II**	**1**
	Total	**5**
SEMESTER – III		
S3007	**Chemistry-III**	**4**
S3008	**Chemistry Lab-III**	**1**
	Total	**5**
SEMESTER – IV		
S4007	**Chemistry-IV**	**4**
S4008	**Chemistry Lab-IV**	**1**
	Total	**5**
SEMESTER – V		
S5007	**Chemistry-V**	**4**
S5008	**Chemistry Lab-V**	**1**
	Total	**5**
SEMESTER – VI		
S6007	**Chemistry-VI**	**4**
S6008	**Chemistry Lab-VI**	**1**
	Total	**5**

SEMESTER-I

S1007: Chemistry-I **Credit(s): 4**

Chemical Bonding

Covalent Bond : Valence bond theory and its limitations, directional characteristic of covalent bond.Hybridisation 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_2, H_2O.

MO theory for homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Structure & Bonding

Hybridization, bond length, bond angles and bond energy, localized & delocalised chemical bond, vander - waals interaction, resonance, hyper conjugation, aromaticity, Inductive & field effect, H-bonding.

Sterochemistry

Concept of isomerism. Types of isomerism. Optical isomerism - Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral & achiral molecules with two stereogenic centre, diastereomers, erythro diastereomers, resolution of enantiomers, inversion, retention. Absolute configuration, D & L and R & S systems of nomenclature.

Geometric isomersism - cis & trans-Isomerism, E & Z system of nomenclature, determination of configuration of geometrical isomers, geometrical isomerism in oximes & alicyclic compounds.

Conformational isomerism - Projection formulae (Fischer, Sawhorse, Newman & flying wedge formulae, conformational analysis of ethane & n-butane, difference between configuration and conformation.

Mechanism of Organic Reactions.

Types of reagents, Electrophiles & nucleophiles. Types of organic reactions. Energy consideration, reactive intermediates-Carbocation, carbanion, free-radicals, carbenes, nitrenes, arynes. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic & stereochemistry studies).

Alkanes

Nomenclature, isomerism, methods of preparation (with special reference to wurtz reaction, Corey - house reaction. Kolbe reaction & decarboxylation of carboxylic acids), physical properties, mechanism of free radical halogenation of alkanes, reactivity & selectivity.

Solid State

Defination of space lattice, unit cell. Laws of crystallograph- (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals, stoichiometric and non stoichiometric defects in solids, thermography & seven segment cell. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, and CsCl (Laue's method and powder method).

Gaseous States

Postulates of kinetic theory of gases, deviation from ideal behaviour, Vander Waals equation of state.

Critical Phenomena : PV isotherms of real gases; continuity of states, the isotherms of Van der Waals equation, relationship between cirtical constants and Vander Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities

Root means square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, means free path and collision diameter. Liquification of gases (based on Jould-Thomson effect).

Suggested Books

1. Selected topics in inorganic chemistry –Malik tuli,Madan
2. Inorganic chemistry Principles of structure and reactivity-Huheey James ,E.Keiter Ellen ,A. Pearson,Edu.Delhi.
3. Stereochemistry of organic compounds-P.S.Kalsi,New age International
4. Organic chemistry Reaction and Reagents-O.P.Agarwal,Krishna Prakashan Meerut
5. Advanced Organic chemistry-Jagdamba singh and LDS Yadav
6. Advanced Physical chemistry –Gurdeep Raj,Goel Publication
7. Essentials of physical Chemistry-Puri, Sharma,Pathania

S1008: **Chemistry Lab-I** **Credit(s): 1**

INORGANIC CHEMISTRY

1. To analyse acidic radicals of dilute H_2SO_4 and concentrated H_2SO_4 group.
2. To analyse mixture containing three acidic and three basic radicals (Group I ,II andVII).
3. To analyse mixture containing three acidic and three basic radicals(Group II,III and VII).
4. To analyse mixture containing three acidic and three basic radicals(Group IV,VI and VII).

5. To analyse mixture containing three acidic and three basic radicals(Group I ,II and V).

ORGANIC CHEMISTRY

1. To purify the impure sample of organic compounds by sublimation .
2. To separate the mixture (1 solid+1 liquid) by distillation .
3. To detect the elements (N and S) from the given organic compound.
4. To detect the element (halogen) from the given organic compound.
5. To purify the impure sample of organic compound by crystallization and decolourised the compound by charcoal.

PHYSICAL CHEMISTRY

1. To prepare standard 0.1 N NaOH solution using 0.1 N Oxalic acid as primary standard solution.
2. To determine strength of unknown CH_3COOH using 0.1 N NaOH as intermediate solution.
3. To determine the percentage composition of a given mixture (non interacting system) by viscosity method.
4. To determine the percentage composition of a given mixture (non interacting system) by surface tension method.
5. To determine the partition coefficient of Iodine between water and carbon tetrachloride (or chloroform, carbon disulphide etc) at room temperature.

SEMESTER-II

S2007: Chemistry-II **Credit(s)-4**

Periodic trends in S-Block Elements and P- Block elements

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies. Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16.

Compounds of P-Block Elements

Boranes, borazine, borohydrides, carbides, silicates (structural principle).

Alkenes :

Nomenclature, isomerism, relative stabilities, methods of preparation: dehydration of alcohols, dehydrohalogenation of alkyl halides, dehalogenation of vic-dihalides, pyrolysis of quarternary ammonium hydroxides; physical properties, chemical reactions: - Catalytic hydrogenation, addition of hydrogen halides, hydroboration - oxidation oxymercuration reduction, epoxidation,

ozonolysis, hydration, hydroxylation with $KMnO_4$, substitution reactions at the allylic & vinylic positions, polymerization; regioselectivity in alcohol dehydration. Saytzeff & hofmann rules for elimination;

Alkynes :
Nomenclature, isomerism, structure & bonding in alkynes, methods of preparation, physical properties, chemical reactions - addition of hydrogen, mechanism of electrophilic & nucleophilic addition , acidity of alkynes, hydroboration - oxidation, metal - ammonia reductions, oxidation & polymerisation.

Alkyl Halide
Nomenclature & classes of alkyl halides, methods of formation, chemical reaction. Mechanism of nucleophilic substitution reactions of alkyl halides, SN2 & SN1 reaction with energy profile diagrams.

Aryl Halides
Methods of formation of aryl halides, nuclear & side chain reactions. The addition - elimination & the elimination - addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides versus alyl, vinyl & aryl halides.

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, Glod number. Liquid in liquids (emulsions), types and preparation of emulsions, emulsifier, **Liquids in solids (gels) :** Classification, preparation and properties, inhibition, general application of colloids.

Chemical Kinetics
Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction Concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order pseudo order, half life and means 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: conductomertric, potentiometric, optical methods, polarimetry and spectrophotometry. Theories of chemical kinetics : effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Suggested Books

1. Selected topics in inorganic chemistry –Malik tuli, Madan.

2. Concise Inorganic Chemistry 5 ^{ed}- J. D. Lee

3. Kinetics and Mechanism of Chemical Transformation-J. Rajaram and J. C. Kuriacose

4. Advanced Physical Chemistry –Gurdeep Raj,Goel Publication

5. Organic Chemistry Reaction and Reagents-O.P.Agarwal,Krishna Prakashan Meerut

6. Chemical Kinetics-Laidler

S2008: Chemistry Lab-II **Credit (s): 1**

INORGANIC CHEMISTRY

1. To analyse mixture containing three acidic and three basic radicals including BO_3^{-3}as the interfering radical.
2. To analyse mixture containing three acidic and three basic radicals including PO_4^{-3}as the interfering radical.
3. To analyse mixture containing three acidic and three basic radicals including $C_2O_4^{-2}$ or F^- theinterfering radical.
4. To analyse mixture containing three acidic and three basic radicals including $C_2O_4^{-2}$ or F^- theinterfering radical.
5. To analyse mixture containing three acidic and three basic radicals .Mixture contains combination of acidic radicals. (Chloride in presence of Bromide or Iodide)
6. To analyse mixture containing three acidic and three basic radicals. Mixture contains combination of acidic radicals.(Oxalate in presence of Carbonate)

ORGANIC CHEMISTRY

1. To detect the functional group (alcoholic and phenolic) from the given organic compound.
2. To detect the functional group (Carboxylic and ester) from the given organic compound.
3. To detect the functional group (Carbonyl and Amide) from the given organic compound.
4. To detect the functional group (Amine and Aniline) from the given organic compound.
5. To detect the functional group (Carbohydrate And Nitro) from the given organic compound.

PHYSICAL CHEMISTRY

1. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at room temperature.
2. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by H_2So_4 at room temperature and compare the relative strength of acids.
3. To determine the specific reaction rate of the hydrolysis of methyl or ethyl acetate catalysed by HCl at higher temperature (40°C) and also determine energy of activation for the reaction.
4. To study the effect of acid strength on the hydrolysis of ester.
5. To prepare colloidal solution of arsenius sulphide.

SEMESTER-III

S3007: Chemistry-III **Credit(s)-4**

Chemistry of Elements of Transition Series

Characteristic properties of d-block elements. Properties of the elements of the first transition series and their binary compounds .comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Alcohol

Classification and nomenclature

Monohydric alcohol - nomenclature, methods of formation of reduction of aldehyde, Ketones, Carboxylic acids and ester. Hydrogen bonding, Acidic nature, Reaction of Alcohols.

Dihydric alcohol - nomenclature, method of formation, chemical reaction of vicinal glycols, oxidative cleavage [$Pb(OAC)_4$ and HIO_4] and pinacol - pinacolone rearrangement.

Trihydric alcohols - nomenclature and methods of formation, chemical reaction of glycerol.

Phenols

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols resonance stabilization of phenoxide ion, reaction of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, claisen rearrangement, Gatterman synthesis, Hauben - Hoesch reaction, Lederer manasse reaction & Reimer Tiemann reaction.

Aldehyde and Ketone - I

Nomenclature and structure of the carbonyl group, Synthesis of aldehyde and Ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketone using 1,3 dithianes, synthesis of ketones from nitrites and from carboxylic acids, physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevengel condensation.Condensation with ammonia and its derivatives, witting reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer - Villiger oxidation of Ketones. Cannizzaro's reaction. Meerwine Pondorof verlay reduction, clemmensen, wolff Kishner, $LiAlH_4$ and $NaBH_4$ reductions.

Thermodynamics

Definition of theromdynamic terms : System, surroundings etc. Types of systems intensive and extensive properties. 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.Standard state, standard enthalpy of formation Hess's law of heat summation and its application. 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.

Second Law of Thermodynamics : Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Concept of Entropy : Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, Clausius inequality, entropy as a criteria of spontaneity and equilibrium.

Third law of thermodynamics : Nernest heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Bibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity.Variation of G and A with P, Vand T.

Suggested Books

1. Advanced Inorganic chemistry-S. K Agarwal, Keemtilal

2. Organic chemistry Reaction and Reagents-O. P. Agarwal, Krishna Prakashan Meerut

3. Advanced Organic chemistry-Jagdamba singh and LDS Yadav

4. Reaction mechanism in Organic chemistry –S M Mukherji and S P Singh, Macmillan

5. Chemical thermodynamics-R. P. Rastogi and R.R Mishra

6. Advanced Physical chemistry –Gurdeep Raj, Goel Publication

7. Chemical thermodynamics-R. C. Srivastava, S. K. Sahaand Abhay K. Jain

S3008 : Chemistry Lab-III **Credit(s): 1**

INORGANIC CHEMISTRY

1. To calibrate fractional weights, pipettes and burettes.
2. To prepare standard solution and dilution -0.1 M to .001M solution.
3. To estimate hardness of water by EDTA.
4. To measure dissolved oxygen in water.
5. To measure Total Solid in sewage.

6. To measure chloride in water.

ORGANIC CHEMISTRY

Thin Layer Chromatography

1. To separate the mixture of Methyl Orange and Methylene Blue by using cyclohexane and ethyl acetate(8.5:1.5)a s solvent system.
2. Preparation and separation of 2,4-dinitro Phenylhydrazone of acetone , 2-butanone,hexane-2-one and hexane-3-one using toluene and petroleum ether(40:60).

Paper Chromatography

3. To separate the mixture of phenylalanine and glycine.Alanine and aspartic acid.Leucine and glutamic acd.Spray reagent –Ninhydrin.
4. To separate the mixture of D,L-alanine,glycine and L-leucine using n-butanol : acetic acid :water(4:1:5).Spray reagent- Ninhydrin.
5. To separate monosaccharides –a mixture of D –galactose and D-fructose using n-butanol : acetone: water (4:1:5) .Spray reagent –aniline hydrogen phthalate.

PHYSICAL CHEMISTRY

1. To determine the solubility of benzoic acid at different temperatures and to determine Δ H of the dissolution process.
2. To determine the water equivalent of the thermos flask or calorimeter.
3. To determine the enthalpy of neutralization or heat of neutralization for a strong acid and strong base.
4. To determine heat of neutralization of a weak acid say acetic acid and hence calculate its heat of ionization or enthalpy of ionization.
5. To determine heat of neutralization of a weak base say NH_4OH and hence calculate its heat of ionization or enthalpy of ionization.

SEMESTER-IV

S4007: Chemistry-IV **Credit(s)-4**

Chemistry of Lanthanide and Actinide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, Separation of Np, Pu and Am from U, Comparison between the later actinides and the later lanthanides

Non-aqueous Solvents

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

U-V Spectra

Elecctromagnetic Spectrum. Absorption spectra Ultraviolet (UV) absorption Spectroscopy - absorption laws (Beer - Lambert's Law), molar absorptivity, presentation and analysis of UV spectra, types of UV spectra, types of electronic transition, effect of conjugation. Concept of Chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shift. UV spectra of conjugated enes and enones.

IR-Spectra

Molecular vibration, Hooke's Law, selection rules, intensity on deposition of IR bands, measurement of IR spectrum, finger print region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

Carboxylic Acid

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, preparation of carboxylic acid. Reaction of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, ester and amides, Reduction of Carboxylic acids. Mechanism of decarboxylation, method of formation and chemical reactions of unsaturated monocarboxylic acids. Decarboxylic acid, methods of formation and effect of heat and dehydrating agents haloacid, hydroxy acids - malic tartaric & citric acid.

Carboxylic Acid Derivatives

Structure and nomenclature of acid chloride, ester, amides (Urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, inter-conversion of acid derivatives by nucleophilic acyl substitution. Preparation of Carboxylic acid derivatives, Chemical reaction, Mechanism of esterification and hydrolysis (Acidic and Basic).

Thermochemistry

Standard state, standard enthalpy of formation Hess's law of heat summation and its application. 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.

ChemicalEquilibrium

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.

Suggested Books

1. Advanced Inorganic chemistry-S. K Agarwal, Keemtil

2. Elementry Organic spectroscopy-Y.R . Sharma

3. Elementry Organic spectroscopy-H. Kaur

4 . Organic Chemistry-R. T. Morrison and R. N. Boyd, Prentice Hall

5. Physical Chemistry –P W Atakins, ELBS

6. Advanced Physical chemistry –Gurdeep Raj, Goel Publication

S4008: Chemistry Lab-IV **Credit(s): 1**

INORGANIC CHEMISTRY

Volumetric Analysis

1. To determine alkali content in antaacid tablet using HCl.
2. To estimate copper using thiosulphate.
3. To determine acetic acid in commercial vinegar using NaOH solution.

Synthesis

4. To prepare Tetraammine copper (II)sulphate.
5. To prepare Ni-DMG complex.

ORGANIC CHEMISTRY

1. To indentify an organic compound (1) through the functional group analysis, determine its M.P and prepare its suitable derivative.
2. To identify an organic compound (2) through the functional group analysis,determine its M.P and prepare its suitable derivative.
3. To identify an organic compound (3) through the functional group analysis,determine its M.P and prepare its suitable derivative.
4. To identify an organic compound (4) through the functional group analysis,determine its M.P and prepare its suitable derivative.
5. To identify an organic compound (5) through the functional group analysis,determine its M.P and prepare its suitable derivative.

PHYSICAL CHEMISTRY

1. To determine the strength of given acid pH metrically.For this you are provided with standard NaOH solution.
2. To draw the solubility curve of phenol –water system and to determine critical solution temperature of the system and the composition of phenol-water system at C.S.T.
3. To determine the C.S.T of phenol-water system in presence of 1% NaCI solution and 1% succinic acid solution.
4. To determine the dissociation constant of a weak acid conductometrically and verify ostwalds dilution law.
5. To determine the transition temperature of the given substance by thermometric method ($MnCI_2.4H_2O$)

SEMESTER-V

S5007: Chemistry-V **Credit(s): 4**

Metal-Ligand Bonding in Transition Metal complexes

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

NMR Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (H^1 NMR) spectrescopy. Nuclear shieding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, area of signals. Interpretation of PMR spectra of simple organicmolecules such as ethyl bromide, ethanol , acetaldehyde, 1,1,2-tribromoethane, ethyl acetate,toluene and acetophenone.

Structure elucidation

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopy techniques.

Phase Equilibrium

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilbria of one component system- water, and S systems phase equilibria of two component system - solid - liquid equilibria, simple eutectic Pb-Ag systems, desilverisation of lead. solid solution - compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3$ - H_2O), Freezing mixtures, acetone-dry ice.

Photochemistry

Introduction, difference between thermal and photochemical processes. Laws of photochemistry : Grothus-Drapper law, Stark -Einstein law, Jablosnski diagram depicting various processes occuring in the exited sate, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized
Reactions

Electrochemistry

Electrical transport - conduction inmetals and in electrolyte solutions, specific conductance and equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlarusch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes. Ostwald's dilution law. Transport number, definition and determination by Hittorf method and moving boundary method.

Types of reversible electrodes - gas - metal ion, metal -metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance. EMF of a cell and its measurements. concentration cell with and with out transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, Buffers - mechanism of buffer action, Henderson-Hazel equation, Hydrolysis of salts.

Suggested Books

1. Selected topics in Inorganic Chemistry –Malik tuli, Madan

2. Elementry Organic spectroscopy-Y.R . Sharma

3. Elementry Organic Spectroscopy-H. Kaur

4. Organic Chemistry Reaction and Reagents-O.P.Agarwal,Krishna Prakashan Meerut

5. Advanced Organic Chemistry-Jagdamba singh and LDS Yadav

6. Advanced Physical Chemistry –Gurdeep Raj,Goel Publication

7. Essentials of Physical Chemistry-Puri, Sharma, Pathania

8. A Text book of Electro- Chemistry-Glasstone

S5008: Chemistry Lab-V **Credit(s): 1**

INORGANIC CHEMISTRY

1. To prepare cis-potassium-dioxalatodiaquachromate (III).
2. To prepare trans-potassium-dioxalatodiaquachromate (III).
3. To prepare sodium trioxalatoferrate (III).
4. To estimate Ni as Ni-DMG in given solution.
5. To estimate Cu as CuSCN in given solution.

ORGANIC CHEMISTRY

1. To separate and identify the organic mixture containing two solid components using water and prepare their suitable derivatives.
2. To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
3. To separate and identify the organic mixture containing two solid components using NaOH and prepare their suitable derivatives.
4. To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives.
5. To separate and identify the organic mixture containing two solid components using $NaHCO_3$ and prepare their suitable derivatives

PHYSICAL CHEMISTRY

1. To determine the strength of the given acid (HCI) conductometrically using standard alkali solution.
2. To determine the strength of the given acid (CH_3COOH) conductometrically using standard alkali solution.
3. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
4. To draw spectral absorption curve for given substance ($K_2Cr_2O_7$ or $KMnO_4$) using spectrophotometer and determine the wavelength for maximum absorption for each of them.Also verify the Lambert Beer's Law and determine the concentration of unknown solution .
5. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine validity of Freundlich and Langmuir adsorption isotherm.

SEMESTER-VI

S6007: Chemistry-VI **Credit(s)-4**

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.

Organometallic Chemistry

Definition, nomenclature and classification of organometallic compounds. A brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

Heterocyclic Compounds

Introduction: Molecular orbital picture and aromatic characteristics of pyrrol,furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives.Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and sixmemberedheteroeycies. Preparation and reactions of Indole, quinoline and isoquinolme with specialreference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Elementray quantum Mechanics

Black-body, radiation, Planck's radiation law, photoelectric effect, heat capacity of solids. Compton effect.De Broglie hypothesis 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.

Physical Properties and Molecular Structure

Optical activity, polarization- (Calusius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetics.

Suggested Books

1. Selected topics in inorganic chemistry –Malik tuli,Madan

2. Inorganic Chemistry Principles of structure and reactivity-Huheey James ,E.Keiter Ellen, A.

Pearson,Edu.Delhi

3. Organic Chemistry Reaction and Reagents-O. P. Agarwal, Krishna Prakashan Meerut

4. Organometallic Chemistry, R.C Mehrotra

5. Reaction mechanism in Organic chemistry –S M Mukherji,and S P Singh,Macmillan

6. A Text book of Quantam Chemistry-A.K .Chandra

7. Organic chemistry –I. L. Finar

S6008: Chemistry Lab-VI **Credit(s): 1**

INORGANIC CHEMISTRY

1. To synthesize Hexaammine nickel (11)chloride.
2. To synthesize prussian blue.
3. To measure fluoride in the given sample by SPANDS method.
4. To separate and estimate Mg(II) and Zn(II).
5. To separate and estimate Cu(II) and Ni(II).
6.

ORGANIC CHEMISTRY

1. (a)To prepare acetanilide from aniline (Acetylation).
   (b) To prepare phenylbenzoate from phenol (Benzoylation).
2. To prepare Iodoform from ethanol and acetone. (Aliphatic Electrophilic Substitution).
3. To prepare m-dinitro benzene from nitro benzene .
4. To prepare p-nitro acetanilide from acetanilide.
5. To prepare Benzoic acid from toluene.

PHYSICAL CHEMISTRY

1. To determine the specific rotation of a given optically active compound.
2. To determine the equivalent conductance of a strong electrolyte KCI or NaCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
3. To determine the equivalent conductance of a strong electrolyte HCI at several concentrations and verify the applicability of Debye Huckel Onsager equation.
4. To study saponification of ethyl acetate conductometrically.
5. To determine the freezing point depression constant of camphor using naphthalene as solute and hence determine the molecular weight of acetanilide by Rast's method.

MATHEMATICS

Semester –I		
Course Code	**Paper**	**Credits**
S1010	Numerical Analysis and Algebra	4
S1011	Mathematics Lab-1	1
	Total	**5**
Semester –II		
S2010	Dynamics and Calculus	4
S2011	Mathematics Lab-II	1
	Total	**5**
Semester –III		
S3010	Differential Equations	4
S3011	Mathematics Lab-III	1
	Total	**5**
Semester –IV		
S4010	Partial Differential Equations	4
S4011	Mathematics Lab-IV	1
	Total	**5**
Semester -V		
S5010	Analysis	4
S5011	Mathematics Lab-V	1
	Total	**5**
Semester -VI		
S6010	Linear and Abstract Algebra	4
S6011	Mathematics Lab-VI	1
	Total	5

Semester-I

S1010: Numerical Analysis and Algebra **Credit(s) : 04**

Numerical Analysis

Numerical solutions of algebraic equations, Interpolation, Numerical differentiation. Numerical Quadrature. System of linear equations. Eigen value computation. Numerical solution to ordinary differential equations of first order.

Algebra :

Introduction, Elementary operations of matrices. Inverse of a matrix. Rank of a matrix. Application of matrices to the system of linear equations, Consistency of the system.

Definition of a group with examples and simple properties, Subgroups, Generation of groups, Cyclic groups, Coset decomposition, Lagrange's theorem and its consequences. Homomorphism and Isomorphism. Permutation groups and Cayley's theorem. Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. The Isomorphism theorems for groups.

Suggested Books

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 1999.
2. C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.
3. S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.
4. C.E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addition-Wesley, 1979.
5. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Co. Inc. New York, 1982.
6. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
7. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
8. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.
9. P.B. Bhattacharya, S.K.Jain, S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.
10. S. Singh, Modern Algebra, Vikas Publ. House, India.

S1011: Mathematics Lab-II **Credit(s) : 1**

Exercises Based on MatLab and Mathematica

Suggested Books

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Semester –II

S2010: Dynamics and Calculus **Credit(s): 4**

Dynamics: Rotation of a vector in a plane. Velocity and acceleration components in Cartesian, polar and intrinsic systems. Central orbit, Kepler's laws of motion, rectilinear simple harmonic motion. Vertical motion on circular and cycloidal curves.

Motion with respect to linearly moving and rotating plane. Coriolis force and centrifugal force.

Calculus : Functions of Two Variables: Limit, Continuity, Differentiability. Partial differentiation, Change of variables, Euler's, Taylor's theorem. Maxima and minima. Double and triple integrals, Change of order in double integrals. Beta and Gamma functions

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems with applications.

Suggested Books

1. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.

2. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.

3. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Company, New Delhi.

4. S. C. Mallik, Mathematical Analysis, Wiley Eastern Ltd, New Delhi.

5. Gabriel Klaumber, Mathematical Analysis, Marcel Dekkar, New York 1975.

6. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson

Education Ltd, 2003.

7. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999.

S2011: Mathematics Lab-II **Credit(s) : 01**

Following topics given below will be taken up using Matlab and Mathematica Softwares.

1. Numerical integration

2. Finding Area and Volume using Integration

3. Differentiation and Integration of Vector point functions.

4. 2-D and 3-D graphics.(Spheres,Cone,Cylinder)

(MATLAB- High performance numeric computation and visualization software.
MATHEMATICA- Stephen Wolfram.)

Suggested Books

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Semester –III

S3010: Differential Equations **Credits : 4**

Ordinary differential equations of first order: initial and boundary conditions, homogeneous equations, linear equations, Exact differential Equation. First order higher degree equations solvable for x, y, p. Singular solution and envelopes.

Linear differential equations with constant coefficients, homogeneous linear differential equations, linear differential equations of second order with variable coefficients.

Series solutions of differential equations. Bessel and Legendre equations. Bessel and Legendre functions.

Suggested Books

1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.
2. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.
3. R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 2000.
4. D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India), 1967.
5. E.A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.
6. B.Rai, D.P.Choudhary,Ordinary Differential Equations, Narosa Publ. 2004.

S3011: Mathematics Lab-II **Credit(s) : 1**

Following topics will be taken up using Matlab and Mathematica Softwares.

MATLAB- High performance numeric computation and visualization software.
MATHEMATICA- Stephen Wolfram.

Suggested Books

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Semester –IV

S4010: Partial Differential Equations **Credits : 4**

Linear partial differential equations of first order. Non linear PDE of first order: Charpit's method.

Linear partial differential equation of second and higher order of homogeneous and non homogeneous forms with constant coefficients. Second order PDE with variable coefficients. Monge's method. Solution of heat and wave equations in one and two dimensions by method of separation of variables.

Suggested Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
2. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
3. S.B. Rao and H.R. Anuradha, Differential Equations, University Press, 1996.
4. W.T.H. Piaggio, Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.

S4011: Mathematics Lab-IV **Credits: 1**

Project:

Following topics given below will be taken up using Matlab and Mathematical Softwares.

1. Centre of gravity by integration: C.G of plane area, arc, surface and solid of revolution.

2. Solving Differential Equations obtained in planetary motions and Simple Harmonic Motions.

Suggested Books

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Semester V

S5010: Analysis **Credits : 4**

Analysis

Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorems of integral calculus, Mean Value theorems of integral calculus.

Improper integrals and their convergence. Comparison test, Abel's and Dirichlet's test, Integral as a function of a parameter and its applications.

Sequences, Theorems on limits of sequences, Monotone convergence theorem, Cauchy's convergence criterion. Infinite series, series of non-negative terms. Comparison test, Ratio test, Rabbe's, logarithmic, De Morgan and Bertrand's tests. Alternating series, Leibnitz's theorem.

Complex Analysis: Analytic functions, Harmonic functions, Elementary functions. Mapping by elementary functions, Mobius transformations, Conformal mappings.

Metric spaces: Introduction. Neighbourhood, limit points, interior points, open and closed set, closure and interior, boundary points. Subspace of a metric space, Completeness. Cantor's intersection theorem. Construction of real numbers as the completion of the incomplete metric space of rationals.

Dense subsets. Separable metric spaces. Continuous functions. Uniform continuity, Isometry and homeomorphism. Equivalent metrics.

Suggested Books

1. Shanti Narayan, A Course of Mathematical Analysis. S. Chand & Co. New Delhi.
2. T. M. Apostol, Mathematical Anslysis, Narosa Publishing House, New Delhi, 1985.
3. R.R. Goldberg, Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970.
4. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
5. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.
6. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co. New Delhi.
7. E. T. Copson, Metric Spaces, Cambridge University Press, 1968.
8. R.V. Churchil & J.W. Brown, Complex Variables and Applications, 5^{th} Edition, McGraw-Hill, New York, 1990.

S5011: Mathematics Lab-V **Credit(s): 1**

Following topics given below will be taken up using Matlab and Mathematica

Softwares.

1. Numerical differentiation

2 Numerical Itegration

3. Solving simultaneous equations of more than three variables

Suggested Books

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Semester –VI

S6010: Linear Algebra **Credit(s): 4**

Vector spaces, subspaces and linear spans, linear dependence and independence. Finite dimensional vector spaces. Linear transformations and their matrix representations. Algebra of linear transformations, the rank and nullity theorem. Change of basis. Dual spaces, bi dual space and natural isomorphism. Eigen values and eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.

Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

Suggested Books

1. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice-Hall of India, New Delhi, 1971.
3. N. Jacobson, Basic Algebra, Vols I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Narosa Publishing House, Vol. I 1996.

S6011: Mathematics Lab-VI **Credit(s): 1**

Following topics given below will be taken up using Matlab and Mathematical Softwares.

1. Complex Plane: Complex curves and Region in Complex plane

2 Complex Integration

3. Singularities, Poles and Residues

Suggested Books:

1. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
2. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
3. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

Microbiology

Objectives of the Course

Enable the student to:

1. Study the world of microbes.
2. Describe and classify the diversity of microbes and its significance.
3. Explain the Ultra structure and functioning of bacterial cell in the submicroscopic and molecular level.
4. Familiarize with the various diseases and measures adopted to control diseases.
5. Acquaint with the aims, objectives and significance of molecular biology.
6. Have an idea on immunology.
7. Familiarize with the recent trends in the field of environmental microbiology.
8. Understand the basic principles related to various physiological functions of microbes.
9. Understand the application of microbiology in different industries.
10. Understand the importance of microbes in human welfare.

Microbiology

Semester –I		
Course Code	**Title**	**Credits**
S1013	**Microbial Diversity**	**4**
S1014	**Microbiology Lab-1**	**1**
	Total	**5**
Semester –II		
S2013	**Bacteria and Microbial Physiology**	**4**
S2014	**Microbiology Lab-II**	**1**
	Total	**5**
Semester –III		
S3013	**Immunology and Medical Microbiology**	**4**
S3014	**Microbiology Lab-III**	**1**
	Total	**5**
Semester –IV		
S4013	**Molecular biology**	**4**
S4014	**Microbiology Lab-IV**	**1**
	Total	**5**
Semester -V		
S5013	**Environmental Microbiology**	**4**
S5014	**Microbiology Lab-V**	**1**
	Total	**5**
Semester -VI		
S6013	**Applied Microbiology**	**4**
S6014	**Microbiology Lab-VI**	**1**
	Total	**5**

Semester I

S1013: Microbial Diversity **Credit(s): 4**

History and Scope of Microbiology- Biogenesis and abiogenesis Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming, Microbiology. Classification of Microbes – Systems of classification (Haeckel, Whittekar, Carl Woese)

Bacterial Morphology and subcellular structures: Morphology of bacteria, Slime layer, Capsule, Cell wall, Cytoplasmic membrane (Fluid mosaic model of Singer - Nicholson); Cytoplasmic inclusion bodies. Flagella, Pilus, Fimbriae (structure, composition and functions). Plasmids and episomes. Ribosomes, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome).

Prokaryotes: Brief description of prokaryotic and eukaryotic Algae and Fungi. General characteristics, vegetative and reproductive structure of Protozoa.

General Properties of virus: virus**,** viroids, virusoids and prions. Nature of virus. Types of virus (on the basis of symmetry, genetic material, host types). Transmission of virus.

Suggested Readings:

1. Stanier, RY., et al., General Microbiology, 5th ed.,2000, Tata-McGraw Hill

2. Atlas, RM., Principles of Microbiology, 2nd ed.,1997, McGraw-Hill

3. Kumar. H.D. Introductory Phycology. Affiliated East-West Press Ltd., Newyork 1988.

4. Singh V., Pande P.C. and Jain D.K. A Text Book of Botany Rastogi and Co. Merrut, 2001.

S1014: Laboratory exercises **Credit(s): 1**

1. Gram Staining
2. Capsule staining
3. Identification of some common fungi :
   (a)Aspergillus
   (b) Mucor

   (c)Panicillium
4. Identification of some common algae
5. Identification of some common virues

S2013: Bacteria and Microbial Physiology **Credit(s): 4**

Bacterial shapes and arrangement: cell membrane, cell wall of bacteria, inclusion bodies, flagella, capsule, slime, fimbriae and pilli. Bacterial endospores – structure, formation and germination.The world of bacteria- A brief outline of salient features of major bacterial groups according to Bergey's manual of systematic Bacteriology Volume I and II.

Introduction to microbial Diversity. Nutritional classification of microorganism. Cultivation of Bacteria: growth of bacteria, growth curve, environmental factors affecting growth. chemoautotroph, chemoheterotroph and photosynthesis in microorganism. Role of chlorophyll, carotenoid and phycobilins. Light and Dark reaction.

Chemolithotrophy. Hydrogen, Iron, Nitrate, Sulphur and oxidizing bacteria. Nitrogen metabolism and N2 Fixation. Nitrate and Sulphate reduction. Methanogenesis.

Respiratory metabolism especially in reference to microbes. EMP and EnterDoudroff Pathway. Glyoxalate pathway, Krebs cycle, reverse TCA cycle, Phosphorylation.

Suggested Reading

Caldwell.D.R(1995) Microbial Physiology and MetabolismBrown Publishers.

Stainer R.Y,IngrahamJ.L,WhelisM.L andPainter P.R General Microbiology.The Macmillan Press Ltd.

Madigan M.T Martinko J.M and Parker J Brock Biology Microorganism Prentice Hall.

Powar and Daginawala General Microbiology Vol II Himalaya Publishing House.

Stryer 5th Ed2001 Biochemistry Freeman W.H

Lehninger 3rd Ed.Principles of Biochemistry. McMillan. 1. General Microbiology, 7th edition, H S Schlegel, Cambridge University Press,
1995
Microbiology ,5th edition M J Pelczar, E C S Chan, N R Kreig, Tata Mc Graw Publication, 2006
Microbiology-a Laboratory Manual, 6th edition, J G Cappuccino and N Sherman, Addison Wesley, Pearson Education, Inc., 2006
Microbiology-an introduction, 9th edition G.J. Tortora, B.R. Funke, C.L. Case Pearson Education, Inc., 2007

S2014: Laboratory exercise **Credit(s):1**

1. Preparation of culture media- liquid and solid media.
2. Isolation of pure culture by pour plate, serial dilution and streak plate method.
3. Cultivation of anaerobic organisms.
4. Sterilization method.
5. Methods of staining bacteria- simple staining.
6. Gram staining.
7. Endospore staining.
8. Negative staining.
9. Methods of quantitative estimation of microorganisms.
10. Effect of pH, temperature on microbial growth.

S3013: Immunology and Medical Microbiology **Total Credit(s): 4**

Overview of immune system; innate immunity and adaptive immunity. Cells and Organs of immune system: lymphocytes, mononuclear phagocytes, granulocytic cells, primary and secondary lymphoid organs. Antigens: Properties of antigens, Adjuvants, Haptens.

Antibodies: Basic structure, classes and function, Polyclonal sera, Monoclonal antibodies. Antigen- Antibody interaction: precipitation reaction, agglutination reaction, neutralization reaction, complement and lytic reaction and phagocytic reaction. histocompatibility complex: Structure and functions. Brief introduction to Vaccines

Discovery and History of pathogenic microorganism. Contribution made by eminent scientists. Classification of medicinally important microorganism. Characteristic of infectious disease. Disease cycle(source of disease, reservoir, carriers.). Normal flora of human body.

Bacterial diseases,epidemiology,pathogenicity, laboratory ,diagnosis, prevention and control of Anthrax, Tuberculosis, Typhoid, Tetanus and Leprosy.General account of fungal diseases mycoses,subcutaneous**.**

Suggested Books

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing Ananthanarayan R. and Panikar. J (1997) Text Book of Microbiology Orient Longman.

3. Mackie and Mc Cartney Medical Microbiology Vol I Microbial Infection. Churchil livingstone 1996.

4. Baron E.J,Peterson LR and Finegold S.M Mosby1990. Bailey and Scott's Diagnostic Microbiology.

5. Greenwood,Slack R.C B and Peutherer J.F Medical Microbiolobgy Churchill Livingstone(Elsevier).

6. Medical Microbiology and Infectious Diseases W.B Saunders &Co. Broude Philadelphia.

S3014: Laboratory exercises **Credit(s):1**

- Determination of ABO blood group
- Determination of Rh factor.
- Determination of differential blood count of WBC
- Estimation of hemoglobin in given blood sample.
- Estimation of RBC in given blood sample
- Estimation of WBC in given blood sample
- Isolation of bacteria from skin surface.
- Detection of antibiotic susceptibility of given microorganism against various antibiotics.
- Study of different type of bacteria gram positive(Staphylococci, Streptococci,Diptheria and Tetanus) gram ngative (Meningitis and Dirrhoea)Mycobacteria and Tuberculosis.

S4013: Molecular biology **Credit(s): 4**

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure,Sailent features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, Genome Structure, Chromatin and the Nucleosome-Chromatin structure-Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative,Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins.

Mechanism of Transcription:RNA Polymerase and the transcription unit.RNA Modifications; Split genes, concept of introns and exons, removal of Introns, spliceosome,machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.

Translation in Prokaryotes: ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetase. Proteins in volved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis. Regulation of translation. Translation-dependent regulation of mRNA and Protein Stability.

Suggested Books

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press,Pearson Pub.

S4014: Laboratory exercise **Credit(s): 1**

1. Preparation of Polytene chromosome from *Chironomous* larva/*Drosophila* larva
2. Demonstration of mammalian sex chromatin.
3. Study of semiconservative replication of DNA through micrographs/schematic representations.
4. Preparation of culture medium (LB) for *E.coli (both solid and liquid)* and raise
5. Demonstration of antibiotic resistance.

S5013: Environmental microbiology **Credit(s): 4**

Introduction to environmental microbiology, scope and importance. Microorganisms in environment: viruses, bacteria, fungi, algae and protozoa. Terrestrial environment: soil and soil subsurface environment, microorganisms in surface soil, shallow and deep subsurface environment.

Aeromicrobiology : atmosphere, aeromicrobiological pathway, microbial survival in air, extramural and intramural aeromicrobiology. Aquatic and extreme environments: microbial habitat in aquatic environment, environment determinants that govern extreme environments.

Microbial transport: factors affecting microbial transport, factors affecting transport of DNA.

Biogeochemical cycling: carbon cycle, nitrogen cycle, sulfur cycle.

Suggested Books

Raina M.Maier, Ian L Pepper, Charles P Gerba. (2000) ENVIRONMENT MICROBIOLOGY . Academic press an imprint of Elsevier(san diego, san Francisco,)

Atlas and Bartha (1998) MICROBIAL ECOLOGY: fundamentals and applications. Fourth edition. Pearson education (Singapore)

S5014: Laboratory exercise **Credit(s):1**

- Isolation of microbes from soil samples.
- Isolation of microbes from water samples.
- Determination of dissolved oxygen from water samples.
- Determine biological oxygen demand from given water samples
- Determine chemical oxygen demand from given water samples.

S6013: Applied Microbiology **Total Credit(s): 4**

Sources and characters of industrially potent microbes, their isolation, purification & maintenance. Screening of useful strains: primary screening & secondary screening. Microbial growth kinetics in batch, continuous & fed-batch fermentation process. Types, principles & designing. Other of bioreactors. Commercial production of antibiotics with special reference to penicillin and its derivatives

Microbiology & production of alcoholic beverages: malt beverages, distilled beverages, wine & champagne. Commercial production of organic acids like acetic, lactic, citric, & gluconic acids. Bioprocess Engineering: Downstream processing, various steps for large scale proteins, Mushroom cultivation.

Food as a substrate for micro organisms - Micro organisms important in food microbiology; Molds, yeasts and bacteria - General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of micro organisms, anaerobic conditions - High temperature - Low temperature - Drying - Food additives.

Contamination and spoilage - Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products - Fish and sea food - Poultry, Spoilage of canned foods. Spoilage and defects of fermented daily products - oriental fermented foods.

Suggested Books

1. Principles of fermentation technology :-Stanbury,Whittaker and Hall,2nd Ed. 1997.Aditya Books.
2. Fermentation Microbiology and Biotechnology :-El-Mansi and Bryce,2002
3. Process Biotechnology Fundamental :-Mukhopadhaya
4. Biochemical Engineering and Biotechnology :-Atkinson B and Mavituna F.
5. Adams MR and Moss MO. (1995). *Food Microbiology*. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
6. Banwart JM. (1987). *Basic Food Microbiology*. 1st edition. CBS Publishers and Distributors, Delhi, India.
7. Davidson PM and Brannen AL. (1993). *Antimicrobials in Foods*. Marcel Dekker, New York.
8. Dillion VM and Board RG. (1996). *Natural Antimicrobial Systems and Food Preservation*. CAB International, Wallingford, Oxon.
9. Frazier WC and Westhoff DC. (1992). *Food Microbiology*. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

S6014: Laboratory exercises **Credit(s): 1**

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any pathogenic bacteria (*Staphylococcus* or *Salmonella*) from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.
7. Determination of potability and faecal contamination of water samples by presumptive test/MPN test, confirmed and completed tests.

Physics

Objectives

The courses of Physics for the curricula of B. Sc. degree are aimed at laying foundations of basic concepts of understanding of nature. Thus, there is special emphasis on Mathematical Physics, Waves and Oscillations, Thermodynamics, Optics, Mechanics and Properties of Matter, Electromagnetism, Special Theory of Relativity, Solid State Physics Quantum Mechanics, Nuclear and Particle Physics and Electronics. Also, there is provision of elective courses which a student can opt in the 6^{th} semester of the degree course. Having conceptual understanding of these subjects a student would be ready for any public exam. Also, a student would be capable of pursuing a Masters course in Physics.

Course Code	Paper	Credits
	Semester-II	
S1016	**Mathematical Physics, Waves and Oscillations**	**4**
S1017	Physics Lab-1	**1**
	Total Credits	**5**
	Semester-II	
S2016	**Thermodynamics, Optics**	**4**
S2017	Physics Lab-2	**1**
	Total Credits	**5**
	Semester-III	
S3016	**Mechanics and Properties of Matter, Electromagnetism**	**4**
S3017	Physics Lab-3	**1**
	Total Credits	**5**
	Semester-IV	
S4016	**Special Theory of Relativity, Solid State Physics**	**4**

S4017	Physics Lab-4	**1**
	Total Credits	**5**
	Semester-V	
S5016	**Quantum Mechanics, Electronics**	**4**
S5017	Physics Lab-5	**1**
	Total Credits	**5**
	Semester-VI	
S6016	**Nuclear and Particle Physics and Elective Paper***	**4**
S6017	Physics Lab-6	**1**
	Total Credits	**5**
	Elective Paper	
	S6016 (A): Computational Physics	
	S6016 (B): Digital Electronics	
	S6016 (C): Statistical Mechanics	
	S6016 (D): Atomic & Molecular Spectroscopy	

Semester I

S1016: Mathematical Physics and Waves and Oscillations **Credit(s): 4**

Mathematical Physics

Dirac Delta Function: Definition. Representation and Properties of Dirac Delta Function.

Vector Calculus: Vector Differentiation. Scalar and Vector Fields. Ordinary and Partial Derivative of a Vector w.r.t. coordinates. Space Curves. Unit Tangent Vector and Unit Normal Vector (without Frenet - Serret Formulae). Directional Derivatives and Normal Derivative. Gradient of a Scalar Field and its Geometrical Interpretation. Divergence and Curl of a Vector Field. Del and Laplacian Operators. Vector Identities. Vector Integration**:** Ordinary Integral of Vectors. Line, Surface and Volume Integrals. Flux of a Vector Field. Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem.

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Multiple Integrals: Double and Triple Integrals: Change of Order of Integration. Change of Variables and Jacobian. Applications of Multiple Integrals: (1) Area Enclosed by Plane Curves, (2) Area of a Curved Surface, (3) Volumes of Solids.

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.

Fourier Series: Fourier Series. Dirichlet Conditions (Statement only). Kronecker's Method for Computation of Fourier Coefficients. Even and Odd Functions. Orthogonality of Sine and Cosine

Functions. Sine and Cosine Series. Applications: Square Wave, Triangular Wave, Output of Full Wave Rectifier and other Simple Functions. Summing of Infinite Series Term-by-Term Differentiation and Integration of a Fourier Series.

Oscillations in Arbitrary Potential Well: Simple Harmonic Oscillations. Differential Equation of SHM and its Solution. Amplitude, Frequency, Time Period and Phase. Velocity and Acceleration. Kinetic, Potential and Total Energy and their Time Average Values. Reference Circle. Rotating Vector Representation of SHM.

Free Oscillations of Systems with One Degree of Freedom: (1) Mass-Spring system, (2) Simple Pendulum, (3) Torsional Pendulum, (4) Oscillations in a U-Tube, (5) Compound pendulum: Centres of Percussion and Oscillation, and (6) Bar Pendulum.

Driven Oscillations: Damped Oscillations: Damping Coefficient, Log Decrement. Forced Oscillations: Transient and Steady States, Amplitude, Phase, Resonance, Sharpness of Resonance, Power Dissipation and Quality Factor. Helmholtz Resonator.

Coupled Oscillators: Normal Coordinates and Normal Modes. Energy Relation and Energy Transfer. Normal Modes of N Coupled Oscillators.

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves:

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Elastic Waves in Solid Rod. Pressure Waves in Glass Columns. Transverse Waves in Strings. Waves in Three Dimensions. Spherical Waves. Fourier Series and Fourier Analysis of Wave Motion. Plane Electromagnetic Waves. Energy and Momentum of Plane EM Waves. Radiation Pressure. Radiation Resistance of free space. EM Waves in dispersive Media. Spectrum of EM Waves

Suggested Books

1. A. P. French, Vibrations and Waves, CBS Pub. & Dist., 1987.

2. K. Uno Ingard, Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

3. Daniel Kleppner and Robert J. Kolenkow An Introduction to Mechanics, McGraw-Hill, 1973.

4. Franks Crawford, Waves: BERKELEY PHYSICS COURSE (SIE), Tata McGrawHill, 2007.

1. M. S. Seymour Lipschutz, Schaum's Outline of Vector Analysis, McGraw-Hill, 2009.

2. D. E. Bourne, P C Kendall, Vector Analysis and Cartesian Tensors, Chapman & Hall,

1992.3. M. R. Spiegel, Schaum's Outline of Theory and Problems of Fourier Analysis, McGraw-Hill, 1974.

4. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited,1985.

S1017: Physics Lab- I **Credit(s): 1**

1: General

(1) To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC

Currents, (d) Capacitances, and (e) Frequencies.

(2) To test a Diode and Transistor using (a) a Multimeter and (b) a CRO.

(3) To measure (a) Voltage, (b) Frequency and (c) Phase Difference using a CRO.

(4) To study Random Errors.

(5) To determine the Height of a Building using a Sextant.

(6) To study the Characteristics of a Series RC Circuit.

2: Mechanics

(1) To determine the Moment of Inertia of a Flywheel.

(2) To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).

(3) To determine the Young's Modulus.

(4) To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

(5) To determine the Elastic Constants of a Wire by Searle's method.

Note

- Students are required to perform at least 8 experiments.

Suggested Books:

1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

4. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Semester II

S2016: Thermodynamics and Optics **Total Credit(s): 4**

Second Law of Thermodynamics: Reversible and Irreversible Changes. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot Cycle. Carnot Engine and its Efficiency. Refrigerator and its Efficiency. Second Law of Thermodynamics : Kelvin-Planck and Clausius Statements and their Equivalence. Carnot Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Entropy: Change in Entropy. Entropy of a State. Clausius Theorem. Clausius Inequality. Second Law of Thermodynamics in terms of Entropy. Entropy of a Perfect Gas. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Impossibility of Attainability of Absolute Zero: Third Law of Thermodynamics. Temperature-Entropy Diagrams. First and second order Phase Transitions.

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials U, H, F and G: Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work. Cooling due to Adiabatic Memagnetization. Approach to Absolute Zero.

Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific Heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

Optics

Interference: Interference: Division of Amplitude and Division of Wavefront. Young's Double Slit Experiment. Lloyd's Mirror and Fresnel's Biprism. Phase Change on Reflection: Stoke's treatment. Interference in Thin Films: Parallel and Wedge-shaped Films. Fringes of Equal Inclination (Haidinger Fringes) and Fringes of Equal Thickness (Fizeau Fringes). Newton's Rings: Measurement of Wavelength and Refractive Index.

Michelson's Interferometer: (1) Idea of form of fringes (No Theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, (5) Standardization of Meter and (6) Visibility of Fringes.

Diffraction: Fresnel diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Comparison of a Zone plate with a Convex lens. Diffraction due to (1) a Straight Edge and (2) a Rectangular Aperture (Slit), (3) a Small Circular Aperture and (4) an Oopaque Circular Disc. Fresnel's Integrals, Cornu's Spiral: Fresnel Diffraction Pattern due to (1) a Straight Edge, (2) a Slit, and (3) a Wire (Qualitatively using Cornu's Spiral).

Fraunhofer diffraction: Diffraction due to (1) a Single Slit, (2) a Double Slit and (3) a Plane

Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

Coherence: Spatial and temporal coherence, Coherence length, Coherence time. Q- factor for LASER. Visibility as a Measure of Coherence. Spatial Coherence and Size of the Source. Temporal Coherence and Spectral Purity.

LASER: Theory of LASER action: Einstein's coefficients, Threshold conditions for LASER Action. Method and Mechanism of production of He-Ne LASER. Semiconductor LASER. Elementary ideas of Q-switching and Mode Locking.

Holography: Holography versus photography. Basic theory of Holography. Applications of Holography in Microscopy and Interferometry.

Optical Communication: Optical fiber as optical wave-guide. Numerical Aperture and Maximum Angle of Acceptance.

Suggested Books

1. Enrico Fermi, Thermodynamics, Courier Dover Publications, 1956.

2. Meghnad Saha, B. N. Srivastava, A Treatise on Heat: Including Kinetic Theory of Gases,

Thermodynamics and Recent Advances in Statistical Thermodynamics, Indian Press, 1958.

3. F. A. Jenkins and Harvey Elliott White, Fundamentals of Optics, McGraw-Hill, 1976.

4. Ajoy Ghatak, Optics, Tata McGraw Hill, 2008.

5. Eugene Hecht and A R Ganesan, Optics, Pearson Education, 2002.

6. A. K. Ghatak & K. Thyagarajan, Contemporary Optics, Plenum Press, 1978.

S2017: Physics Lab II **Credit(s): 1**

1: Experiments with Compound Pendulums

(1) To determine g by Bar Pendulum.

(2) To determine g by Kater's Pendulum.

2: Experiments with Springs

(1) To study the Motion of a Spring and determine (a) Spring Constant (b) Value of g, and (c) Modulus of Rigidity

(2) To investigate the Motion of Coupled Oscillators.

3: Experiments with Resistance

(1) To determine a Low Resistance by Carey Foster's Bridge.

(2) To determine a Low Resistance by a Potentiometer.

(3) To determine High Resistance by Leakage of a Capacitor.

4: Experiments with Capacitance

(1) To determine the Ratio of Two Capacitances by de Sauty's Bridge.

(2) To determine the Dielectric Constant of a Dielectric placed inside a parallel plate capacitor using a B.G.

5: Experiments to understand Self & Mutual Inductance

(1) To determine Self Inductance of a Coil by Anderson's Bridge using AC

(2) To determine Self Inductance of a Coil by Rayleigh's Method.

(3) To determine the Mutual Inductance of Two Coils by Absolute method using a B.G.

6: Experiments with A.C. Circuits

(1) To study response curve of a Series LCR circuit and determine its (a) Resonant Frequency, (b) Impedance at Resonance and (c) Quality Factor Q, and (d) Band Width.

(2) To study the response curve of a Parallel LCR circuit and determine its (a) Anti-Resonant Frequency and (b) Quality Factor Q.

Note

- Each Student is required to perform at least 8 experiments.

Suggested Books

1. Geeta Sanon, B. Sc. Practical Physics, 1st Edn. (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

4. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Semester III

S3016: Mechanics and Electricity and Magnetism **Credit(s): 4**

Mechanics

Work and Energy Theorem: Work and Kinetic Energy Theorem. Conservative and Non-Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

Elastic and Inelastic Collisions between particles. Centre of Mass and Laboratory Frames.

Rotational Dynamics: Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Kinetic Energy of Rotation. Motion involving both Translation and Rotation.

Elasticity: Relation Between Elastic Coefficients. Twisting Torque on a Cylinder or Wire.

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

Gravitation and Central Force Motion: Law of gravitation. Inertial and Gravitational Mass. Potential and Field due to Spherical Shell and Solid Sphere.

Motion of a Particle under Central Force Field. Two Body Problem and its Reduction to One Body Problem and its Solution. The Energy Equation and Energy Diagram. Kepler's Laws (Ideas Only). Orbits of Artificial Satellites.

Inertial and Non- Inertial Systems: Reference Frames: Inertial Frames and Galilean Transformations. Galilean Invariance and Conservation Laws. Non-inertial Frames and Fictitious Forces. Uniformly Rotating Frame. Physics Laws in Rotating Coordinate Systems. Centrifugal forces: Coriolis Force and its Applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Electricity and Magnetism

Electric Field and Electric Potential: Electric Field: Electric Field and Lines. Electric Field **E** due to a Ring of Charge. Electric Flux. Gauss's law. Gauss's law in Differential form. Applications of Gauss's Law: **E** due to (1) an Infinite Line of Charge, (2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge and Two Parallel Charged Sheets, (4) a Charged Spherical Shell, (5) a Charged Conducting Sphere, (6) a Uniformly Charged Sphere, (7) Two Charged Concentric Spherical Shells and (8) a Charged Conductor. Force on the Surface of a Charged Conductor and Electrostatic Energy in the Medium surrounding a Charged Conductor.

Electric Potential: Line Integral of Electric Field. Electric Potential Difference and Electric Potential V (Line integral). Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Potential and Electric Field of (1) a Dipole, (2) A Charged Wire and (3) A Charged Disc. Force and Torque on a Dipole. Conductors in an Electrostatic Field. Description of a System of Charged Conductors. An Isolated Conductor and Capacitance. Method of Images and its Application to: (1) Plane Infinite Sheet and (2) Sphere.

Electrostatic Energy of (1) A Point Charge; (2) A System of Point Charges; (3) A Uniform Sphere; and (4) A Capacitor.

Dielectric Properties of Matter: Dielectrics: Electric Field in Matter. Dielectric Constant. Parallel Plate Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector. Electric Susceptibility. Gauss's law in Dielectrics. Displacement vector **D**. Relations between the three Electric Vectors. Capacitors filled with Dielectrics.

Magnetic Field: Magnetic Effect of Currents: Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B.** Magnetic Flux. Biot-Savart's Law: **B** due to (1) a Straight Current Carrying Conductor and (2) Current Loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital law (Integral and Differential Forms): B due to (1) a Solenoid and (2) a Toroid. Properties of **B.**

Forces on an Isolated Moving Charge. Magnetic Force on a Current Carrying Wire. Torque on a Current Loop in a Uniform Magnetic Field.

Magnetic Properties of Matter: Magnetism of Matter: Gauss's law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (**M**). Magnetic Intensity (**H**). Relation between **B**, **M** and **H**. Stored Magnetic Energy in Matter. Magnetic Circuit. B-H Curve Hysteresis.

Electromagnetic induction: Faraday's law (Differential and Integral forms). Lenz's Law. Self and Mutual Induction. Energy stored in a Magnetic Field.

Suggested Books

1. Daniel Kleppner, Robert J. Kolenkow, An introduction to mechanics, McGraw-Hill, 1973.
2. Charles Kittel,Walter Knight, Malvin Ruderman,Carl Helmholz,Burton Moyer,Mechanics Berkeley physics course.
3. D. S. Mathur Mechanics, S. Chand & Company Limited, 2000.
4. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill Education, 1986.
5. Arthur F. Kip, Fundamentals of Electricity and Magnetism, McGraw-Hill, 1968.
6. J. H. Fewkes & John Yarwood, Electricity & Magnetism, Oxford Univ. Press, 1991.
7. David J. Griffiths, Introduction to Electrodynamics, Benjamin Cummings, 1998 (Also, PHI).

S3017: Physics Lab- III **Credit(s): 1**

1: Experiment on Mechanical Equivalent of Heat

To determine J by Callender and Barne's constant flow method.

2: Experiments on Thermal Conductivity

(1) To determine the Coefficient of Thermal Conductivity of Copper by Searle's Apparatus.

(2) To determine the Coefficient of Thermal Conductivity of Copper by Angstrom's Method.

(3) To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.

3: Experiments with Resistance and Temperature Devices

(1) To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).

(2) To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.

4: Experiments with Thermocouples

(1) To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

(2) To Calibrate a Thermocouple to measure Temperature in a Specified Range using (1) Null Method (2) Direct Measurement using an Op-Amp Difference Amplifier and to determine Neutral Temperature.

Note

- Each student is required to perform at least 8 experiments.

Suggested Books

1. Geeta Sanon, B. Sc. Practical Physics, 1st Edn. (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

4. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Semester IV

S4016: Special Theory of Relativity and Solid State Physics **Credit(s): 4**

Tensors

Transformation of Co-ordinates. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Pseudotensors. Invariant Tensors: Kronecker Delta. Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors. Vector Algebra and Calculus using Cartesian Tensors: Scalar and Vector Products, Scalar and Vector Triple Products.

Michelson-Morley Experiment and its Outcome.

Transformations: Galilean Transformations. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and Order of Events.

Proper Time. Length Contraction. Time Dilation. Relativistic Transformation of Velocity, Relativistic Addition of Velocities. Frequency and Wave Number.

Mass- energy Equivalence principle. Variation of Mass with Velocity. Relativistic relation between energy and momentum. Relativistic Doppler effect. Relativistic Kinematics.

The idea of Space-Time and Minkowski Space. Null-Cone representation. Metric Tensor.

Four Vector Formalism: Four Velocities, Four Momenta. Transformation of Energy and Momentum.

Bucherer's experiment. Segnac's experiment.

Equivalence Principle. Mach's Principle. Einstein's Box Experiments.

Solid State Physics

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of

Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law.

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Einstein and Debye Theories of Specific Heat of Solids. *T3* Law.

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant.

Electrical Properties of Materials: Elementary Band Theory of Solids. Bloch Theorm. Kronig-Penney Model. Effective Mass of Electron. Concept of Holes. Band Gaps. Energy Band Diagram and Classification of Solids. Law of Mass Action. Insulators, and Semiconductors. Direct and Indirect Band Gap. Intrinsic and Extrinsic Semiconductors. p- and n- Type Semiconductors. Conductivity in Semiconductors. Hall Effect in Semiconductors (Qualitative Discussion Only).

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth.

Isotope effect. Idea of BCS theory (No derivation): Cooper Pair and Coherence length. Variation of Superconducting Energy Gap with Temperature. Experimental Evidence of Phonons. Josephson Effect.

Suggested Books

1. David J. Griffiths, Introduction to Electrodynamics, Benjamin Cummings, 1998 (Also, PHI).

2. Arthur Beiser, Prospects in Modern Physics, McGraw-Hill Book Company (1998).

3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.

4. A. J. Dekkar, Solid State Physics, Macmillan India Limited, 2000.

5. J. S. Blackmore, Solid State Physics, Cambridge University Press, Cambridge.

6. N. W. Ascroft and N. D. Mermin, Solid State Physics, (Harcourt Asia, Singapore 2003).

S4017: Physics Lab IV **Credit(s): 1**

1: Experiments on Reflection, Refraction and Dispersion

(1) To determine the Refractive Index of the Material of a given Prism using Mercury Light.

(2) To determine the Refractive Index of a Liquid by Total Internal Reflection using Wollaston's Air-film.

(3) To determine the Refractive Index of (1) Glass and (2) a Liquid by Total Internal Reflection using a Gaussian Eyepiece.

(4) To determine the Dispersive Power of the Material of a given Prism using Mercury Light.

(5) To determine the value of Cauchy Constants.

(6) To determine the Resolving Power of a Prism.

2: Experiments on Interference

(1) To determine wavelength of sodium light using Fresnel Biprism.

(2) To determine wavelength of sodium light using Newton's Rings.

(3) To determine the Thickness of a Thin Paper by measuring the Width of the Interference Fringes produced by a Wedge-Shaped Film.

(4) To determination Wavelength of Sodium Light using Michelson's Interferometer.

3: Experiments on Diffraction

(1) To determine the Diameter of a Thin Wire by studying the Diffraction Produced by it.

(2) To determine the wavelength of Laser light using Diffraction of Single Slit.

(3) To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.

(4) To determine the Dispersive Power of a Plane Diffraction Grating.

(5) To determine the Resloving Power of a Plane Diffraction Grating.

(6) To determine the (1) Wavelength and (2) Angular Spread of He-Ne Laser using Plane

Diffraction Grating.

(7) To study the Polarization of Light by Reflection and to determine the Polarizing Angle for air- glass interface.

(8) To measure the Intensity using Photosensor and Laser in diffraction patterns of single and double slits.

Note

***** Students are required to perform at least 8 experiments.

Suggested Books

1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

4. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Semester V

S5016: Physics-V **Credit(s): 4**

Quantum Mechanics

Particles and Waves: Inadequacies in Classical Physics. Blackbody Radiation: Quantum Theory of Light. Photoelectric Effect. Compton Effect. Franck-Hertz experiment. Wave Nature of Matter: De Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave description of Particles by Wave Packets. Group and Phase Velocities and Relation between them. Two- Slit Experiment with Electrons. Probability. Wave Amplitude and Wave Functions. Heisenberg's Uncertainty Principle (Uncertainty Relations involving Canonical Pair of Variables): Derivation from Wave Packets. γ-ray Microscope.

Basic Postulates and Formalism: Energy, Momentum and Hamiltonian Operators. Time-independent Schrodinger Wave Equation for Stationary States. Properties of Wave Function. Interpretation of Wave Function. Probability Density and Probability. Conditions for Physical

Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Expectation Values. Wave Function of a Free Particle.

Applications of Schrödinger Wave Equation:

Eigen Functions and Eigenvalues for a Particle in a One Dimensional Box.

Bound State Problems: General Features of a Bound Particle System, (1) One Dimensional Simple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy, (2) Quantum Theory of Hydrogen Atom : Particle in a Spherically Symmetric Potential. Schrodinger Equation. Separation of Variables. Radial Solutions and Principal Quantum. Number, Orbital and Magnetic Quantum Numbers.

Problems in One Dimension: (1) Finite Potential Step: Reflection and Transmission. Stationary Solutions. Probability Current. Attractive and Repulsive Potential Barriers. (2) Quantum Phenomenon of Tunneling: Tunnel Effect. Tunnel Diode (Qualitative Description). (3) Finite Potential Well (Square Well).

Electronics: Solid State Electronic Devices

Circuit Analysis: Kirchhoff's Laws, Mesh and Node Analysis of dc and ac Circuits, Duality in Networks. Network Theorems. Norton's Theorem. Thevenin's Theorem. Equivalent Star (T) and delta (π) Networks of a Given Network, Star to Delta and Delta to Star Conversion. Wheatstone Bridge and its Applications to Wein Bridge and Anderson Bridge.

Semiconductor Diodes: p and n Type Semiconductors. Energy Level Diagram. Conductivity and Mobility. pn Junction Fabrication (Simple Idea). Barrier Formation in pn Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode (Recombination, Drift and Saturation of Drift Velocity). Derivation of Mathematical Equations for Barrier Potential, Barrier Width and Current for Step Junction. pn junction and its characteristics. Static and Dynamic Resistance. Diode Equivalent Circuit. Ideal Diode. Load Line Analysis of Diodes. Load Line and Q-point.

Two-terminal Devices and their Applications: (1) Rectifier Diode. Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency. Qualitative idea of C, L and π - Filters. (2) Zener Diode and Voltage Regulation. (3) Photo Diode, (4) Tunnel Diode, (5) LED (6) Varactor Diode.

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α, β and γ and Relations between them. Load Line Analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff, and Saturation Regions. Transistor in Active Region and Equivalent Circuit.

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Resistance, Voltage and Power Gains. Class A, B, and C Amplifiers.

Coupled Amplifiers: RC-Coupled Amplifier and its Frequency Response of Voltage Gain.

Feedback in Amplifiers, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance and Gain, Stability, Distortion and Noise.

Sinusoidal Oscillators: Barkhauson's Criterion for Self-sustained Oscillations. RC Phase Shift Oscillator, Determination of Frequency. Hartley Oscillator. Colpitts Oscillator.

Non-Sinusoidal Oscillators – Astable and Monostable Multivibrators.

Modulation and Demodulation: Types of Modulation. Amplitude Modulation. Modulation Index. Analysis of Amplitude Modulated Wave. Sideband Frequencies in AM Wave. CE Amplitude Modulator. Demodulation of AM Wave using Diode Detector. Idea of Frequency, Phase, and Digital Modulation.

Suggested Books

1. L. I. Schiff, Quantum Mechanics, 3rd edition, (McGraw Hill Book Co., New York 1968).
2. E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)
3. J. L. Powell & B. Crasemann, Quantum Mechanics, (Addison-Wesley Pubs.Co.,1965)
4. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India , 2004)
5. E. M. Lifshitz and L. D. Landau, Quantum Mechanics: Non-Relativistic Theory (Course of Theoretical Physics, Vol 3), 3rd Edition, Butterworth-Heinemann (1981).
6. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India, 2004)
7. Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 8Th Edition, Pearson Education, India, 2004.
8. A. P. Malvino, Electronic Principals, Glencoe, 1993.
9. Allen Mottershead, Electronic Circuits and Devices, PHI, 1997.

S5017: Physics Lab- V **Credit(s): 1**

1: Experiments for Determination of Fundamental Constants

(1) To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode.

(2) To determine the value of Planck's Constant using a Photoelectric Cell.

(3) To determine the value of Planck's Constant using LEDs of at least 4 Different Wavelengths.

2: Experiments on Atomic & Molecular Physics

(1) To determine the value of e/m by (a) Magnetic Focussing or (b) Bar Magnet to determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.

(2) To determine the Wavelength of H-alpha Emission Line of Hydrogen Atom.

(3) To determine the Absorption Lines in the Rotational Spectrum of Iodine Vapour.

3: Miscellaneous

(1) To determine the Wavelength and the Angular Spread of a He-Ne Laser.

(2) To determine the value of Stefan's Constant.

Note: Each Student is required to perform at least 6 experiments.

Suggested Books

1. Geeta Sanon, B. Sc. Practical Physics, 1st Edn. (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

4. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Semester VI

S6016: Physics- VI **Credit(s): 4**

Nuclear & Particle Physics

Structure of nuclei: Basic Properties of Nuclei: (1) Mass, (2) Radii, (3) Charge, (4) Angular Momentum, (5) Spin, (5) Magnetic Moment (μ), (6) Stability and (7) Binding Energy.

Radioactivity: Law of Radioactive Decay. Half-life, Theory of Successive Radioactive Transformations. Radioactive Series, Binding Energy, Mass Formula.

α-decay: Range of α-particles, Geiger-Nuttal law and α-particle Spectra. Gamow Theory of Alpha Decay.

β-decay: Energy Spectra and Neutrino Hypothesis.

γ-decay: Origin of γ-rays, Nuclear Isomerism and Internal Conversion.

Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct

Reaction. Compound Nucleus. Scattering Problem in One Dimension : Reflection and Transmission by a Finite Potential Step. Stationary Solutions, Attractive and Repulsive Potential Barriers. Scattering Cross-section. Reaction Rate. Q-value of Reaction. Fission and Fusion.

Nuclear Models: Liquid Drop Model. Mass formula. Shell Model. Meson Theory of Nuclear Forces and Discovery of Pion.

Accelerators: Van de Graaff Generator, Linear Accelerator, Cyclotron, Betatron and Light and Heavy Ion Synchro-Cyclotron. Idea of Large Hadron Collider.

Detectors of Nuclear Radiations: Interaction of Energetic particles with matter. Ionization chamber. GM Counter. Cloud Chambers. Wilson Cloud Chamber. Bubble Chamber. Scintillation Detectors. Semiconductor Detectors (Qualitative Discussion Only). An Idea about Detectors used in Large Hadron Collider.

Elementary Particles (Qualitative Discussion Only): Fundamental Interactions. Classification of Elementary Particles. Particles and Antiparticles. Baryons, Hyperons, Leptons, and Mesons. Elementary Particle Quantum Numbers : Baryon Number, Lepton Number, Strangeness, Electric Charge, Hypercharge and Isospin.

Elective from the list prescribed

Suggested Books

1. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

2. Bernard L. Cohen, Concepts of Nuclear Physics, Tata Mcgraw Hill (1998).

3. R.A. Dunlap, Introduction to the Physics of Nuclei and Particles, Singapore: Thomson Asia (2004).

4. Irving Kaplan, Nuclear physics, Oxford & IBH, 1962.

5. Kenneth S. Krane, Introductory Nuclear Physics, John Wiley & Sons, 1988.

Elective Papers

One has to choose one of the following four elective papers

S6016 (Elective 1): Computational Physics

Exercises to understand any five of the following problems:

(i) Solving differential equations
(ii) Evaluating integrals
(iii) Stochastic methods, especially Monte Carlo methods
(iv) Specialized partial differential equation methods, for example the finite difference method and the finite element method
(v) The matrix eigen value problem – the problem of finding eigen values of very large matrices, and their corresponding eigenvectors (eigen states in quantum physics).
(vi) Understanding Molecular dynamics by computational means.
(vii) Understanding Computational fluid dynamics
(viii) Understanding Computational Magneto-hydrodynamics

Suggested Books

1. Andi Klein and Alexander Godunov, Introductory Computational Physics **(2006)**

2. Rubin H. Landau, José Páez and Cristian C. Bordeianu and A Survey of Computational Physics: Introductory Computational Science.

S6016 (Elective 2): Digital Electronics

Analog Circuits: Integrated Circuits (Qualitative Treatment only): Active and Passive components. Discrete Circuit Component. Wafer. Chip. Advantages and Drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (Basic Idea and Definitions Only). Classification of ICs. Fabrication of Components on Monolithic ICs. Examples of Linear and Digital ICs.

Operational Amplifiers (Use Black Box approach): Basic Characteristics of Op-Amps. Characteristics of an Ideal Op-Amp. Feedback in Amplifiers . Open-loop and Closed-loop Gain. Frequency Response. CMRR. Virtual ground.

Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Unity follower, (5) Differentiator, (6) Integrator, (7) Zero Crossing Detector.

Timers (Use Black Box approach): 555 Timer and its Applications: Astable and Monostable Multivibrator.

Digital Circuits: Difference Between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND AND NOR Gates. Exclusive OR and Exclusive NOR Gates.

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Data processing circuits: Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders, Parity Checkers.

Memories: Read-only memories (ROM), PROM, EPROM.

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement Method).

Half Adders and Full Adders and Subtractors (only up to Eight Bits).

Sequential Circuits: RS, D, and JK Flip-Flops. Level Clocked and Edge Triggered Flip-Flops.

Preset and Clear Operations. Race-around Conditions in JK Flip-Flops. Master-Slave JK Flip-

Flop (As Building Block of Sequential Circuits).

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out, and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Counters: Asynchronous and Synchronous Counters. Ring Counters. Decade Counter. D/A and A/D conversion: D/A converter – Resistive network. Accuracy and Resolution.

Suggested Books

1. D. P. Leach & A. P. Malvino, Digital principles and applications, (Glencoe, 1995).

2. Thomas L. Floyd, Digital Fundamentals, 3rd Edition, Universal Book Stall, India, 1998.

3. Robert F Coughlin and Frederick F Driscoll Operational Amplifiers and Linear Integrated Circuits, 4th Edition, PHI, 1992.

4. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson, 2000.

S6016 (Elective 3): Statistical Mechanics

Classical Statistics: Entropy and Thermodynamic Probability. Maxwell-Boltzmann Distribution Law. Ensemble Concept. Partition Function. Thermodynamic Functions of Finite Number of Energy Levels. Negative Temperature. Thermodynamic Functions of an Ideal Gas. Classical Entropy Expression, Gibbs Paradox. Law of Equipartition of Energy – Applications to Specific Heat and its Limitations.

Classical Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure Temperature Dependence. Kirchhoff's Law. Stefan-Boltzmann Law and Wien's Displacement law. Saha's Ionization Formula.

Quantum Theory of Radiation

Radiation: Stefan-Boltzmann Law: Thermodynamic Proof. Radiation Pressure. Spectral Distribution of Black Body Radiation. Wien's Distribution Law and Displacement Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation : Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law and (4) Wien's Displacement Law from Planck's Law.

Bose-Einstein Statistics: B-E distribution law. Thermodynamic functions of a Completely Degenerate Bose Gas. Bose-Einstein condensation, properties of liquid He (qualitative description). Radiation as photon gas. Bose's derivation of Planck's law.

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law. Thermodynamic functions of an ideal Completely Degenerate Fermi Gas. Fermi Energy. Electron gas in a Metal. Specific Heat of Metals. Chandrashekhar Limit of mass and White Dwarfs.

Suggested Books

1. F Reif, Statistical Physics: Berkeley Physics Course, McGraw-Hill, Company Ltd, 2008)

2. S.Lokanathan and R .S. Gambhir, Statistical and Thermal Physics: An introduction PHI.

3. K. Huang, Statistical Mechanics, Wiley, 1987.

Elective 4: Atomic and Molecular Spectroscopy

Determination of e/m of the Electron. Thermionic Emission. Isotopes and Isobars.

Introduction to Spectroscopy: X-rays: Ionizing Power, X-ray Diffraction, Bragg's Law. Bohr Atomic Model, Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley Law.

Atoms in Electric and Magnetic Fields: Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Many electron atoms: Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Molecular Spectra: Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Vibrational Energy Levels, Selection Rules and Vibration Spectra. Rotation-Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra. Determination of Internuclear Distance.

Raman Effect: Quantum Theory of Raman Effect. Characteristics of Raman Lines. Stoke's and Anti-Stoke's Lines. Complimentary Character of Raman and infrared Spectra.

LASER: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

Suggested Books

1. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

2. J. B. Rajam (with foreword by Louis de Broglie) Atomic physics, S. Chand & Co., 2007.

3. Ghatak and Thyagarajan, Optoelectronics, Oxford University Press.

S6017: Physics Lab VI **Credit(s): 1**

1: Experiments on Nuclear Detectors

(1) To study GM characteristics and determine slope of the plateau of GM tube.

(2) To study random behaviour of nuclear phenomena.

(3) To determine the attenuation coefficient using Gama radiations.

2: Combinational Logic

(1) To verify and design AND, OR, NOT and XOR gates using NAND gates.

(2) To design a combinational logic system for a specified Truth Table.

(3) To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.

(4) To minimize a given Logic Circuit.

3: Multivibrators and Sweep Circuits

(1) To study the characteristics of a UJT and design a simple Relaxation Oscillator.

(2) To design an Astable Multivibrator of given specifications using 555 Timer.

(3) To design a Monostable Multivibrator of given specifications using 555 Timer and to measure the Pulse-Width of its output.

(4) To design a Sweep of given Amplitude and Time.

2: Modulation

(1) To study Amplitude Modulation using Transistor.

(2) To study Pulse Width / Pulse Position and Pulse Amplitude Modulation using ICs.

Note

- Each student is required to perform at least 8 experiments.

Statistics

Objectives of the Course

This course is designed to provide the science student a intense foundational introduction to the fundamental concepts in Statistics. The course continues the introduction to the student started in Statistics to many branches of Sceinces and concentrates on pertinent and concrete examples and applications. After completing the course the student should be able to work basic problem and word problems in probability, and statistics.

It is imperative to know the importance and scope of the discipline, to inculcate interest in statistics to impart knowledge of science as the basic objective of Education, to develop a scientific attitude to make students open minded, to develop an ability to work on their own and to make them fit for the society, to expose themselves to the diversity amongst life forms, to develop skill in practical analysis along with collection and interpretation of statistical materials and data, to develop an ability for the application of the acquired knowledge in the fields of statistics so as to make our country self reliant and self sufficient and to make them able to appreciate and apply ethical principles to statistical research and studies.The science/ mathematics/ engineering/ business student should have mastered and demonstrated the following quantitative skills after completing Statistics

Statistics

Semester –I		
Course Code	**Title**	**Credits**
S1019	**Statistics-I**	4
S1020	**Statistical Lab-I**	1
	Total	**5**
Semester –II		
S2019	**Statistics-II**	4
S2020	**Statistical Lab-II**	1
	Total	**5**
Semester –III		
S3019	**Statistics-III**	4
S3020	**Statistical Lab-III**	1
	Total	**5**
Semester –IV		
S4019	**Statistics-IV**	4
S4020	**Statistical Lab-IV**	1
	Total	**5**
Semester -V		
S5019	**Statistics-V**	4
S5020	**Statistical Lab-V**	1
	Total	**5**
Semester -VI		
S6019	**Statistics-VI**	4
S6020	**Statistical Lab-VI**	1
	Total	5

SEMESTER- I

S1019: Statistics-I **Credit(s): 4**

Types of data: Discrete and continuous data, Frequency and non-frequency data, Different types of scales, Primary data (designing a questionnaire and schedule), Secondary data (major sources including some government publication). Statistical Methods: Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data.

Presentation of data by table and by diagrams, Construction of tables (with one or more factors), diagrammatic and graphical representation of grouped data, frequency and cumulative frequency distribution and their applications, histogram, frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogive. Bivariate data-scatter diagram,

Concept of central tendency and its measures, partition values, dispersion and relative dispersion, moments, absolute moments and factorial moments Sheppard's correction for moments (without derivation), skewness, kurtosis and their measures.

Definition of probability, classical and relative frequency approach to probability, axiomatic approach to probability and its properties, merits and demerits of these approaches, total and compound probability, conditional probability theorems, independence of events, Bayes theorem and its applications. Random experiment: Trial, sample point, sample space, definitions of equally likely, mutually exclusive and exhaustive events,

Continuous random variable: Probability density function, distribution function, joint density function of two continuous variables, marginal and conditional probability density functions.

Discrete and continuous distributions: Uniform, binomial, Poisson, geometric, negative Binomial, hypergeometric, normal, beta, gamma, bivariate and Normal distributions.

S1020: STATISTICAL LAB-I **Credit(s): 01**

Practical-:
comprising the following two parts:
Part A: Based on Papers STH 101
Part B: Introduction to Computer fundamentals and Electronic Spread sheet.

SEMESTER- II

S2019: Statistics-II **Credit(s): 4**

DESCRIPTIVE STATISTICS

Bivariate data: Scatter diagram, product moment correlation coefficient and its properties, coefficient of determination, correlation ratio, interclass correlation, concept of error in regression, principle of least square, fitting of linear regression and related results, rank correlation. Partial and multiple correlation in three variables, their measures and related results. Theory of attributes: Independence and Association of attributes, various measures of association for two way and three way classified data.

DISTRIBUTION THEORY

Expectation of random variable and its properties, conditional expectation, moment in terms of expectation, moment generating function of a random variable, their properties and uses, probability generating function, Tchebycheff's inequality and its applications, convergence in probability and in distribution.

Discrete and continuous probability distributions and their properties including degenerate distribution. Standard discrete and continuous distributions: Uniform, binomial, Poisson, geometric, negative Binomial, hypergeometric, beta, gamma, bivariate Normal distributions.

Suggested Books

1. Goon A.M., Gupta A.K. and Das Gupta B. (1999): Fundamental of Statistics, Vol. I, World Press, Calcutta.
2. Mood A.M., Greybill, F.A. and Bose D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
3. Hogg R.V. and Craig A.T. (1972): Introduction to Mathematical Statistics, Amerind Publishing Co.
4. Mukhopadhyay, P. (1996): Mathematical Statistics, New Central Book Agency.
5. Rohtagi V.K. (1967) : An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
6. Hoel P.G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.

S2020: STATISTICS LAB-II **Credit(s) : 01**

Practical-II:

Based on Papers **S2019**

SEMESTER- III

S3019: Statistics-III **Credits: 4**

STATISTICAL INFERENCE

Concept of random sample from a distribution, statistic and its sampling distribution, standard error of an estimate, standard errors of sample mean and proportion, sampling distribution of sum of Binomial, Poisson random variables and mean of normal distribution, requirement of a good estimator with examples. Simple, composite null and alternative hypotheses, critical region, types of error, level of significance, p-values, size and power of a test, chi-square, t and f distributions and their properties (without proof), testing of equality of two means and two variances of two normal distributions, testing for the significance of sample correlation coefficient and testing the equality of means and variances of bivariate normal distributions.

STATISTICAL INFERENCE

Statement of weak law of large number and central limit theorem, use of central limit theorem for testing a single mean, single proportion equality of two means and two proportions, Fisher's Z transformation and its uses, Pearson's chi-square test for goodness of fit, test of independence of two attributes. Definition of order statistics and their distributions, sign test, run test, median test, Spearmen's rank correlation test, Wilcoxon-Mann Whitney test, Kolmogorov, Smirnov one sample and two sample tests.

Suggested Books

1. Mood A.M., Greybill F.A. and Bose D.C. (1974) : Introduction to the Theory of Statistics, McGraw Hill.
2. Freund J.E. (2001) : Mathematical Statistics, Prentice hall of India.
3. Goom A.M., Gupta M.K. and Das Gupta B. (1991) : Fundamental of Statistics, Vol. I, World press, Calcutta.
4. Rohtagi V.K. (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
5. Rao C.R. (1973) : Linear Statistical Inference and its Applications, Revised edition, Weley Eastern, 183.
6. Hoges J.L. and Lehmann E.L. (1964): Basic Concepts of Probability and Statistics, Holden Day.
7. Snedecor G.W. and Cochran W.G. (1967) : Statistical Methods, Iowa State University Press.

S3020: STATISTICS LAB-III **Credits: 01**

Practical III:
Based on Papers **S3019**

SEMESTER- IV

S4019: Statistics-IV **Credits: 4**

SAMPLE SURVEYS

Concept of population and sample, need for sampling, complete enumeration versus sampling, Basic concepts in sampling, sampling and Non-sampling errors, Acquaintance with the working (questionnaires, sampling design, methods followed in field investigation, principal findings, etc.) of NSSO and other agencies under taking sample surveys.

Simple random sampling with and without replacement, estimation of population mean, population proportions and their standard errors. Stratified random sampling, proportional and optimum allocation, comparison with simple random sampling for fixed sample size.

Ratio, product and regression methods of estimation, estimation of population mean, evaluation of bias and variance to the first order of approximation, comparison with simple random sampling.

Systematic sampling (when population size (N) is an integer multiple of sampling size (n)).

Estimation of population mean and standard error of this estimate, comparison with simple random sampling. Elementary idea of cluster sampling.

DESIGN OF EXPERIMENTS

Analysis of variance for one way and two way classifications, need for design of experiments, basic principle of experimental design: randomization, replication and local control, complete analysis and

layout of completely randomized design, randomized block design and Latin square design.

Factorial experiments and their advantages, main and interaction effects in 2^2 and 2^3 factorial experiments.

Suggested Books

1. Cochran W.G. (1977) :Sampling Techniques, John Wiley and Sons, New York.
2. Sukhtme P.V., Sukhatme B.V., Sukhatme S. and Asok C. (1984) : Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1986) : Fundamentals of Statistics, Vol. II, world Press, Calcutta.
4. Sampath S. (2000) : Sampling Theory and Methods, Narosa Publishing House, New Delhi.
5. Des Raj (2000) : Sample Survey Theory, Narosa Publishing House, New Delhi.
6. Murthy M.N. (1967) : Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
7. Kish L (1965): Survey Sampling, John Wiley and Sons, New York.
8. Hansen M.H., Hurwitz W.N. and Madow W.G. (1975) : Sample Survey Method and Theory, Vol. I, Methods and Applications, Vol. II, New York and London, Wiley Publication.
9. Cochran W.G. and Cox G.M. (1957) : Experimental Design, John Wiley and Sons.
10. Das, M.N. and Giri J. (1986) : Design and Analysis of Experiments, Springer Verlag.

11. Kempthorne O. (1965): The Design and Analysis of Experiments, Wiley Eastern.

S4020: STATISTICS LAB-IV **Credit(s) : 01**

Practical IV:
Based on Papers **S4019**

SEMESTER- V

S5019: Statistics-V **Credits: 4**

APPLIED STATISTICS

Demographic Methods: Sources of demographic data, census, registration, ad hoc surveys, hospital records, demographic profiles of the Indian census.
Measurement of Mortality and Life Table: Crude death rate, Standardized death rates, Age-specific death rates, Infant Mortality rate, Death rate by cause, Complete life table and its main features, Uses of life table.
Measurement of Fertility: Crude birth rate, general fertility rate, age specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate.
Index Numbers: Price relatives and quantity or volume relatives, Link and chain relatives composition of index numbers; Laspeyre's, Paasche's, Marshal Edgeworth's and Fisher's index numbers; chain base index number, tests for index number, cost of living index number.

Time Series Analysis: Economic time series, different components, illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.
Statistical process and product control: Quality of a product, need for quality control, basic concept of
process control, process capability and product control, general theory of control charts, causes of variation in quality, control limits, sub grouping summary of out of control criteria. Charts for attributes: p chart, np chart, c-chart, V chart. Charts for variables: R, (X, R), (X, σ) charts.

Suggested Books

1. Mukhopadhyay, P. (1994) :Applied Statistics, new Central Book Agency Pvt. Ltd., Calcutta.
2. Srivastava O.S. (1983) : A Text Book of Demography, Vikas Publishing House, new Delhi.
3. Benjamin B. (1959): Health and Vital Statistics, Allen and Unuwin.
4. Goon A.M., Gupta M.K. and Das Gupta B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
5. Duncan A.J. (1974) : Quality Control and Industrial Statistics, IV Edision, Taraporewala and Sons.
6. Montomery, D.C. (1991): Introduction to the Statistical Quality Control, IInd Editions, John Wiley and Sons.
7. Brown R.G. (1963): Smoothing, Forecasting and Prediction of Discrete Time Series, Prentice

Hall.
8. Chatfield C. (1980) : The Analysis of Time Series, IInd Edision Chapman and Hall.

S5020: **STATISTICS LAB-V** **Credits: 01**

Practical V:
Based on Papers **S5019**

SEMESTER- VI

S6019: Statistics-VI **Credits: 4**

DEMAND ANALYSIS, ANALYSIS OF INCOME DISTRIBUTION AND QUEUING THEORY

Theory and analysis of consumer's demand, law of demand, price elasticity of demand, estimation of demand curves, forms of demand functions, Engel's curve, income elasticity of demand.
Analysis of income and allied distributions: Pareto distribution, graphical test, fitting of Pareto law, illustration, lognormal distribution and properties, Lorenz curve, Gini's coefficient.
Elements of queuing theory, characteristics of queues, Poisson process, distribution of inter-arrival time, definition of steady state condition, (M/M/1) : (∞ / FIFO) and (M/M/1) : (N/ FIFO models, birth and death process, (M/M/K): (∞ / FIFO) and (M/M/K) : (N / FIFO) models.
Finite and infinite length models with associated distribution of queue length and waiting time, steady – state solutions of (M/Ek / 1) and (Ek / 1) queues, machine interface problem.

ELEMENTS OF STOCHASTIC PROCESSES
Definition and examples of stochastic process: classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces, types of stochastic processes elementary problems, random walk, gambler's ruin problem.
Markov chains: Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems, basic limit theorem of Markov Chain (statement only):, stationary probability distribution, applications.
Continuous time Markov Chain: Poisson process and related inter-arrival time distribution, pure birth process, pure death process, birth and death process, problems.
Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction problems.

Suggested Books

1. Karlin S. and Taylor H.M. (1995): A First Course in Stochastic Process, Academic Press
2. Hoel P.G., Port S.C. and Stone C.J. (1991): Introduction to Stochastic Process, Universal Book Stall.

3. Parzen E. (1962): Stochastic Process, Holden-Day
4. Cinlar E. (1975): Introduction to Stochastic Processes, Prentice Hall.
5. Adke S. R. and Manjunath S. M. (1984): An Introduction to Finite Markov Processes, Wiley Eastern.
6. Medli J. (1996): Stochastic Processes, new Age International (P) Ltd.
7. Ross S. M. (1983): Stochastic Process, John Wiley.
8. Taylor H. M. and Karlin S. (1999): Stochastic Modeling, Academic Press.

S6020: STATISTICS LAB-VI **Credits: 01**

Practical VI:
Based on Papers **S6019**

Zoology

Objectives of the Course

The undergraduate curriculum in zoology is designed to equip the scholars in life sciences with in-depth knowledge and practical skills in various aspects of animal biology. The curriculum endeavors' to prepare students in a wide range of science-based skills that provide the learning base for future careers in disciplines such as health sciences, agriculture, environmental management, the emerging biotechnologies, publishing, teaching, research and consultancy. Zoology is the study of Animal Biology in all its aspects, from cells to populations and from neurons to behaviour. In this course the student will gain an in-depth study of various invertebrate and vertebrate specimens. The purpose of this course is to acquaint students with the identification, systematics, life history, anatomy, and adaptive strategies of the vertebrates and to expose them to field techniques used in their study.

Zoology

Semester –I		
Course Code	**Title**	**Credits**
S1022	**Animal Diversity (Non Chordates)**	4
S1023	Practical Lab-I	1
	Total	**5**
Semester –II		
S2022	**Molecular Biology and Genetics**	4
S2023	Practical Lab-II	1
	Total	**5**
Semester –III		
S3022	**Biology of Chordates**	4
S3023	Practical Lab-III	1
	Total	**5**
Semester –IV		
S4022	**Developmental Biology, Immunology and Evolution**	4
S4023	Practical Lab-IV	1
	Total	**5**
Semester -V		
S5022	**Ecology, Ethology and Biostatistics**	4
S5023	Practical Lab-V	1
	Total	**5**
Semester -VI		
S6022	**Animal Physiology and Biochemistry**	4
S6023	Practical Lab-VI	1
	Total	5

SEMESTER-I

S1022: Animal Diversity (Non Chordates) **CREDIT(S)-4**

Animal Diversity (Non chordates)

Taxonomy and classification: General principles of taxonomy - Binomial nomenclature, - Trinomial nomenclature, Rules of nomenclature**,** Concept of Five kingdom, concept of protozoa, metazoan and levels of organization. Basis of Classification: symmetry, coelom, segmentation and embryology.

Protozoa: General characters and Outline Classification upto class, Locomotion, Economic importance.

Porifera: General characters and Outline Classification upto class, Economic importance, canal system of sponges.

Coelenterata: General characters and Outline Classification upto class, Coral and coral reefs.

Ctenophora: General characters and Outline Classification upto class.

Platyhelminthes: General characters and Outline Classification upto class, parasitic adaptations

Aschelminthes: General characters and Outline Classification upto class.

Annelida: General characters and Outline Classification upto class, vermiculture (outline).

Onychophora- Peripatus (salient features) and as connecting link.

Arthropoda: General characters and Outline Classification upto class, Metamorphosis in insects, General introduction about Apiculture, Sericulture.

Mollusca: General characters and Outline Classification upto class, General introduction about Pearl culture.

Echinodermata: General characters and Outline Classification upto class, Water vascular system of star fish.

Hemichordata: Classification (upto class) and Habit, habitat, distribution and General characters.

Suggested books

- R.L.Kotpal :Modern text book of biology – Invertebrate –(Rastogi Publication, Meerut).
- Jordan, E. L. : Invertebrate Zoology (S. Chand Co. New Delhi.).
- Dhami and Dhami : Invertebrate Zoology (S. Chand & Co. New Delhi).
- Shrivastava, : Economic Zoology. (Commercial Pub.brue,N.Delhi).
- Vishwapremi K.K., : Economic Zoology (Akashdeep Pub.House,New Delhi).
- V.P.Agrawal and L. D.Chaturvedi: A text book of Invertebrate Zoology –(Jagmander Book Agency, New Delhi).

S1023: Laboratory Exercises **Credit(s)-1**

Organization and working of optical microscope, compound and dissecting,

1. Method of preparation of permanent slides.
2. Study of museum specimens and Permanent Slides:
    - ***Protozoa****: W.M. of Amoeba, Euglena, Balantidium, Elphidium, Opalina, Nyctotherus,Vorticella; Paramecium: binary fission, conjugation*
    - ***Porifera****: Leucosolenia,Euplectella.*
    - ***Coelentrata****: Hydra w.m., Obelia colony, Obelia Medusa,Vellela, Alcyonium, Metridium, Gorgonia, Physalia, Penatulla,Aureli.*
    - ***Platyhelminthes****: Taenia, Scolex of Taenia, Planaria w.m.*
    - ***Aschelhelminthes*** *: Ascaris, Dracunculus.*
    - ***Annelida****: Neanthes, Heteronereis, Aphrodite, Arenicola,Pontobdella,*
    - ***Arthropoda****: Limulus, Spider, Scorpion, Centipede, Millipede, Lepas, Balanus, Squilla, Eupagurus, Crab, Mantis, Locust, moth, Beetle, Pediculus w.m., Bedbug w.m., Termite w.m., Cyclops w.m.*
    - ***Onychophora*** *: Peripatus.*
    - ***Mollusca****: Chiton, Aplysia, Cypraea, Mytilus, Pearl oyster, Dentalium, Loligo, Nautilus.*
    - ***Echinodermata****: Pentaceros, Echinus, Ophiothrix, Antedon.*
    - ***Hemichordata*** *: Balanoglossus*
3. Larval forms of invertebrates-Taenia (cysticerus), Fasiola (miracidium, radia, cercaria, sporocyst). Crustacean larva (megalopa larva, nauplius larva, zoea larva), Unio (glochidium larva).
4. Life cycles of selected invertebrates- Honeybee, silk worm.
5. Permanent preparation of study materials- Hydra, Obelia colony, sponge-fibre, spicules, gemmules, Nereis parapodia.
6. Study of parasitic (ectoparasites and endoparasites) invertebrates.
7. Preparation of culture of Paramecium/ Tribolium.

SEMESTER II

S2022: Molecular Biology and Genetics **Credit(s)-4**

Genetic Material: Nucleic acids- Identification of genetic material, Evidences that DNA is the genetic material, Evidences that RNA is the genetic material, DNA: structure, polymorphism.
DNA Replication (Prokaryotes and Eukaryotes): Experiments of Messelson and Stahl; Mechanism of replication, Enzymology of DNA replication (Enzymes and Proteins associated with DNA replication), Elementary idea about DNA repairs.

RNA– Central Dogma, Types of RNA (mRNA, rRNA, tRNA), Synthesis of RNA (Transcription in Prokaryote and Eukaryotes), RNA processing, RNA splicing.
Genetic Code – Essential features, Wobble hypothesis.

Protein synthesis –Translation in Prokaryotes and Eukaryotes.

Heredity: Mendel and his work, Laws of Inheritance,
Gene interaction (Intragenic and Intergenic interaction)
Multiple allelism
Sex- linked Inheritance

Gene– Concept, types and functions of gene.
Regulation of gene expression: Inducible system; Lac operon, Repressible sysem; Tryptophan.
Cytoplasmic inheritance in animals
Mutations, Eugenics, Genetic counseling, Euthenics, Euphenics

Suggested books

- De Roberties, E.D.P.and De Roberties, E.M.F.: Cell and Molecular Biology, B.I. Publications Pvt. Ltd. Lippincott Williams and Wilkins.
- Karp, G.: Cell and Molecular Biology Concepts and Experiments, John Wiley and Sons.
- Lodish, H, Matsudaira, P. and Darnell, J. Molecular cell biology, W.H. Freeman and company.
- Gardner : genetics
- Rastogi V.B.: Genetics
- Freifelder, D. Essential of Molecular biology, Narosa Publishing House.
- Rajan, S.S. Introduction of molecular biology, Anmol Publications Pvt. New Delhi.
- Rastogi, S.C. Cell biology, New age international (P) Ltd, Publishers.

S2023: Laboratory Exercises **Credit(s): 1**

1. Study of mitotic cell division.
2. Study of meiotic cell division.
3. Cytological preparation of mitotic stages from onion root tip.
4. Cytological preparation of meiotic stages from grasshopper testes.
5. Study of gaint chromosomes in salivary glands of Chironomous larva of *Drosophila*.
6. Study of Barr body for identification of Gender in Human.
7. Identification of male and female drosophila.
8. Study of life-cycle of drosophila.
9. Identification of wild and mutants (yellow body, ebony, vestigial wings, and white eye)
10. Study of permanent prepared slides: Sex comb, Salivary gland chromosomes.
11. Human pedigree analysis (theoretical fundamental and exercises).

SEMESTER-III

S3022: Biology of Chordates **CREDIT(S): 4**

Protochordata: Classification upto order, General characters,
Ascidia: retrogressive metamorphosis, salient features of Amphioxus.
Agnatha: Classification upto order, General characters,
Salient features: Petromyzon, Ammocoet larva.
Gnathostomata: Classification upto order, General characters, Salient features of Ostracoderm.
Pisces: Migration in fishes, Adaptive radiation in fishes, Pisciculture, Parental care
Salient features: Dipnoi (Lung fishes), Scoliodon.
Amphibia: Classification upto order, General characters, Adaptive radiation in Amphibian, Neoteny, Parental care.
Reptilia: Classification upto order, General characters, Poisonous and non-poisonous snakes, poison apparatus.
Aves: Classification upto order, General characters, Flight adaptation and Migration in birds, Perching mechanism; feather and its development.
Mammals: Classification upto order, General characters, Dentition, hair and its development.

Suggested books

- R.L.Kotpal :Modern text book of biology –Vertebrate –(Rastogi Publication, Meerut).
- Young, J.Z. : Life of Vertebrate.(E L B S) 1983.Oxford.
- Dalela, R.C. : A text book of Chordate Zoology, (Jai Prakash Nath publications, Meerut.).
- Newman, H.H. : The phylum Chordate, (Satish Book Enterprise, Agra).
- Jordon, E.L. : Vertebate Zoology, (S.Chand and Co., New Delhi.).
- B.B. Waykar, A.Y. Mahajan, B.C.: More Animal Diversity. (Prashant Publication Jalgaon)
- G.P. Vani, P. M. Vyawahare.: Animal Diversity. (Prashant Publication Jalgaon)
- Gilbert : Development biology

S3023: Laboratory Exercises **Credit(s): 1**

Study of museum specimens and Permanent Slides: **Protochordates** - Amphioxus, *Amphioxus*: VLS Anterior region, T S passing through Oral Hood, TS passing through pharynx and gonads, through caudal region.

Agnatha – Petromyzon.

Pisces - Hippocampus, Rhacophorus, Zygaena, Torpedo, Chimaera, Acipenser. Amia, Clarias, Agnuilla, Exocoetus, Echeneis, Protopterus
Amphibians - Icthyophis, Proteus, Ambystoma; Axolotal, Alytes; Hyla, Frog: VS of skin.
Reptiles - Testudo; Chelone; and fresh water Tortoise; Sphenodon; Hemidactylus. Phrynosoma; Draco; Chameleon; Hydrophis; Viper; Crocodilus.
Aves – Archaeopteryx, V.S. skin of bird.
Mammals -Ornithorhynchus, Tachyglossus, Macropus, Bat, Loris; Manis. V.S. skin of mammal, T.S. of mammalian liver, Duodenum, pancreas, stomach, intestine, testes, ovary, kidney, spinal cord.

1. **Study of scales in fishes** : cycloid scales, ctenoid scales, Placoid scales.
2. **Anatomy :** General viscera, afferent and efferent branchial blood vessels, cranial nerves of Scoliodon
3. **Permanent preparations of the following:** Placoid scales; Herdmania spicules, Striped muscle fibers and blood film of any vertebrate.

Note:- Study of live animals should be done without paining them prefer studies of species which are easy to culture. Digital media can be used to study various characters of animal species.
Use of animals for dissection is subject to the conditions that these are not banned under the Wild life (Protection) Act

SEMESTER-IV

S4022: Developmental Biology, Immunology and Evolution **CREDIT(S): 4**

Animal development: Gametogenesis (Spermatogenesis and oogenesis - vitellogenesis), fertilization, cleavage and morulation, blastulation, gastrulation, fate map, morphogenetic movement, Significance of cleavage and gastrulation.
Parthenogenesis

Elementary idea about embryonic induction: primary organizer and competence.
Developmental stages of chick (upto 96 hours).
Elementary idea of stem cells, teratology, ageing, cloning, transgenic animals.

Immunology -Overview of immune system; types of immunity
Mechanism of humoral immunity, Immunity regulating cells : Macrophages, lymphocytes (B & T types), Plasma cells and memory cells.
Antigens: Properties of antigens, Haptens
Antibodies: Basic structure, classes and function,

Antigen-Antibody interaction: precipitation reaction, agglutination reaction, neutralization reaction, complement and lytic reaction and phagocytosis.

Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism or mutation theory.
Natural Selection, Genetic basis of evolution : Speciation, Isolation, Variation, Adaptations, Convergence and Divergence Adaptation. Mimicry.
Palaentology- fossils; geological division of earth crust; imperfection of the geological record, Continental drift.

Suggested Books

1. Gilbert, S.F. (2006) 8th edn. Developmental Biology, Sinauer Associates,Inc.
- Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
- Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing
- Ridley, M. : Evolution, Oxford University Press.
- Arora, M.P., Kanta, C. : Organic Evolution, Himalayan Publishing House.
- Rastogi, V.B.: Organic Evolution, Rastogi Publications, Meerut**.**
- Rastogi, V.B.: Development Biology

S4023: Laboratory Exercises **Credit(s): 1**

1. Study of development stages of frog: - egg, cleavage, blastula, gastrula, neurula (neural plate, neural fold, neural tube), tadpole larva, metamorphic stages of tadpole.
2. Study of development stages of chick - 18h, 24h, 33h, 48h, 72h , 96h of incubation.
3. Window making in shell of egg to study chick embryo.
4. Identification of blood groups in humans.
5. Determination of Rh factor in humans.
6. Study of cell permeability in mammalian RBC.
7. Study of evolution of Horse through various models.
8. Adaptive modification of feet/claws in birds.

SEMESTER-V

S5022: Ecology, Ethology and Biostatistics **CREDIT(S): 4**

Ecology, Ethology and Biostatistics
Basic concepts of ecology.
Biogeochemical cycles- O_2, CO_2, N, P, H_2O cycle and role of microbes.

Population Ecology: Density and methods of its measurement, natality, mortality, age and ratio distribution, biotic potential, dispersal and dispersion of population, population interactions and propagation, brief idea of demography.

Community Ecology: Characteristics of natural communities structure, composition, stratification, host-parasite interactions.
Ecological Succession: Types and patterns of succession, concept of climax (mono-, di-, polyclimax), ecotone and edge effect, niche.
Major biomes of the world. Ecological indicators.

Concepts of Ethology- Motivation, Fixed Action Patterns (FAP), Sign Stimulus; Innate Releasing Mechanism (IRM); Action Specific Energy (ASE); Learning; Imprinting.
Methods of Studying Behaviour : Studies in Laboratory- Neuroanatomical, Neurophysiological and Neurochemical techniques.
Brief account on Pheromones, Biological Clocks, Orientation.

Introduction: Definition, Functions, scope and application of biostatistics.
Frequency distribution: Collection and tabulation of data, Graphical presentation of frequency distribution- Bar diagram, Histogram, Frequency Polygon, smooth frequency curve, ogives, Pie charts.
Measures of Central Value: Average; Mean, Mode, Median. Mean and Standard Deviation.
Statistical Inference: test of significance of mean; Standard error of mean and standard deviation; student's 't' test , chi-square test.

Suggested Books

- Odum, E.P.: Fundamental of Ecology, W.B. Sunders, New Delhi.
- Odum, E.P.: Fundamental of Ecology, W.B. Sunders, New Delhi.
- Verma, P.S. and Agarwal, U.K.: Environmental Biology, S. Chand and co., New Delhi.
- Gupta, P.K.: Environmental Biology, Rastogi Publication, Meerut.
- Manning,A.: An introduction to Behaviour, Edward Arnold, London.
- Mathur, R.: Animal Behaviour, Rastogi Publications, Meerut.
- Wallace, R.A.: Animal Behaviour, Goodyear Publishing Co., 18, Grazimek Encyclopedia of Ethology.
- Bailey: Biostatistics
- Goon, A.K.M and Gupta, B.D.: Fundamental of Stastistics.
- Gupta, S.P.: Biostatistics.

S5023: Laboratory Exercises **Credit(s): 1**

Water analysis: alkalinity, acidity, dissolved oxygen, B.O.D. (Biological oxygen demand),free carbon dioxide,

1. **Soil analysis :** moisture content, water holding capacity, carbonate and bicarbonate
2. Behavior of Paramecium/ Zoo-planktons (Thigmotrophism, thermotrophism, chemotrophism).

3. Study of any stored insect pest / Food preference in Tribolium.
4. Antennal grooming in Cockroach / Phototactic response in Earthworm or grain or pulse pests.
5. Listing of all animals found in and around your locality or A visit to a zoo/ national park / wildlife sanctuary.
6. Construction of Frequency table, Histogram, Polygon, Pie-chart.
7. Exercise on Mean (Arithmetic, Geometric, Harmonic), Mode & Median.

SEMESTER-VI

S6022: Animal Physiology and Biochemistry **CREDIT(S): 4**

Physiology of Digestion: Nature of food stuff, various types of digestive enzymes and their action in alimentary canal, hormonal control.
Physiology of Respiration: Mechanism of breathing: exchange of gases, transport of oxygen & carbon dioxide in blood**,** regulation of respiration**.**
Physiology of Circulation: Composition and function of blood, mechanism of blood clotting, heart beat, cardiac cycle, blood pressure, body temperature regulation and homeostasis.
Physiology of nerve impulse and Reflex Action: Functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission**,** reflex action and its control.
Physiology of muscle contraction: Functional architecture of skeletal muscles, chemical and biophysical events during contraction and relaxation of muscle fibre.
Physiology of Excretion : Nitrogenous excretory products, role of liver in formation of these end products, Functional architecture of a nephron, mechanism and regulation of urine formation.
Physiology of endocrine glands: Types of Endocrine glands, their secretion, functions and mechanism of action, disorders related to hypo and hyper secretion – pituitary, adrenal, thyroid, islet of langerhan's, gonads (testes & Ovary).
Preliminary idea of Neurosecretion, Hypothalamic control of Pituitary function, Neuroendocrine and endocrine mechanism of insects.
Structure, function and significance of Carbohydrates, Proteins and Lipid.
Carbohydrate Metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Oxidative Phosphorylation , electron transport chain, Regulation of metabolism
Protein Metabolism **:** Transamination, Deamination**,** Decaboxylation, fate of ammonia (Ornithine cycle).
Lipid Metabolism: β-oxidation of fatty acids.

Suggested books

- A Textbook of Animal Physiology; Berry, A.K.; Emkay Publisher, Delhi
- Text Book of Medical Physiology; Chatterjee, M.N and Shinde, R.; Jaypee brothers.
- Animal Physiology: adaptation and Environment, Schiemdt Neilsen. Cambridge

- Animal physiology and biochemistry, Dr. K.V. Sastry; rastogi publications, Meerut, India.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IVEdition. W.H Freeman and Co.
- Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill.
- Biochemistry, Berry, A.K. Emkey Pub. New Delhi.
- H.S. Srivastava, Element of Biochemistry, Rastogi Publications Meerut.
- Leninger, A.D. Principles of Biochemistry, CBS Publishers and Distributors, Shahdra, Delhi.
- Jain,J.L. Fundamentals of Biochemistry ,S.Chand publishers New Delhi.
- Murray, R.K.,Harper's Biochemisttry; Appleton and Lange , Norwalk, Connecticut

S6023: Laboratory Exercises **Credit(s): 1**

Study of blood count (theoretical fundamental).

1. Counting of red blood cells in given blood sample
2. Counting of white blood cells in given blood sample.
3. Differential count of W. B. Cs.
4. Estimation of haemoglobin content in given blood sample.
5. Estimation of haematocrit values in given blood sample.
6. Demonstration of enzyme activity (catalases) in microorganisms.
7. Study of salivary digestion.
8. Study of histological structure of major endocrine glands of mammals.
9. Qualitative estimation of carbohydrates in given samples.
10. Qualitative estimation of proteins in given samples.
11. Qualitative estimation of lipids in given samples.
12. Identification of different kinds of mono-, di- and polysaccharides in the given samples.
13. Paper chromatography.

B.Sc. Biotechnology

Semester – I		
Course Code	Title	Credits
S1025	Cell Biology	4
S1026	Practical Lab	1
S1027	Biological Macromolecules	4
S1028	Practical Lab	1
S1029	Microbiology	4
S1030	Practical Lab	1
	Total	15
Semester – II		
S2025	Metabolic Pathways	4
S2026	Practical Lab	1
S2027	Genetics	4
S2028	Practical Lab	1
S2029	Analytical Techniques	4
S2030	Practical Lab	1
	Total	15
Semester – III		

S3025	Introductory Immunology and Animal Tissue Culture	4
S3026	Practical Lab	1
S3027	r-DNA Technology	4
S3028	Practical Lab	1
S3029	Medical Biotechnology	4
S3030	Practical Lab	1
	Total	15
Semester – IV		
S4025	Molecular Biology	4
S4026	Practical Lab	1
S4027	Plant Biotechnology	4
S4028	Practical Lab	1
S4029	Industrial Biotechnology	4
S4030	Practical Lab	1
	Total	15
Semester – V		
S5025	Bio-Informatics and Biostatistics	4

S5026	Practical Lab	1
S5027	Environmental Biotechnology and Biodiversity	4
S5028	Practical Lab	1
S5029	Scientific Writing and Project Management	4
S5030	Practical Lab	1
	Total	15
Semester – VI		
S6025	Projects	18

Semester I

S1025: CELL BIOLOGY **Credit(s): 4**

Cell: Shapes, Morphology, Structure, Function, Relationship including organelles and their Biogenesis (e.g., Endoplasmic reticulum, Mitochondria, Chloroplast, Golgi body, nucleus, lysosomes, vacuoles); Cell theory; Membrane structure.

Cell divisions: Cell cycles, Mitosis phases, structure and functions of spindle apparatus; anaphasic chromosome movement; Meiosis: phases, synaptonemal complex formation and fate of chiasmata.

Transport across membrane: Active, Passive, Facilitated; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

Chromosome organization: eukaryotic and prokaryotic, Chromosomes morphology: Centromere, Telomere; Specialized types of chromosomes: Sex chromosomes, Lampbrush chromosome, Polytene chromosomes; Chromosomes aberrations: deletion, duplication, translocation, inversion; Aneuploidy and polyploidy; Structure and numerical aberrations involving chromosomes: evolution of wheat cotton and rice, hereditary defects- Kleinefelter, Turner, Cri-du-chat and Down syndrome.

TEXT / REFERENCE BOOKS

1. Strickberger “Genetics” (Macmillan)
2. Freifelder “Genetics”

S1026: Practical-I **Credit(S): 1**

1. To study prepared slides of mitosis
2. To perform and identify different stages of mitosis in onion root tip
3. To study prepared slides of meiosis
4. To perform and identify different stages of mitosis in onion flower bud
5. Giant chromosome
6. To study slides of different cell organelles
7. Introduction to microtomy and apparatus handling
8. Histochemical localization of lipid
9. Histochemical localization of starch
10. Histochemical localization of protein

S1027: BIOLOGICAL MACROMOLECULES **Credit(s):4**

Molecular interactions, The concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson-Hasselbalch equation, dissociation of amino acids; Vitamins: Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity.

Carbohydrates: Intoduction, biological importance. Definition, Classification, {glyceraldehydes, Simple Aldose, Simple Ketose, D-glucose, Conformation of D glucose}, Monosaccharides other than glucose, glyocosidic, bond, disaccharides, polysaccharides [starch, glycogen, peptidoglycan, proteoglycan matrix]

Lipids: Introduction Structure, distribution and biological importance of fats and fatty acids; Chemical properties and characterization of Fats, Waxes, cerebrosides, gangliosides, phospholipids and proteolipids; Steroids and bile salts. Prostaglandins

Amino acids: Definition, Classification, Structure and types; Proteins: Classification, structure and properties, biologically active peptides, classification and properties of proteins, conformation and structure of proteins-primary, secondary, tertiary and quaternary; Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides; Structure, types and biological role of RNA and DNA

TEXT / REFERENCE BOOKS

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffory Zubey
3. Biochemistry: Stryer

S1028: Practical-II **Credit(s): 1**

1. Preparation of solutions of given normality and its standardization.
2. Standardization of pH meter by using prepared buffer solutions
3. Preparation of buffer solutions
4. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter.
5. To prepare buffer solutions in the pH range of 2.2 to 8.0
6. Qualitative estimation of carbohydrates
7. Qualitative estimation of proteins
8. Qualitative estimation of lipids
9. Titrimetric estimation of molar and mass concentration of sulfuric acid
10. Determination of acid value of oil

S1029: MICROBIOLOGY **Credit(s): 4**

Microbes in our lives: Brief history of microbiology, Scope of Microbiology. Position of microorganisms in biological world, Whittaker's Five-kingdom and three-kingdom concept of living organisms ; General features of Eubacteria and Archaebacteria (major difference within Eubacteria), Stains & Staining techniques: Definition of auxochrome; Chromophores; Acidic and Basic dyes; Classification of stains; Simple and differential staining: theories of staining, mordant and its function; Gram staining; acid fast staining; endospore staining; negative staining; capsule staining; flagella staining; mechanism of gram staining

Morphology and subcellular structures: Bacterial morphology, Slime layer, Mycelial morphology: Actinomycetes, Capsule, Cell wall, Ribosome, Cytoplasmic membrane (Fluid mosaic model); Cytoplasmic inclusion bodies - (inorganic, organic); Exospores & Cysts: types & structure; Endospore, Flagella, Pilus, Fimbriae (structure, composition and functions). Plasmids and episomes. Nuclear material, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome); Bacterial cell wall biosynthesis and structure. Microbial Nutrition: Nutritional types (definition and example) - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria); Chemoorganotrophs, Effect of oxygen on growth - classification on the basis of oxygen requirement and tolerance

Bacterial Growth: Growth phases - Generation time. Kinetics of growth, Types of culture: Batch, Continuous and Synchronous. Physical factors influencing growth like temperature. pH, osmotic pressure, salt concentration; Microbial Reproduction: Different modes and mechanism of microbial DNA replication – rolling circle model & Theta structure Bidirectional replication; Sexuality and bacterial recombination –Rarity in Bacteria, Male and female nessin bacteria (F+, F ’and Hfr), Plasmids and pilus mediated transfer of genes in the conjugation process in *E.coli*,

Control of growth of Microbes: Sterilization, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent (definition, application & examples); physical method of disinfection

and sterilization - dry heat, moist heat, filtration, radiation (mode of action, applications); Chemical control – dye solutions, alcohol, acid, alkali, halogen, heavy metal, phenol, phenol derivatives, formaldehyde, ethylene oxide, detergents (mode of action, applications). Assessment of chemical disinfectant; phenol coefficient-definition and method of determination

TEXT / REFERENCE BOOKS

1. Stanier, RY., et al., General Microbiology, 5th ed.,2000, Tata-McGraw Hill

2. Atlas, RM., Principles of Microbiology, 2nd ed.,1997, McGraw-Hill

S1030: Practical-III **Credit(s): 1**

1. Simple staining
2. Gram staining
3. Endospore staining
4. Acid fast staining
5. Introduction to different types of media
6. Preparation of Nutrient Agar media for bacterial culture
7. Preparation of Potato Dextrose Agar media for fungal culture
8. Preparation of Nutrient and SDA Broth for fungal culture
9. Culture microflora from soil and air
10. Culture microflora from water by spreading and serial dilution method

SEMESTER-II

S2025: METABOLIC PATHWAYS **Credit(s): 4**

Bioenergetics; General concepts of Thermodynamics: Laws of Thermodynamics, Enthalpy, Entropy, Free energy & Chemical Equilibria, High Energy Bonds & Compounds, Oxidation-reduction Reactions & Redox potential, Metabolism: Introduction (Anabolism & catabolism), Experimental Approaches, Mathematical problems

Carbohydrate metabolism: Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation & ETS, Gluconeogenesis Photosynthesis and Photorespiration: Light and Dark reactions

Lipid metabolism: Fatty acid degradation, Fatty acid synthesis, Regulation of fatty acid metabolism.

Amino acid metabolism: Amino acid degradation & Biosynthesis, Urea cycle; Nucleotide metabolism: Synthesis of purine & pyrimidine nucleotides, nucleotide degradation, Associated metabolic disorders.

TEXT / REFERENCE BOOKS

1. Outlines of Biochemistry: Conn & Stumpf
2. Principles of Biochemistry: Voet & Voet
3. Principles of Biochemistry: Jeffory Zubey
4. Clinical Biochemistry: D.C Deb
5. Biochemistry: Stryer
6. Lehninger's Principles of Biochemistry: Nelson & Cox

S2026: Practical-IV **Credit(s): 1**

1. Quantitative estimation of Protein
2. Quantitative estimation of carbohydrates
3. Quantitative estimation of lipids
4. Quantitative estimation of RNA
5. Quantitative estimation of DNA
6. Chlorophyll estimation
7. Separation of dyes using radial paper chromatography
8. Amino acid separation using paper chromatography
9. Amino acid separation using thin layer chromatography
10. Determination of saponification value

S2027: GENETICS **Credit(s): 4**

Mendelian principles: Principle of segregation, monoclonal crosses, dominance, codominance, semidominance, lethal genes. Principle of independent assortment: dihybrid and trihybrid ratios, gene interactions, epistasis, multiple alleles. Sex determination and linkage: Mechanism of sex determination: Simple mechanisms, One or a few genes, identification of sex chromosomes, XX-XY mechanism, Y chromosome and sex determination in mammals

Balanced concept of sex determination in Drosophila, haploidy and sex determination in hymenoptera, environmental factors in sex determination, sex differentiation, sex influenced dominance, sex limited gene expression, sex linked inheritance. Principles of linkage: Crossing over, cytological basis of crossing over, chromosome mapping by two factor crosses, interference, ordered tetrad data, somatic cell hybridization. Molecular mechanism of crossing over, gene conversion

Classical versus molecular concept of the gene; Cis-trans complementation, deletion mapping. Mutations: induced mutations in plants, animal and microbes for economic benefit of man spontaneous and induced; induced mutations in plants, animal and microbes for economic benefit of man; induced mutations in plants, animal and microbes for economic benefit of man; Extra-chromosomal inheritance: Cytoplasmic inheritance, mitochondrial and chloroplast genetic systems.

Population Genetics: Behavioral genetics, Hardy-Weinberg frequencies, inbreeding, calculating F from pedigrees, outbreeding and assorted mating, genetic equilibrium, chemotaxis; Prenatal diagnosis, Genetic Counselling Ethics and Genetics.

TEXT / REFERENCE BOOKS

1. Strickberger “Genetics” (Macmillan)
2. Freifelder “Genetics”

S2028: Practical-V **Credit(s): 1**

1. Mendel's law of inheritance
2. Study of various chromosomal abnormalities
3. Karyotyping of normal human cells
4. Karyotyping of abnormal human cells
5. Pedigree analysis
6. Problems related to pedigree analysis (2)
7. Linkage study in Drosophila.
8. Problems related to linkage (2)

S2029: ANALYTICAL TECHNIQUES **Credit(s): 4**

Instruments, basic principle and usage: pH meter, Measurement of pH: Principles of glass and reference electrodes, types of electrodes, complications of pH measurement Microscopy: Simple microscopy, Phase contrast microscopy and electron microscopy (TEM and SEM). Sedimentation – sedimentation velocity, preparative and analytical ultracentrifugation techniques.

Electrophoresis Basic principles of electrophoresis, AGE and SDS-PAGE and their importance Radioisotopic Techniques: Types of radioisotopes used in Biochemistry, units of radioactivity measurements, isotopes commonly used in biochemical studies – 32P, 35S, 14C and 3H), Autoradiography. Biological hazards of radiation and safety measures in handling radioisotopes; Biological applications

Chromatography: General principles and applications of – Adsorption chromatography, Ion-exchange chromatography, Thin-layer chromatography, Hydrophobic chromatography, Gas-liquid chromatography, HPLC, Affinity chromatography, Paper chromatography.

Spectroscopic Techniques: Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic.

TEXT / REFERENCE BOOKS

1. Textbook of optics and atomic physics – P.P. Khandelwal (Himlaya Publishing House
2. Nuclear physics an introduction – S.B. Patel (New Age International) Biophysics – Pattabhi and Gautham (Narosa Publishing House)
3. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
4. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
5. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
6. Introduction to atomic spectra – H.E. White (Mc Graw Hill)

7. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell (W.H. Freeman and Co.)
8. Biophysics - Cotrell (Eastern Economy Edition)
9. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub., Mumbai)

S2030: Practical-VI **Credit(s): 1**

1. Calibration of spectrophotometer
2. Verification of Beer-Lambert Law
3. Quantitative estimation of Protein
4. Quantitative estimation of carbohydrates
5. Quantitative estimation of lipids
6. Mendel's law of inheritance
7. Study of various chromosomal abnormalities
8. Chlorophyll estimation
9. Amino acid separation using paper chromatography
10. Amino acid separation using thin layer chromatography
11. Problems related to pedigree analysis (2)

SEMESTER-III

S3025: INTRODUCTORY IMMUNOLOGY AND ANIMAL TISSUE CULTURE

Credit(s): 4

Overviews of immune system: Historical perspectives. Types of immunity: Innate and acquired. Features of immune response: Memory, Specificity and recognition of self and non-self, Clonal nature of immune response; Hematopoiesis and differentiation; Cells and organs of the immune system

Antigen: Immunogenicity v/s antigenicity, factors affecting immunogenicity, nature of immunogen, biological system, epitopes, haptens and antigenicity; Immunoglobulins: Structure of antibody, antibody mediated effector functions, antibody classes and biological activities; Monoclonal antibodies: Production and applications

Antigen-Antibody interactions: types: precipitation and agglutination reaction, radioimmunoassay, ELISA, chemiluminescence, ELISPOT assay, western blot, immunoprecipitation, immunofluorescence, flow cytometry and fluorescence. Major histocompatibility complex: General organization, MHC molecules: structure & genes, their mode of antigen presentation and interaction, cellular distribution of MHC, regulation of MHC expression and disease susceptibility.

Complement system: Function, components, activation, regulation and deficiencies of complement. Immune response to infectious diseases: Bacteria, viruses and intracellular parasites. Vaccines: Active and Passive Immunization Types of Vaccines – Inactivate Attenuated, Purified macromolecules and Recombinant-vector, DNA, Multivalent subunit Vaccines.

Scope of Animal Tissue Culture, Culture Media Simulating natural conditions for growth of animal cells: Natural media-Plasma Clot, biological fluids tissue extract, embryo extract, Importance of Serum in media, Chemical defined media. Primary Culture: Cell lines, and cloning desegregation of tissue, isolation of tissue, enzyme desegregation, and mechanical desegregation. Secondary Culture: Transformed animal cells and continuous cell lines. Transfection of animal cell lines, HAT selection Selectable Markers and

Transplantations of Cultural Cells. Expression of cloned proteins in animal cell-Expression vector, over production and downstream processing of the expressed proteins; Growth factors-promoting proliferation of animal cells EGF, FGF, PDGF, IL-I, II-2, NGE and Erythropoietin. Transgenic Animals Techniques and Applications and Transgenic mice and sheep

TEXT / REFERENCE BOOKS

1. Roitt I.M, Brostoff, J., Male D.K. (2001). Immunology (Illustrated Publisher, Mosby)

2. T. J. Kindt, R.A. G. B. A. Osborne, J. Kuby (2006). Immunology (W.H. Freeman and Company, New York)

3. Austyn, J.M., Wood, K.J. (1993). Principles of cellular and molecular immunology (Oxford University Press Inc. New York)

4. Paul, W.E. (2008). Fundamental immunology (Lippincott Williams & Wilkins).

5. Birch J.R., Lennox E.S. (1995). Monoclonal antibodies: Principles and applications (Wiley-Liss).

6. T.G. Parslow, D.P. Stites, A.I. Terr (1997). Medical immunology (Lange Medical Books/McGraw-Hill)

7. Ian Freshncy (4th Edition) Buttler.

9. Elements of Biotechnology –P.K. Gupta (1st Edition-200) Rastogi Publications.

S3026: Practical-VII **Credit(s): 1**

1. Differential leucocytes count.
2. Total leucocytes.
3. Total RBC count.
4. Haemagglutination assay.
5. Separation of serum from blood..
6. Double immuno diffusion test using specific antibody and antigen.
7. Direct and indirect ELISA.
8. Blood grouping
9. Oucterlouny Double diffusion (ODD)
10. Rocket Immuno-electrophoresis

S3027: r-DNA TECHNOLOGY **Credit(s): 4**

Expression of genes in prokaryotic and eukaryotic systems Gene structure in prokaryotic and eukaryotic cells. Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, post translational processing of mRNA, extra chromosomal DNA and its functions. Restriction endonuclease, Ribonucleases, taq DNA, SI nuclease, Alkaline phosphatase, klenow enzyme, methyl transferase, restrication modification system

Preparation of desirged gene by genomic DNA, from reverse transcriptase and by gene machine; Vectors: bacteriophages, cosmids, Triplasmids, yeast artificial chromosome, shuttle and binary vectors, DNA labelling radioactive and non-radioactive methods

DNA sequencing, Southern and Northern blotting in situ, DNA fingerprinting, Ligation method for gene transfer, Gene transfer technology cDNA and genomic DNA library, gene isolation and cloning, Polymerase chain reaction and site directed mutagenesis,- Expression of cloned gene in recombinant cells, production of biochemicals with examples.

Application of rDNA technology Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

TEXT / REFERENCE BOOKS

1. D.M. Glover, Genetic Engineering, Cloning DNA, Chapman and Hall, New York, 1980

2. S. Mahesh and A.B. Vedamurthy, Biotechnology-4 (rDNA Technology, Environmental biotechnology, Animal cell culture), New Age publisher.

3. T. A. Brown

4. Primrose

S3028: Practical-VIII **Credit(s): 1**

1. Isolation of genomic DNA
2. Isolation of plasmid
3. Agarose gel electrophoresis
4. Restriction Digestion DNA/plasmid
5. Isolation of RNA
6. Ligation

S3029: MEDICAL BIOTECHNOLOGY **Credit(s): 4**

Gene therapy – background, types of gene therapy (*ex vivo* & *in vivo*), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics.

Expressing cloned proteins in animal cells; Overproduction and processing of chosen proteins, the need to express in animal cells; Gene Delivery methods – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering; Tissue Engineering – Skin, Liver, Pancreas

Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases; Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology; Synthetic therapy – synthetic DNAs, therapeutic Ribozymes, synthetic drugs.

Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues; Production of artificial tissues or organs; Cell Adhesion-based therapy – integrins, inflammation, cancer & metastasis; Drug designing, Drug delivery and targeting: conventional & new approaches to drug delivery. Use of antibodies, vaccines, interferon's, receptors, growth factors, lysosomes in drug delivery and disease control; Biotechnology in fertility control, disease diagnosis and disease treatment. Forensic medicine

TEXT / REFERENCE BOOKS

1. Text Box of Microbiology R. Ananthanarayanan and C. K. Jayaram Paniker, Orient Longman, 1997.
2. Medical Microbiology, Vol 1; Microbial infection : Mackie and MaCartny, Churchil Livingstone, 1996
3. Bailey and Scott's Diagnostic Microbiology: Baron EJ, Peterson LR and Finegold SM Mosby, 1990.

4. Essential immunology (1995) - Roitt, I. M. Blackwell Scientific Publications Oxford.
5. Fundamental immunology: W.E. Paul 1984, Raven Press, New York.
6. Fundamentals of immunology: R.M. Coleman, M.F. Lombord and R.E. Sicarc (1992), 2nd ed, C. Brown publishers.
7. Immunology: D.M. Weir and J Steward, 7thEd, (1993).
8. Broude A.I. (1981) : Medical " Microbiology" ; and Infectious Diseases, W.B. Saunders & Co. Philadelphia.
9. An Introduction to Immunology: Ian R. Tizzard.

S3030: Practical-IX **Credit(s): 1**

1. Differential leucocytes count.
2. Total leucocytes.
3. Total RBC count.
4. Separation of serum from blood.
5. Direct and indirect ELISA.
6. Blood grouping
7. Oucterlouny Double diffusion (ODD)
8. Rocket Immuno-electrophoresis

SEMESTER-IV

S4025: MOLECULAR BIOLOGY **Credit(s): 4**

Nucleic Acids: as the genetic material, structure and aggregation of DNA and RNA, DNA double helix, different conformations of double helix, DNA supercoiling, denaturation and renaturation of DNA, C-value paradox, Cot value and curve, chemical complexity; DNA replication: Mechanism, Enzymes and accessory proteins involved, DNA damage, DNA mutagenesis and DNA repair (SOS and excision repair); Homologous recombination, site specific recombination and transposons.

Transcription in prokaryotes and eukaryotes: General and specific transcription factors, Regulatory elements and mechanism of transcription regulation, Modifications of RNA; Genetic code: deciphering the genetic code, nature of the code.

Translation in prokaryotes and eukaryotes: machinery- tRNA, Ribosomes, mRNA, aminoacyl-tRNA synthases and aminoacylation of tRNA; Mechanisms of initiation, elongation and termination, Regulation of translation, post translational modifications of proteins, protein localization, protein degradation.

Regulation of gene expression in prokaryotes: lac and trp operons - induction, repression and attenuation mechanism; Genomics, Transcriptomics and Proteomics- an overview

TEXT / REFERENCE BOOKS

1. Glick, B.T and Pastermak J.J (1998) Molecular Biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.

2. Howe.C. (1995) Gene Cloning and Manipulations, Cambridge University Press, USA

3. Lewin, B., Gene VI New York, Oxford University Press.

4. Rigby, P.W.J. (1987) Genetic Engineering, Academic Press Inc. Florida, USA.

5. Sambrooket al (2000) Molecular Cloning Volumes I, II, & III Cold spring Harbor Laboratory Press, New York, USA

6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology and Biotechnology (Indian Edition) Royal Society of Chemistry U.K

7. Karp.G (2002) Cell and Molecular Biology, 3rd Edition, John Wiley and Sons; INC
8. Cell and Molecular Biology- P.K. Gupta, Rastogi Publishers, Meerut.
9. Bruce alberts et al (2008) Molecular Biology of the Cell, Fifth ed, , Garland Science, Taylor and Francis group
10. Voet and Voet , Biochemistry (2004) John Willey and Sons Inc.
11. Benjamin Lewin Genes IX, (2007) John Willy & Sons.
12. Molecular Biology of the Genes (2007) James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Inglis CSHLP (2007), Benjamin Cummings
13. Molecular Cell Biology (2007) Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, HiddePloegh, Paul Matsudaira, Freeman & Co.

S4026: Practical-X **Credit(s): 1**

1. Isolation of genomic DNA
2. Demonstration of Gel electrophoresis
3. Demonstration of SDS-PAGE
4. Quantification of RNA
5. Quantification of DNA

S4027: PLANT BIOTECHNOLOGY **Credit(s): 4**

History: Milestones in the history of plant tissue culture, Concepts of Cell theory & Cellular totipotency. Cellular totipotency: Introduction, cyto-differentiation, orgenogenic differentiation, loss of morphogenic potential in long-term cultures, practical applications of cellular totipotency. 'Explant' for plant tissue culture: histological and/or cellular characteristics Response of explants *in vitro* – Dedifferentiation and redifferentiation a) callus formation b) organogenesis (direct and indirect) c) embryogenesis (direct and indirect); Infrastructure & Organization of plant tissue culture laboratory: Laboratory Requirements, different work areas, equipments & instruments required, techniques, other requirements. Aseptic techniques: Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions; Tissue Culture Media: Introduction, nutritional requirements of the explants, PGR's and their *in vitro* roles, media constituents, media selection, media preparation; Callus culture technique: Introduction, principle, factors affecting, Morphology & internal structure, genetic variation

Cell and Suspension Culture: Introduction, principle, isolation of single cells, suspension cultures, culture of single cells, types, growth & growth measurement, synchronization, plant cell reactors, applications of cell culture; Protoplast Culture: Protoplast isolation, culture and regeneration, Somatic hybridization – Protoplast fusion techniques, selection of hybrids, production of symmetric & asymmetric hybrids & cybrid production. Genetic transformations – DNA uptake by seeds, pollens, transformation of protoplasts, agrobacterium mediated transformations, direct DNA transfer methods – electroporation, microprojectile bombardment, and microinjection, use of marker genes, integration & expression of foreign DNA; Different routes of multiplication in vitro – a) axillary bud proliferation, b) somatic embryogenesis, c) organogenesis; Organ culture technique – Introduction, principle, factors affecting w.r.t. root tip culture, leaf culture, shoot tip & meristem culture

Haploid Plant Production: Anther, pollen, ovule and ovary culture Introduction, techniques, factor affecting, plant regeneration, homozygous lines, applications, limitations. Triploid Production: Introduction, callusing, histology and cytology of cells, Somaclonal variation – Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism, assessment; Embryo Culture: Introduction, techniques, culture requirements role of the suspensor in embryo culture, precocious germination, morphogenesis in the culture of seeds with partially differentiated embryos, microsurgical experiments, morphogenetic potential of the embryo callus, practical applications. Embryo rescue, Production of artificial seeds – techniques, factors affecting; *In-vitro* pollination and fertilization: Introduction, terminology, in vitro pollination, in vitro fertilization, applications; Micropropagation: Introduction, techniques, applications, production of virus free plants.

Production of secondary metabolites in vitro: Introduction, principle, strategies used to optimize product yield, biotransformation, and commercial aspects; Germplasm Conservation: Introduction, long-term storages, short or medium term storage, cryopreservation, DNA banking; Bioreactors and terminator seed technology. Apprehensions and challenges; Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

TEXT / REFERENCE BOOKS

1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.

2. Plant tissue Culture: Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996) Elsevier,

Amsterdam.

3. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002

S4028: Practical-XI **Credit(s): 1**

1. Introduction to different types of media
2. Preparation of synthetic seeds
3. Bergmann's cell plating technique for single cell culture
4. Composition of various plant tissue culture media
5. Preparation of stock solution for M.S. media
6. Preparation of stock solution for various growth hormones
7. Preparation of M.S. media for seed inoculation
8. Inoculation of seed in M.S. media for micro-propagation

S4029: INDUSTRIAL BIOTECHNOLOGY **Credit(s): 4**

Introduction, Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing; Substrates for bioconversion processes and design of media; Isolation, preservation and improvement of industrial microorganisms, Cell culture techniques and aseptic transfers; Techniques and Instrumentation: Filtration, centrifugation, aqueous two phase system, ion exchange chromatography, gel permeation chromatography, affinity chromatography, spectrometry, automation, bioassay, automated sequencers, mass spectrometry, ORD, CD.

Metabolic basis for product formation; Production of secondary metabolites-penicillin, tetracycline etc; Process technology for the production of cell biomass and some primary metabolites, e.g. ethanol, acetone-butanol, citric acid, dextran and amino acids; Microbial production of industrial enzymes-glucose isomerase, cellulase & lipases

Metal recovery and microbial desulphurization of coal; Applications of bioconversion, transformation of steroids and sterols; Transformation of non-steroidal compounds, antibiotics and pesticides; Bioenergy-fuel from biomass, production and economics of biofuels

Biomolecules of Commercial Products: Biomass (Baker's Yeast), Amino Acids (L-Lysine), Antibiotics (Penicillin), Extra Cellular Polysaccharides (Xanthan Gum), Nucleotides (5-GMP), Vitamins (B12), Pigments (Shikonin), trehalose, subtilisin, chymosin, vitamin B12, hepatitis B vaccine, insulin, erythropoietin, monoclonal antibodies.

TEXT / REFERENCE BOOKS:

1. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.

2. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.

3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.

4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.

5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.
6. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.
7. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
8. Microbial Biotechnology: Channarayaappa, University press, Hyderabad, 2003
9. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
10. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.

S4030: Practical-XII **Credit(s): 1**

1. Sauerkraut Production
2. Preparation of ginger wine
3. Preparation of grape wine
4. Production of citric acid
5. Estimation of citric acid produced
6. MBRT test

SEMESTER-V

S5025: BIO-INFORMATICS AND BIOSTATISTICS **Credit(s): 4**

Introduction to Genomic data and Data Organization: Sequence Data Banks: Introduction to sequence date banks-protein sequence data bank. NBFR-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank-Gene Bank, EMBL nucleotide sequence data bank.

Introduction to MSDN (Microbial Strain Data Network): Numerical Coding Systems of Microbes, Hybridoma Data Bank Structure, Virus Information System Cell line information system; other important Data banks in the area of Biotechnology/life sciences/biodiversity; Sequence analysis: Analysis Tools for Sequence Data Banks; BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles. Secondary Structure predictions; prediction algorithms; Tertiary Structure predictions

Importance and applications Tabulation and Classification of data, Frequency distribution and Graphical distribution of data Measure of Central tendencies Mean, Media, mode and their properties. Measures and Dispersion, Mean deviation, Variance, Standard deviation and Coefficient of Variation. Correlation and regression

Hypothesis Testing Student T-test. Probability and Distribution Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their Applications, Different Models of data presentation with special reference to biological samples

TEXT / REFERENCE BOOKS

1. Lesk, Introduction to Bio Informatics, OUP

2. Developing Bioinformatics Computer Skills, Cynthia Gibas and Per Jambeck, 2001 SPD

3. Introduction to Bioinformatics, Atwood, Pearson Education

4. Beginning Perl for Bio-informatics, Tisdall, SPD

5. Biocomputing: Informatics and Genome Project, Smith, D.W., 1994, Academic Press, NY
6. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Baxevanis, A.D., Quellette, B.F.F., John Wiely & Sons.
7. Biostatistics. S.P. Gupta

S5026: Practical-XIII **Credit(s): 1**

1. To retrieve the sequence of the Human keratin protein from GenBank database and to interpret the results.
2. To retrieve the structure of a protein and viewing it in RASMOL viewer.
3. To find the similarity between sequences using BLAST
4. To find the similarity between sequences using FASTA
5. To align more than two sequences and find out the similarity between those sequences
6. To perform Sequence analysis by using EMBOSS
7. Exercise of biostatistics

S5027: ENVIRONMENTAL BIOTECHNOLOGY AND BIODIVERSITY

Credit(s): 4

Ecology & Biodiversity: Introductory concepts, The biological world and Ecology: Ecological balance and consequences of change, Biological word and eco-systems; Biochemical Diversity in ecosystem development; Diversity indices; Cellular diversity and the classification of living system – Prokaryotic & Eukaryotic organisms, General physical properties and Tolerance to environmental conditions; Microbial Biodiversity – strategies – bio-prospecting and recovery.

Air Pollution Control Methods and Equipment Primary and secondary air pollutants, standards, sampling, basic ideas of air pollution control equipments, Bag Filter, Electrostatic Precipitators, cyclone separators, Wet-scrubbers, Bio-scrubbers, Electrostatic precipitators, High volume sampler, RSPM Sampler, Control of specific gaseous pollutants.

Wastewater Treatment by Biotechnological Processes Water pollution; sources and classification of pollutants, B.O.D, C.O.D, D.O, T.D.S, Oil and grease, Metals etc. Standards, sampling and method of analysis, Bacteriological measurements. Overview of treatment principles and theory of aeration, Municipal Sewer and Industrial Wastewater Treatment –Principles, operation and design aspects of: Activated Sludge process, Extended Aeration, Nitrification-denitrification, Trickling Filter, Mechanically aerated lagoons, Concepts of Waste stabilization ponds, Aquatic plant systems, Ranking of waste water treatment processes, common effluent treatment plant.

Environmental Biotechnology: Specialized aspects Oil pollution – treatment with micro-organisms, Bioremediation—recovery of metals from waste water and sludge, xenobiotics, degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, .Anaerobic and aerobic composting, Vermiculture, Wetland Management, Membrane based waste water treatment processes – case studies, Bioleaching

TEXT / REFERENCE BOOKS

1. Odum, E.P., Fundamentals of Ecology

2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 3rd ed., Tata McGrawhill

3. Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999

4. Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH

S5028: Practical XIV **Credit(s): 1**

1. Temporary Hardness, permanent hardness, total hardness
2. Alkanity and acidity of water
3. Estimation BOD
4. COD
5. DO of water
6. TS TDS of water
7. Estimation of chloride in water
8. Carbonate and Bicarbonate estimation

S5029: SCIENTIFIC WRITING & PROJECT MANAGEMENT Credit(s): 4

Communication: Language and communication, differences between speech and writing, distinct features of speech and writing. Pronunciation and ascent, stress and intonation Communication with Media and as a part of science: Written media of Communication: formal and informal writings; formal writings/reports, handbooks, writing assignments, Purpose, scope and types of Letters & memorandum, Notices, Minutes, Manual, Leaflet, Complaints & Suggestion, Job Application. Visual Media of communication: slide presentation, Pictures & Photographs, Posters & Advertisement, the art of illustrations: figures. Non-Verbal Media of Communication; Oral Presentations: Listening and Speaking Skills.

Written Communication: Report and Paper Programme of writing: Thinking & planning, information, ideas, Selection of topic, topic outline, order of paragraph writing, introductory, developmental, transitional and concluding paragraphs, revising. Report: Purpose and scope of Report, Types of Report, characteristics of Good Report, Essential Requisites of Good Report-Writing, Planning the Report, Outlining Issues for Analysis, Writing the Reports. Scientific literature: Gathering data using the Library/Internet (Abstracts and journals in biotechnology, e-Journals, and major libraries subscribing journals related to biotechnology in the region and country), Listing Reference Material.

Scientific document: Compilation of experimental records, writing progress reports, short communications, review articles, dissertation and thesis. Editing & correcting. Paper: Organization and writing a research paper; Writing the Discussion or Body of an Article; Writing the exit; Writing the Lead. Preparation of research projects: Organization of a research project, identification of gap areas in the subject, aims and objectives of the projects, possible outcome of the project, funds requirements and justification(s). Reading: How to read, making notes as you read, writing a book review.

Designing and Writing for Electronic Media: Using Internet as a Writing Tool; Designing and Writing for Multi-media; Writing and Designing for World Wide Web; Group Communication: Problem of Group Communication- Meeting - types of meeting,

Advantages & Disadvantages of Meeting, Preparation for Meeting, conduct of a Meeting, Responsibility of participants. Interview: Purpose, Types of interviews – promotion, appraisal, exit, telephone. Employment or selection Interview: Candidate's preparation, Question commonly asked in interview, role of interviewer, Interviewer's preparation.

TEXT / REFERENCE BOOKS:

1. How to Write & Present Technical Information, 3rd Edition, Charles H. Sides, Cambridge University Press. 1999.

2. Garffey, Mary Ellen Business Communication, Cincinnati: South-Western College Publishing, 2000

3. Parley E Stevens and Daniel G Riardaw. Technical Report Writing Today N Delhi AITBS, 1998.

4. Business Communication, By urmila Rai & S. M. Rai. Himalaya Pub. (Tenth Ed.)

5. For Report writing practice demonstrate IEEE paper Format.(http:// www.ieee.org/portal/cms_docs/pubs/confpubcenter/pdfs/samplems.pdf, http://www.ieee.org/portal/cms_docs_iportals/iportals/publications/journmag /transactions/TRANS-JOUR.doc)

6. Written communication in English - Sarah Freeman

7. English for students of science - A. Roy & P.L. Sharma

8. McMillan Grammar: A hand book of "Augustine & Joseph" - Orient Longman

9. A new guide to précis writing - R.W. Jepson (O.L.)

10. Effective Writing for engineers, managers, scientists.Tichy, (1988). A.J., Wiley, New York and London.

11. Successful scientific writing: A step-by-step guide for the biological and medical sciences (2008) 3rd edition By Janice R. Matthews, Robert W. Matthews. Printed in United Kingdom at the University Press, Cambridge.

12. Research proposals: A guide to success. (1995) 3rd edition by Thomas E. Ogden, Israel A. Goldberg. Academic Press, USA/UK.

13. How to write & publish a scientific paper: 5th edition by Robert A. Day. Oryx press.

14. Best practices in biotechnology business development: Valuation, licensing, cash flow, pharmacoeconomics, market Selection, communication, and Intellectual Property (2008). Yali Friedman (Editor). Logos Press, Washington DC.
15. Developing Communication Skill By Krishna Mohan, Meera Banerji. McMillan
16. Writing as thinking: A guided process approach. M. Frank. Englewood Cliffs, Prentice Hall Reagents.
17. Study Writing; A course in written English. For academic and professional purposes. L. Hamp-Lyons and B. Heasely Cambridge Univ. Press.
18. A comprehensive grammar of the English language. R. Quirk, S. Greenbaum, G. Leech and J. Svartik. Longman, London.
19. Technical Report Writing Today. Daniel G. Riordan & Steven A. Panley. Biztaantra.
20. Technical Report Writing Today. Daniel G. Riordan, Steven E. Pauley, Biztantra (2004), 8th edition
21. Contemporary Business Communication, Scot Ober, Biztantra, 5th Edition (2004).

S5030: Practical: XV **Credit(s): 1**

Practical's based on the theory syllabus

S6025: PROJECT **Credit(s): 18**

A project work should be done individually under the guidance of one of the faculty of JECRC university (Life Sciences) on any topic related to the subject after one Educational tour at any place in India. The duration of tour should be at least one week at the spot.

The work should be documented & also presented by the candidate in front of an external in a seminar/presentation.

Microbiology

Semester –I		
Course Code	**Title**	**Credits**
S1032	**Physicochemical Techniques**	4
S1033	Practical Lab	1
S1034	**Microbial Diversity**	4
S1035	Practical Lab	1
S1036	**Biochemistry**	4
S1037	Practical Lab	1
	Total	**15**
Semester –II		
S2032	**Bacteriology**	4
S2033	Practical Lab	1
S2034	**Immunology**	4
S2035	Practical Lab	1
S2036	**Phycology**	4
S2037	Practical Lab	1
	Total	**15**
Semester –III		
S3032	**Mycology**	4
S3033	Practical Lab	1
S3034	**Virology**	4
S3035	Practical Lab	1
S3036	**Molecular biology**	4
S3037	Practical Lab	1
	Total	**15**

Semester –IV		
S4032	**Microbial Genetics**	4
S4033	Practical Lab	1
S4034	**Biostatistics**	4
S4035	Practical Lab	1
S4036	**Environmental microbiology**	4
S4037	Practical Lab	1
	Total	**15**
Semester -V		
S5032	**Microbial Physiology**	4
S5033	Practical Lab	1
S5034	**Food Microbiology**	4
S5035	Practical Lab	1
S5036	**Bio-informatics**	4
S5037	Practical Lab	1
	Total	**15**
Semester -VI		
S6032	**Industrial Microbiology**	4
S6033	Practical Lab	1
S6034	**Medical Microbiology**	4
S6035	Practical Lab	1
S6036	**Project Training**	5
	Total	15

Microbiology

Course Objective

1) To familiarize students with fundamental concept of basic techniques and their applications.

2) It is expected that the knowledge gained through this course will make student competent to meet the challenges of academic and professional courses.

3.) To train the student in various aspects related to applied microbiology and medical microbiology.

S1032 Physicochemical Techniques

Contact Hours: 60
Credits: 04

Unit-I

Instruments, basic principle and usage: pH meter, Measurement of pH: Principles of glass and reference electrodes, types of electrodes, complications of pH measurement
Microscopy: Simple microscopy, Phase contrast microscopy and electron microscopy (TEM and SEM). (15 hrs.)

Unit -II

Sedimentation – sedimentation velocity, preparative and analytical ultracentrifugation techniques.
Electrophoresis Basic principles of electrophoresis, AGE and SDS-PAGE and their importance. (10 hrs.)

Unit - III

Radioisotopic Techniques: Types of radioisotopes used in Biochemistry, units of radioactivity measurements, isotopes commonly used in biochemical studies – ^{32}P, ^{35}S, ^{14}C and ^{3}H), Autoradiography. Biological hazards of radiation and safety measures In handling radioisotopes. Biological applications. (15 hrs.)

Unit IV

Chromatography: General principles and applications of – Adsorption chromatography, Ion-exchange chromatography, Thin-layer chromatography, Gas-liquid chromatography, HPLC, Affinity chromatography, Paper chromatography.
Spectroscopic Techniques: Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic techniques.

(20 hrs.)

Suggested Readings:

1. Textbook of optics and atomic physics – P.P. Khandelwal (Himlaya Publishing House)
2. Nuclear physics an introduction – S.B. Patel (New Age International)

Biophysics – Pattabhi and Gautham (Narosa Publishing House)

3. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
4. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
5. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
6. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
7. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell (W.H. Freeman and Co.)

Laboratory exercise

1.Determination of the pH of given soil sample

2.Determination of size of given microorganism using Micrometry
3. Demonstration of Electrophoresis
4. Separation of chlorophyll a and b using paper chromatography
5. Explaination of Beer lambert's law

S1034 Microbial Diversity

Contact Hours: 60
Credits: 04

Unit-I

Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming, Scope of Microbiology. Classification of Microbes – Systems of classification, Numerical taxonomy, Identifying characters for Classification, General properties and principles of classification of microorganisms Systematics of bacteria and Nutritional types. Classification on the basis of oxygen requirement**.** (15 hrs.)

Unit -II

Bacterial Morphology and subcellular structures: Morphology of bacteria, Slime layer, Mycelial morphology: Actinomycetes, Capsule, Cell wall, Ribosome, Cytoplasmic membrane, Cytoplasmic inclusion bodies - inorganic, organic; Exospores & Cysts: types & structure; Endospore, Flagella, Pilus, Fimbriae (structure, composition and functions). Plasmids and episomes. Nuclear material, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome). Bacterial cell wall biosynthesis and structure.

(15 hrs.)

Unit -III

Brief description of eukaryotic Algae , Fungi and protozoa : General characteristics, vegetative and reproductive structure of Protozoa: *Giardia, Entamoeba* and *Plasmodium*

(15 hrs.)

Unit -IV

General Properties of other viruses, viroids and prions : Viroids, prions, Filamentous DNA phages, Single stranded RNA phages, Cauliflower Mosaic, Virus of Plants; HIV, Vaccinia and Simian virus of animals, Insect virus. (15 Hrs.)

Suggested Readings:

1. Stanier, RY., et al., General Microbiology, 5th ed.,2000, Tata-McGraw Hill

2. Atlas, RM., Principles of Microbiology, 2nd ed.,1997, McGraw-Hill

Laboratory exercise

6. Gram Staining
7. Capsule staining
8. Identification of some common fungi (Aspergillus, Mucor, Panicillium)
9. Identification of some common algae
10. Identification of some common viruses

S1036 BIOCHEMISTRY

Contact Hours: 60
Credits: 04

Unit I

Introduction to biochemistry, scope and importance

Classification and biological importance of Carbohydrates; Glycolysis, Citric acid cycle.

15 Hrs.

Unit II

Classification and biological importance of Amino acids and Proteins; Transamination, Deamination**,** Urea cycle **15 Hrs.**

Unit III

Classification and biological importance of lipids; Biosynthesis and β-oxidation of palmatic acid

Definition and classification of enzymes and vitamin

15 Hrs.

Unit IV

Inborn error of metabolism , vitamin deficiency diseases. Enzymes: as biocatalyst, classification, specificity, active site, isozymes. **15 Hrs**

Suggested Readings:

- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IVEdition. W.H Freeman and Co.
- Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill.
- Biochemistry, Berry, A.K. Emkey Pub. New Delhi.
- Donald Voet and Judith G. Voet Biochemistry, John Wiley and Sons., New York.

- Lubert Stryer, Biochemistry International Student edition W.H. Freeman and Company, New York.
- H.S. Srivastava, Element of Biochemistry, Rastogi Publications Meerut.
- Leninger, A.D. Principles of Biochemistry, CBS Publishers and Distributors, Shahdra, Delhi.
- Jain,J.L.Fundamentals of Biochemistry ,S.Chand publishers New Delhi.
- Murray, R.K.,Harper's Biochemisttry;Appleton and Lange , Norwalk,Connecticut

Laboratory exercise

1. Qualitative test for carbohydrate in the given sample.
2. Qualitative test for lipid in the given sample.
3. Qualitative test for amino acids and proteins in the given sample.

II semester

S2032 Bacteriology

Contact Hours: 60
Credits: 04

Unit I

Form and function of bacteria : Internal structure, Bacterial shapes and arrangement, cell membrane, cell wall of bacteria, inclusion bodies, flagella, capsule, slime, fimbriae and pilli. Bacterial endospores – structure, formation and germination.

The world of bacteria- A brief outline of salient features of major bacterial groups according to Bergey's manual of systematic Bacteriology Volume I and II.

Unit II

Detail study of two examples with each of the group as mentioned under :

Gram negative Eubacteria: The Spirochetes ,Aerobic/microaerophilic, motile, helical/vibroid, Gram negative Bacteria.Non motile , Gram negative curved bacteria. Aerobic Gram negative rods and Cocci .Facultative anaerobic Gram negative rods, Anaerobic Gram negative straight, curved and helical rods. Dissimilatory sulphate or sulphur reducing bacteria. Anaerobic Gram negative Cocci. Rickettsia, Chlamydia , Mycoplasmas.

Unit III

Gram positive Eubacteria: Gram positive Cocci ,endospore forming Gram positive bacteria ,Nonspore forming Gram positive Rods of regular shape ,Nonspore forming Gram positive Rods of irregular shape,Mycobacterium .

Unit IV

Archaeobacteria: Methanotrophs and Halophils, Cultivation of Bacteria: growth of bacteria, growth curve, environmental factors affecting growth.

Suggested Readings:

1. General Microbiology, 7th edition, H S Schlegel, Cambridge University Press, 1995
2. Microbiology ,5th edition M J Pelczar, E C S Chan, N R Kreig, Tata Mc Graw Publication, 2006
3. Microbiology-a Laboratory Manual, 6th edition, J G Cappuccino and N Sherman, Addison Wesley, Pearson Education, Inc., 2006
4. Microbiology-an introduction, 9th edition G.J. Tortora, B.R. Funke, C.L. Case Pearson Education, Inc., 2007

Laboratory exercise

11. Preparation of culture media- liquid and solid media.
12. Isolation of pure culture by pour plate, serial dilution and streak plate method.
13. Cultivation of anaerobic organisms.
14. Sterilization method.
15. Methods of staining bacteria- simple staining.
16. Gram staining.
17. Endospore staining.
18. Negative staining.

S2034 Immunology

Contact Hours: 60
Credits: 04

Unit I

Overview of immune system; innate immunity and adaptive immunity

Cells and Organs of immune system: lymphocytes, mononuclear phagocytes, granulocytic cells, primary and secondary lymphoid organs

15 Hrs.

Unit II

Antigens: Properties of antigens, Adjuvants, Haptens.

Antibodies: Basic structure, classes and function, Polyclonal sera, Monoclonal antibodies

15 Hrs.

Unit III

Antigen- Antibody interaction: precipitation reaction, agglutination reaction, neutralization reaction, complement and lytic reaction and phagocytic reaction.

Major histocompatibility complex: Structure and functions

15 Hrs.

Unit IV

Immune System in Health and Disease: Brief introduction to Vaccines, Immunodeficiency and autoimmunity.

15 Hrs.

Suggested Readings

Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI edition. Roitt's Essential Immunology, Blackwell Publishing

Laboratory exercise

- Determination of ABO blood group
- Determination of Rh factor.
- Determination of differential blood count of WBC
- Estimation of hemoglobin in given blood sample.
- Estimation of RBC in given blood sample
- Estimation of WBC in given blood sample

S2036 Phycology

Contact Hours: 60
Credits: 04

Unit I

Algae - General characteristics; Ecology and distribution, Range of thallus organization and reproduction; Basic criteria used in classification (Fritsch, and Smith)

Unit II

Important classes in relation to applied Phycology listed below (one member in each class) Cyanophyceae, Chlorophyceae, Xanthophyceae and Phaeophyceae.

Unit III

Eoconomic importance of algae, algal ecology, role in biotechnology.

Unit IV

Lichen- ascolichen, basidiolichen, deuterolichen. Economic Importance of lichen.

Suggested Reading

1. Gilbart, M. Smith, Cryptogamic Botany Vol I and II, IInd Ed. Tata McGraw Hill Publishing Compancy Ltd. N.D. 1985.

2. Glemawat M.S., Kapoor, J.N. and Narayan H.S. : A text book of Algae. Ramesh Book Depot. Jaipur 1976.

3. Kumar. H.D. Introductory Phycology. Affiliated East-West Press Ltd., Newyork 1988.

4. Singh V., Pande P.C. and Jain D.K. A Text Book of Botany Rastogi and Co. Merrut, 2001.

Laboratory Exercises

Study of classwork material by making suitable temporary slides and *Nostoc, Volvox, Chlamydomonas, Chlorella, Vaucheria, Ectocarpus, Polysiphonia.*

Semister-III

S3032 MYCOLOGY

Contact Hours: 60
Credits: 04

Unit I

Introduction to fungi. History, General features, thallus organization,asexual and sexual reproduction, life cycle biological and economic importance of fungi. What is Diseases. Important symptoms of plant disease caused by fungi and control measures.

Unit II

Classification of fungi (Saccardo, Alexopolus and Mims and Ainsworth).Brief general account, structure, importance and life cycle of some important classes of fungi viz.(Myxomycetes, Phycomycetes, Oomycetes and Zygomycetes).

Unit III

Brief general account, structure, importance and life cycle of some important classes of fungi(Ascomycetes, Basidiomycetes and Deuteromycetes).

Unit IV

Culture of Fungi (media types). Identification and Description of some commonly occurring fungi of Rhizosphere.

Suggested Readings:

1. Vashishtha,B.R Botany for Degree students(Fungi).S.Chand and Company.NewDelhi.
2. DubeH.C Fungi Rastogi Publication. Merrut
3. Sarabhai and Saxena A Text Book of Botany. Rastogi Publication.Merrut.
4. Sharma.O.P. Fungi,Today and Tomorrow Publication.2000
5. Alexopolus and Mims.Introductory Mycology. John Wiley and Sons.NewYork.2000.
6. Mehrotra and Aneja. An Introduction to Mycology.

Laboratory Exercises

1. Study of symptom, vegetative, and reproductive part of plant diseases of each classesviz.Myxomycetes,oomycetes,phycomycetes,ascomycetes,zygomycetes,basidiomycetes and deuteromycetes.
2. Study of symptom caused by fungal pathogen on humans.

S3034 Virology

Contact Hours: 60
Credits: 04

Unit I

Brief history on discovery of virus. Nomenclature and classification(LHT and as per VII report of the international committee on taxonomy of viruses)Distinctive properties of virus. Morphology and ultrastructure (capsid, envelop and viral genome, their types and structure).

Unit II

Virus related agents (viroids,Prions)Bacteriophage,(structural organization life cycle.) Plant Virus: Classification and nomenclature,general symptom and effect of virus on plant(paddy, tomato and sugarcane).

Unit III

Animal viruses: Classification and nomenclature. Epidemiology, replication, pathogenicity prevention and treatment of RNA virus, Picorna virus, Rhabdovirus, HIV virus and DNA virus, Pox virus, Herpes virus and Hepatitis virus.

Unit IV

Transmission of plant virus.Virus of cyanobacteria and fungi. Cultivation of virus on embryonated eggs, experimental animals and cell cultures.

Suggested Readings:-

Dimmock Nj PrimroseS B.(1994) Intro. to Modern Virology IV Ed. Blackwell Scientific Publications, Oxford.

Morag C. and Timbury M. (1994) Medical Microbiology Xth Ed Churchill Living stone,London.

Conrat HF Kimball PC and Levy JA (1994) Virology III Ed. Prentice Hall, Englewood Cliff, NewJersey.

Ronald M Atlas (1995) Principles of Microbiology. Moseby Year book Inc. Missouri.

Kenneth M Smith Plant Viruses Universal Book Stall, New Delhi.

Powar and Daginawala General Microbiology Vol II Himalaya Publishing House

Biswas and Biswas An Itroduction to Virus. Vikas Publishing House.

Laboratory Exercises

1. Study of various symptom produced in plant due to virus infection.
2. Study of viral diseases of plants/animals(specimen/photograph).
3. Different type of viruses(Photograph/sketches).
4. Cultivation of virus on embryonated eggs.

S3036 Molecular biology

Contact Hours: 60
Credits: 04

Unit -I

DNA Structure: Miescher to Watson and Crick model, Sailent features of double helix, Types of DNA, denaturation and renaturation, DNA topology - linking number, topoisomerases; Organization of DNA in Eukaryotes. RNA Structure, Organelle DNA -- mitochondria and

chloroplast DNA. Genome Structure, Chromatin and the Nucleosome Chromatin structure-Euchromatin, Heterochromatin in Eukaryotes.

15 hrs

Unit -II

The Replication of DNA (In Eukaryotes)
Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative,Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins. Mechanism of Transcription: RNA Polymerase and the transcription unit.

15 hrs

Unit -III

Translation (In Eukaryotes) Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Structure of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis. Regulation of translation. Translation-dependent regulation of mRNA and Protein Stability.

Unit IV

RNA Modifications; Split genes, concept of introns and exons, removal of Introns, spliceosome, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.Transcription Regulation in Eukaryotes**,** Conserved mechanism of regulation, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene Silencing.

15 hrs

Suggested Readings

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Laboratory Exercises

1. Preparation of Polytene chromosome from *Chironomous* larva/*Drosophila* larva
2. Demonstration of mammalian sex chromatin.
3. Perform Southern Blot Hybridization (Restrict DNA for Southern Blot electrophoresis, perform electrophoresis of restricted DNA, perform southern transfer, hybridization and detection of gene of interest)
7. Study of semiconservative replication of DNA through micrographs/schematic representations.
8. Preparation of culture medium (LB) for *E.coli (both solid and liquid)* and raise culture of *E.coli*.

IVsemester

S4032 Microbial Genetics

Contact Hours: 60
Credits: 04

Unit I

DNA structure and replication in microorganisms:
DNA as a genetic material, structure of DNA and RNA, DNA replication (conservative and semi-conservative replication, conformational flexibility of DNA), Replication in prokaryotes and eukaryotes.

Unit II

Transcription in microorganisms:
Mechanism of transcription in prokaryotes , Enzymes and transcription factors, post transcriptional modifications.

10 hrs

Translation and regulation of gene expression in microorganisms:
The genetic code, central dogma. Translational machinery in eukaryotes and eukaryotes. Mechanism of initiation, elongation and termination. Inhibitors of protein synthesis. Regulation of gene expression in prokaryotes-operon concept, positive and negative regulation of *lac* operon. **20 hrs**

Unit III

Mutations and mutant selection

Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, spontaneous and induced mutations, mutation frequency, applications of mutation, Methods of mutant selection – direct selection, antibiotic selection, replica plating, conditional lethality and its use in mutant selection.

Mechanism of DNA repair – photo reactivation, excision repair, mismatch repair, SOS repair.

Unit IV

Recombination in bacteria

Transformation, transduction and conjugation, Use of tansformation, transduction and conjugation in gene mapping, a brief idea of cloning vectors (plasmids, cosmids, bacteriophages)

15 hrs

Essential Readings:

1. Principles of Genetics, 8th edition, Gardener E J, John Wiley and Sons Publications, 2005.
2. Gene VI, Lewin, B, New York, Oxford University Press, 2000.
3. Cell and Molecular Biology, 4th edition, Gerald Karp, John Wiley and Sons. 2005.
4. Biochemistry and Molecular Biology, 3rd edition, Elliott W H and Elliot D C, Oxford University Press, 2005.
5. Essentials of Molecular Biology, 3rd edition, Malacinski G M and Freifelder D Jones and Bartlett Publishers, 1998.
6. Cell and Molecular Biology, 3rd edition, Philip Scheeler and Donald E Bianchi, John Wiley and Sons. 1987.
7. Microbial Genetics, 2nd edition, Stanley R Maloy, John E Cronnan, David Freifelder. Jones and Barlett Publishers, 1994.

Laboratory Exercises

1. Isolation of antibiotic resistant bacteria.
2. Isolation of fungi from soil.
3. Identification of fungi by lactophenol cotton blue staining.
4. Enumeration of fungal spores by haemocytometer
5. Identification of Algae (permanent slides).
6. Identification of protozoa (permanent slides).
7. Preparation of protozoan culture.
8. Studies of live protozoa and preparation of slides.

S4034 Biostatistics

Contact Hours: 60
Credits: 04

Unit -I

Introduction, Definition, Functions, scope and application of biostasistic. Understanding the concepts of descriptive and inferential stastics. **Frequency distribution,** Collection of data : Primary and secondary data, tabulation of data, descret and continuous series. Graphical presented : Types of diagrams, Graphs of frequency distribution- Bar diagrams, Histogram, frequency Polygon, smooth frequency curve, Ogives.

15 hrs

Unit -II

Measures of Central Value, Introduction, Definition and Limitation of Average ; Arithmetic Average–Mean; Arithmetic , Geometric, Harmonic and Positional Average- Mode, Median. **Measures of Dispersion,** Introduction, Definition, various measures of variation ; Range, Quartile deviation, Mean Deviation, Standard Deviation, Variance. **Statistical Inference,** Testing of Hypothesis ; Procedure, test of significance of mean; Standard error of mean and standard deviation ; student's 't' test , chi-square test. **15 hrs**

Unit -III

Correlation, Introduction, definition, kinds- negative, positive and zero correlation, coefficient of correlation, methods of studying correlation-scatter diagram, Karl pearson's coefficient of correlation, Rank correlation. **15 hrs**

Unit -IV

Probability, Introduction, definition, types and theorems of probability, theoretical distribution and calculations of probability. **Regression Analysis,** Introduction, definition, regression equation, regression lines and regression coefficients.

15 hrs

Suggested Readings

1. Edmondson and D. Druce : *Advanced Biology Statistics*, Oxford University Press; 1996.
2. W. Danial : Biostatistics : *A foundation for Analysis in Health Sciences*, John Wiley and Sons Inc; 2004.

3.Goon, A.K.M and Gupta, B.D., Fundamental of Stastistics.

Laboratory Exercises

1.Construction of Frequency table.
2.Histograms, Polygones, Pie-charts.
3.Exercies on Mean (Arithmetic, Geomatric, Harmonic), Mode & Median.

S4036 Environmental microbiology

Contact Hours: 60
Credits: 04

Unit I

Introduction to environmental microbiology, scope and importance. Microorganisms in environment: viruses, bacteria, fungi, algae and protozoa.Terrestrial environment: soil and soil subsurface environment, microorganisms in surface soil, shallow and deep subsurface environment.

Unit II

Aeromicrobiology : atmosphere, aeromicrobiological pathway, microbial survival in air, extramural and intramural aeromicrobiology.

15 Hrs.

Unit III

Microbial transport: factors affecting microbial transport, factors affecting transport of DNA.

Biogeochemical cycling: carbon cycle, nitrogen cycle, sulfur cycle.

15 Hrs.

Unit -IV

Aquatic and extreme environments: microbial habitat in aquatic environment, environment determinants that govern extreme environments

15 Hrs.

Suggested readings:

Raina M.Maier, Ian L Pepper, Charles P Gerba. (2000) ENVIRONMENT MICROBIOLOGY . Academic press an imprint of Elsevier(san diego, san Francisco,)

Atlas and Bartha (1998) MICROBIAL ECOLOGY: fundamentals and applications. Fourth edition. Pearson education (Singapore)

Laboratory exercise

- Isolation of microbes from soil samples.
- Isolation of microbes from water samples.
- Determination of dissolved oxygen from water samples.
- Determine biological oxygen demand from given water samples
- Determine chemical oxygen demand from given water samples.

Semester V

S5032 Microbial Physiology

Contact Hours: 60
Credits: 04

Unit I

Introduction to microbial Diversity. Nutritional classification of microorganism. Chemoautotroph, chemoheterotroph and photosynthesis in microorganism. Role of chlorophyll, carotenoid and phycobilins. Light and Dark reaction.

Unit II

Chemolithotrophy. Hydrogen, Iron, Nitrate, Sulphur and oxidizing bacteria. Nitrogen metabolism and N2 Fixation. Nitrate and Sulphate reduction. Methanogenisis.

Unit III

Respiratory metabolism especially in reference to microbes.EMP and EnterDoudroff Pathway. Glyoxalate pathway Krebs cycle,reverse TCA cycle, Phosphorylation.

Unit IV

Prokaryotic life cycle, the growth curve, measurement of microbial growth, influence of environmental factors on growth.

Suggested Reading:

Caldwell.D.R(1995) Microbial Physiology and MetabolismBrown Publishers.

Stainer R.Y,IngrahamJ.L,WhelisM.L andPainter P.R General Microbiology.The Macmillan Press Ltd.

Madigan M.T Martinko J.M and Parker J Brock Biology Microorganism Prentice Hall.

Powar and Daginawala General Microbiology Vol II Himalaya Publishing House.

J.L Jain- Biochemistry.

Keshav Trehan Biochemistry

Stryer 5th Ed2001 Biochemistry Freeman W.H

Lehninger 3rd Ed.Principles of Biochemistry. McMillan.

Laboratory exercise

(1)Demonstration of selective and differential media.

(2) Demonstration of effect of PH on bacterial growth.

(3) Demonstration on the effect of salt on bacterial growth.

(4) Demonstration of the effect of metal on bacterial growth

S5034 Food Microbiology

Contact Hours: 60
Credits: 04

Unit I

Food as a substrate for micro organisms - Micro organisms important in food microbiology; Molds, yeasts and bacteria - General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of micro organisms, anaerobic conditions - High temperature - Low temperature - Drying - Food additives.

Unit II **15 hrs**

Contamination and spoilage - Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products - Fish and sea food - Poultry, Spoilage of canned foods. Spoilage and defects of fermented daily products - oriental fermented foods.

Unit III **15 hrs**

Food borne infections and intoxications - bacterial, non -bacterial - Food borne disease outbreaks - Laboratory testing - preventing measures - Food sanitation - plant sanitation

15 hrs

Unit IV

Employees' health standards - waste treatment and disposal - quality control. Food fermentations : Bread cheese, vinegar, fermented vegetables, fermented daffy products.

15 hrs

Suggested Readings

1. Adams MR and Moss MO. (1995). *Food Microbiology*. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). *Basic Food Microbiology*. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). *Antimicrobials in Foods*. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). *Natural Antimicrobial Systems and Food Preservation*. CAB International, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). *Food Microbiology*. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). *New Methods of Food Preservation*. Blackie Academic and Professional, London.

Suggested Practicals

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any pathogenic bacteria (*Staphylococcus* or *Salmonella*) from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.

S5036 Bio-informatics

Contact Hours: 60
Credits: 04

Unit I

Introduction to Genomic data and Data Organization: Sequence Data Banks – Introduction to sequence data banks – protein sequence data bank. Nucleic acid sequence data bank – GenBank, EMBL nucleotide sequence data bank, AIDS virus sequence data bank. RRNA data bank, structural data banks – protein Data Bank (PDB).

Introduction to MSDN - Microbial Strain Data Network: Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; other important Data banks in the area of microbiology.

Unit II

Sequence analysis: Analysis Tools for Sequence Data Banks; Pair wise alignment - NEEDLEMAN and Wunsch algorithm, Smith Waterman, BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles.

Unit III

Secondary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking, Tertiary Structure predictions; prediction alogrithsms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. Proteomics and drug delivery - Reverse genetics - Transcription and replication of negative strand viruses

Unit IV

Applications in Biotechnology: Protein classifications, Fold libraries, Protein structure prediction: Fold recognition, Protein structure predictions: Comparative modeling, Advanced topics: Protein folding, Proteinlig and interactions, Molecular Modeling & Dynamics, Drug Designing.

Suggested Readings

1. Lesk, Introduction to Bio Informatics, OUP
2. Developing Bioinformatics Computer Skills, Cynthia Gibas and Per Jambeck, 2001 SPD
3. Introduction to Bioinformatics, Atwood, Pearson Education
4. Beginning Perl for Bio-informatics, Tisdall, SPD
5. Biocomputing: Informatics and Genome Project, Smith, D.W., 1994, Academic Press, NY
6. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Baxevanis, A.D., Quellette, B.F.F., John Wiely

Semester- VI
S6032 Industrial Microbiology

Contact Hours: 60
Credits: 04

Unit I

Sources and characters of industrially potent microbes, their isolation, purification & maintenance. Screening of useful strains: primary screening & secondary screening, engineering. Microbial growth kinetics in batch, continuous & fed-batch fermentation process .
[15Hrs.]

Unit II

Aerobic bioreactor: principles & designing. Other types of bioreactors. Commercial production of antibiotics with special reference to penicillin and its derivatives.

[15 Hrs.].

Unit III

Microbiology & production of alcoholic beverages: malt beverages, distilled beverages, wine & champagne. Commercial production of organic acids like acetic, lactic, citric, & gluconic acids.

Unit IV

Immobilization of microbial enzymes and whole cells and their applications in industries. Bioprocess Engineering: Downstream processing, various steps for large scale proteins, Mushroom cultivation. Petroleum microbiology. Patent protection for biological inventions.
[15 Hrs.].

Suggested Readings:

8. Principles of fermentation technology :-Stanbury,Whittaker and Hall,2nd Ed. 1997.Aditya Books.
9. Fermentation Microbiology and Biotechnology :-El-Mansi and Bryce,2002
10. Process Biotechnology Fundamental :-Mukhopadhaya
11. Biochemical Engineering and Biotechnology :-Atkinson B and Mavituna F.

S6034 Medical Microbiology

Contact Hours: 60
Credits: 04

Unit I

Discovery and History of pathogenic microorganism.Contribution made by eminent scientists.Classification of medicinally important microorganism. Normal flora of human body.

Unit II

Characteristic of infectious disease.Disease cycle(source of disease,reservoir, carriers.).Bacterial diseases,epidemiology,pathogenicity, laboratory ,diagnosis, prevention and control of Anthrax, Tuberculosis, Typhoid, Tetanus and Leprosy.

Unit III

General account of viral and protozoan diseases.Pneumonia, Influenza,Mumps,Measles,Polio, HepatitisB, Malaria and Leishmaniasis. Brief account of STD diseases. Antibiotic Ist, IInd, IIIrd and IV th generation antibiotics. Mode of action of antibiotic on microorganism(in brief).

Unit IV

General account of fungal diseases mycoses,subcutaneous**.** Transmission of pathogens(Air borne,contact transmission and vector transmission).control measures.

Suggested Readings:

Ananthanarayan R. and Panikar. J (1997) Text Book of Microbiology Orient Longman.

Mackie and Mc Cartney Medical Microbiology Vol I Microbial Infection. Churchil livingstone 1996.

Baron E.J,Peterson LR and Finegold S.M Mosby1990. Bailey and Scott's Diagnostic Microbiology.

Greenwood,Slack R.C B and Peutherer J.F Medical Microbiolobgy Churchill Livingstone(Elsevier).

Laboratory exercise

(1) Isolation of bacteria from skin surface.

(2) Detection of antibiotic susceptibility of given microorganism against various antibiotics.

(3) Study of different type of bacteria gram positive(Staphylococci, Streptococci,Diptheria and Tetanus) gram ngative (Meningitis and Dirrhoea)Mycobacteria and Tuberculosis.

(4) Study of symptom and structure of some fungal pathogen of human.

(5) Study of structure of viral pathogen of Pneumonia, Influenza,Mumps,Measles,Polio,Hepatitis B,Smllpox and AIDS.

(6) Study of life cycle of Malaria parasite(various stages).

(7) Study of life cycle of Leishmania parasite(various stages).

(8) Types of vaccines.

Semester- VI

S6036 Project Training

Contact Hours: 75
Credits: 05

Project Training
(In house project work)

The dissertation work will involve practical work on a problem suggested by the supervisor of the candidate. The student will submit the dissertation report at the end of VI semester.

Computer Applications

Objectives of the course

The courses of Computer Science and its applications have been designed to strengthen the course contents of pure sciences by supplementing the knowledge of the supporting subjects and techniques. The advancements in Computer techniques are irresistible. In fact, the knowledge of computing techniques not only supports the development of other sciences but, it helps accelerated growth of these subjects.

The skills of '**Presentation, Publication and Graphing Techniques**', '**Programming with C**', '**Programming with C++ and Introduction to JAVA**' and '**Web Designing Techniques**' have been provisioned in the syllabi of courses on Computer Science and its Applications. These computing techniques are not only inevitable for Mathematics and Physics graduates but, they are extremely necessary for the Bio-science graduates too keeping in view the importance of Bio-Informatics.

Computer Applications

B. Sc.(For - *All Combinations*)
Subject: Computer Applications
Teaching Scheme

Course Code	Subject	Credits
Semester-I		
G1002	**Presentation, Publication and Graphing Techniques**	3
G1003	**Computer Lab-I**	1
	Total	4
Semester-II		
G2002	**Programming with C**	3
G2003	**Computer Lab-II**	1
	Total	4
Semester-III		
G3002	**Programming with C++ and JAVA**	3
G3003	**Computer Lab-III**	1
	Total	4
Semester-IV		
G4002	**Web Designing Techniques**	3
G4003	**Computer Lab-IV**	1
	Total	4

G1002: Presentation, Publication and Graphing Techniques

B. Tech. / B. Sc. 1st Semester

Contact Hours per week: 3

Credits: 3

Presentation Techniques

Power Point Presentation. Data Presentation. Graphics and curves presentation. Multi Media Presentation. Creation of *flash* videos

Documentation and Publication Techniques

Introduction to Word Processor(s). Excel Sheet Preparations. Graphics in the Excel. LaTeX file Preparation. Working on ***Adobe Premier Pro*/ *Maya / Coral Draw***

Graphing Techniques

Data Curve plotting: Using Excel, Origin and Gnu Plot.Functional Plotting: Using Gnu Plot, Origin. Introduction to **Mathematica / MatLab** explorations. Functional Plots using **Mathematica / MatLab.** Animation graphics using **Mathematica / MatLab**

Suggested Books

4. MATLAB (An Introduction with Application): Amos Gilat, Wiley India.
5. Getting Started with MATLAB: Rudra Pratap, Oxford University Press.
6. A Concise Introduction to MATLAB: William J. Palm III, Tata McGraw Hill Education Private Limited.

G1003: Computer Lab – I

B. Sc./B. Tech.-I Semester
Contact Hours per week: 2 hrs
Credit(s): 1

List of Experiments

PowerPoint:
Introduction to the IDE of Power Point, Introduction to various toolbars like – Quick access, Placeholders, Creating title slides, slide shows, Introduction to layouts, themes, Clipboard, font paragraph, Drawing & Editing, Animations, Transitions, Spell Check, Outline, Tab, slides tabs, Sorter view and Printing

MS Word:
Introduction to IDE of Microsoft Word, Functionality of various tool bars – Quick Access, Title, Ribbon, Ruler, and Status Bars. Understanding document Views, Formatting, Editing and Understanding non printing characters, Using AutoText, Using Indentation & Alignment, and Style set Page breaks, Page numbers and Setting Page Layouts and Printing Documents

MS Excel:
Introduction to Electronic Spreadsheet, Worksheet, Cells, Quick Access Toolbar, Formula Bar, Status Bar, Clipboard, Font, Alignment, Number, Cells, Styles, Editing, Perform Mathematical Calculations, Working with Headers & Footers, Perform Automatic Calculations, Perform Advanced Mathematical Calculations, Work with Long Text, format Numbers, Excel Functions, Using Reference Operators and Printing
Charts: Creating and applying chart layout, Adding Labels, Switching Data, Changing the Chart Style, Size and Position, Chart Type

G2002: Introduction to Computer Programming (Programming with C)

B. Tech. and B. Sc. 2nd Semester

Contact Hours per week: 3

Credits: 3

Introduction

Stored Program Architecture of Computers, Evolution of Processors (In terms of word length & Speed only), Storage Device- Primary Memory and Secondary Storage, Working Principle of Primary Storage devices- RAM, ROM, PROM, EPROM, EEPROM, Random, Direct, Sequential access methods.

Number System

Data Representation, Concept of radix and representation of numbers in radix r with special cases of r=2, 8, 10 and 16 with conversion from radix r1 to radix r2. r's and (r-1)'s complement. Representation of Integer in sign-magnitude, signed 1's and 2's complement. Floating point representation. Concept of bias and normalization. Representation of alphabets.

Binary Codes: Binary arithmetic, Addition and subtraction of Integers and floating point numbers. Multiplication of Integers. Gray code, BCD 8421 and 2421, Excess-3 and Excess-3 gray codes. (Not

Programming in C

Structure of C Program, Concept of Preprocessor, Macro Substitution, Intermediate code, Object Code, Executable Code. Compilation Process, Basic Data types, Importance of braces ({ }) in C Program, enumerated data type, Identifiers, Scope of Variable, Storage Class, Constants, Expressions in C, Type Casting, Control Statements, printf( ), scanf ( ), reading single character. Command Line Arguments.

Arrays in C, Pointers, Using pointers to represent arrays, Dynamic Memory allocation, Structures, using typedef, Arrays of Structures & pointers.Functions in C, Passing Parameters (By value & Reference), using returned data, Passing arrays, structures, array of structures, pointer to structures etc., passing characters and strings, The void pointer.

Suggested Books

1. Let Us C: Bala Guruswami, TATA McGraw Hill.

G2003: COMPUTER LAB - II

B. Tech./B. Sc. - II Semester
Contact Hours per week: 2 hrs
Credit(s): 1

List of Exercises

The lab is to be conducted on Linux platform. vi editor is to be used.

1. Simple OS Commands, vi editor, compiling program, compiler options, linking libraries.
2. Simple input output program integer, real character and string. (Formatted & Unformatted)
3. Conditional statement programs (if, if-else-if, switch-case)
4. Looping Program. (for, while, do-while)
5. Program based on array (one, two and three dimensions)
6. Program using Structure and Union.
7. Program using Function (with and without recursion)
8. Simple programs using pointers.
9. File handling.

G3002: Programming with C++ and JAVA

B. Sc. III Semester

Contact Hours per week: 3

Credits-3

Programming in C++

C++ Overview, C++ Characteristics,Object-Oriented Terminology,Polymorphism, Object-Oriented Paradigm, Abstract Data Types, I/O Services, Standard Template Library, Standards Compliance, Functions and Variables, Functions: Declaration and Definition, Variables: Definition, Declaration, and Scope, Variables: Dynamic Creation and Derived Data, Arrays and Strings in C++, Qualifiers, Classes in C++, Defining Classes in C++, Classes and Encapsulation, Member Functions, Instantiating and Using Classes, Using Constructors, Multiple Constructors and Initialization Lists, Using Destructors to Destroy Instances, Using Destructors to Destroy Instances, Operator Overloading, Operator Overloading, Working with Overloaded Operator Methods, Initialization and Assignment, Initialization vs. Assignment, The Copy Constructor, Assigning Values, Specialized Constructors and Methods, Constant and Static Class Members, Inheritance, Overview of Inheritance, Defining Base and Derived Classes, Constructor and Destructor Calls, Input and Output in C++ Programs, Input and Output in C++ Programs, Standard Streams, Manipulators, Unformatted Input and Output.

Introduction to JAVA Tools

Introduction to Object Orientated Programming, Abstraction, Object Oriented Programming Principles, Features of JAVA, Introduction to Java byte code, Java Virtual machine. Differences between C++ and JAVA

Suggested Books

2. Let Us C: Bala Guruswami, TATA McGraw Hill.
3. Programming with C, C++: Yashwant Kanitkar

G3003: Computer Lab-III (Object Oriented Programming)

Faculty of Engineering & Technology

B.Tech. /B.Sc. IV Sem

Contact Hours per week: 3 hrs

List of Experiments

1. To write a simple program for understanding of C++ program structure without any CLASS declaration. Program may be based on simple input output, understanding of keyword using.

2. Write a C++ program to demonstrate concept of declaration of class with public & private member, constructors, object creation using constructors, access restrictions, defining member functions within and outside a class. Scope resolution operators, accessing an object's data members and functions through different type of object handle name of object, reference to object, pointer to object, assigning class objects to each other.

3. Program involving multiple classes (without inheritance) to accomplish a task. Demonstrate composition of class.

4. Demonstration Friend function friend classes and this pointer.

5. Demonstration dynamic memory management using new & delete & static class members.

6. Demonstration of restrictions an operator overloading, operator functions as member function and/ or friend function, overloading stream insertion and stream extraction, operators, overloading operators etc.

7. Demonstrator use of protected members, public & private protected classes, multilevel inheritance etc.

8. Demonstrating multiple inheritance, virtual functions, virtual base classes, abstract classes

G4002: Web Designing Techniques

B. Tech. (All Branches except Comp. Science) / B. Sc. 4th Semester

Contact Hours per week: 3

Credits-3

Introduction to Networking Technology

Computer network, uses of computer networks, network hardware, network protocol, Reference models: The OSI reference model, the TCP/IP Reference model, a comparison of the OSI and TCP/IP reference models. Introduction of Ethernet, Hub, Client Server Architecture, Switch, modem.

The World Wide Web (WWW)

HTML History, Hypertext and Hypertext Markup Language.**HTML Documents**: Tags, Elements of an HTML Document: Text Elements, Tag Elements, Structural elements of HTML documents, Header tags, Body tags, Paragraphs, Title.

List: Numbered list, Non-Numbered lists, Definition lists

Formatting HTML Documents: Logical styles (source code, text enhancements, variables), Physical Styles (Bold, Italic, underlined, crossed),

Managing images in html: Image format (quality, size, type), Importing images (scanners), Tags used to insert images.

Frames

Tables in HTML documents: Tags used in table definition, Tags used for border thickness,

Tags used for cell spacing, Tags used for table size, Dividing table with lines, Dividing lines with cells, Cell types: Titles cells, Data cells

Hypertext and Link in HTML Documents

URL/FTP/HTTP

Types of links: Internal Links, External Link, Link Tags, Links with images and buttons, Links that send email messages Special effects in HTML documents.

Web Designing with PHP (Introduction)

Orientation and First Steps: PHP's Place in the Web World, Basic Rules of PHP Programs, Application of PHP on the internet. Advantages of PHP.

G4003: Computer Lab-IV (Web Development)

Faculty of Engineering & Technology

B. Tech. /B.Sc. IV Sem

Contact Hours per week: 2 hrs

List of Exercises

Develop a static html page using style sheet to show your own profile.

• Add a page to show 5 photos and

• Add a page to show your academics in a table

• Add a page containing 5 links to your favorite website

• Add navigational links to all above pages (add menu).

2. Update your homepage, by creating few html file.

3. Use Cascading Style Sheets to format your all pages in a common format.

4. Basic programs:

• Write a simple "hello word" program.

• Write a program to accept two strings (name and age) from user. Print welcome statement.

• Write a program to create a calculator, which can support add, subtraction and multiply and division operation.

• Write a program to take input parameters for a table (no. of rows and no. of columns), and create the desired table.

• Create a "Contact Me" page -

• Ask user to enter his name, email ID,

• Use Java-Script to verify entered email address.

• Store submitted value in a MySql database.

• Display latest 5 submitted records in contact me page.

• Display above record with navigation support. (e.g. next, prev

Environmental Studies

Environmental studies deals with every issue that affects an organism. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human impacts on its integrity. It is an applied science as its seeks practical answers to making human civilization sustainable on the earth's finite resources. Its components include biology, geology, chemistry, physics, engineering, sociology, health, anthropology, economics, statistics, computers and philosophy. As we look around at the area in which we live, we see that our surroundings were originally a natural landscape such as a forest, a river, a mountain, a desert, or a combination of these elements. Most of us live in landscapes that have been heavily modified by human beings, in villages, towns or cities. But even those of us who live in cities get our food supply from surrounding villages and these in turn are dependent on natural landscapes such as forests, grasslands, rivers, seashores, for resources such as water for agriculture, fuel wood, fodder, and fish.

Environmental Studies

Semester –I		
Course Code	**Title**	**Credits**
G3004	**Environmental Studies**	3
	Total	3

ENVIRONMENTAL STUDIES

G3004 **Credit(s): 3**

The Multidisciplinary nature of environmental studies: Definition, scope and importance

a) Need for public awareness

b) History of environmental studies

c) Important personalities in the world and India contributing to environmental concepts

d) NGOs working in the field of environmental conservation in India.

Ecosystems

a) Concept of an ecosystem.

b) Structure and function of an ecosystem

c) Producers, consumers and decomposers

d) Energy flow in ecosystem

e) Food chains, food webs and ecological pyramids

f) Introduction, types, characteristic features, structure and function of the following ecosystem:-

1) Forest ecosystem

2) Grassland ecosystem

3) Desert ecosystem.

4)Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Environmental ethics : Issues and possible solutions

g) Environmental ethics : Issues and possible solutions

Natural Resources :Renewable and non-renewable resources :

a) Forest resources : Use and over -exploitation, deforestation case studies. Timber extraction, mining, dams and their effects on forest and tribal people

b) Water resources : Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water conservation, rain water harvesting, watershed management

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes, caused by agriculture and overgrazing, effects of Modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy need, renewable and non-renewable energy sources, use of alternate energy sources. Case studies

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

g) Role of an individual in conservation of natural resources.

h)Equitable use of resources for sustainable lifestyles.

Biodiversity and its conservation

a) Biogeographical classification of India

b) Value of Biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values

c) Biodiversity at global, National and local level

d) India as a mega-diversity nation

e) Hot-spot of biodiversity

f) Threats to biodiversity :habitat loss, poaching of wildlife, man wildlife conflicts

g) Endangered and endemic species of India

h)Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity

i)Population growth, variation among nations.

j)Environment and human health.

Environmental Pollution

Causes and effects and control measures of :-

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Social Issues and the Environment

a) Solid waste management : Causes, effects and control measures of urban and industrial wastes.

b) Disaster management : floods, earthquake, cyclone and land-slides

c) From Unsustainable to Sustainable development

d) Urban problems related to energy

e) Climate change, global warming, acid rain, ozone layer depletion nuclear accidents and holocaust.

f) Consumerism and waste product

g) Environmental Protection laws in India

Suggested Books

1. Agarwal K.C. 2001 Environmental Biology, Nidi publ. Ltd. Bikaner
2. Bharucha Erach, The Biodiversity of India, Map in Publishing Pvt. Ltd. Ahemdabad-380013, India, E-mail: Mapincenet, net
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
4. Clark R.S., Marine pollution, Clanderson Press Oxford

5. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T. 2001, Environmental & Encyclopedia, Jaico Publ. House, Mumbai, 1196p
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env. Institute. Oxford Univ. Press, 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay .
10. Heywood, V.H & Watson, R.T.1995 . Global Biodiversity Assessment. Cambridge Univ. Press1140p
11. Jadhav, H & Bhosale, V.M.1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p
12. Mckinney, M.L. & Schoeb, R.M. 1996. Environmental Science systems & solutions, Web enhanced edition 639p
13. Mhaskar A.K. Matter Hazardous. Techno-Science Publications
14. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co
15. Odium, E.P. 1971. Fundamentals of Ecology, W.B.Saunders Co. USA. 574p
16. Rao M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford & IBH Publ .Co. Pvt. Ltd. 345p
17. Sharma B.K., 2001. Environmental Chemistry Goel Publ. House, Meeru
18. Townsend C.,Harper J, and Micheal Begon, Essentials of Ecology, Blackwell Science
19. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and standards, Vol I an II, Enviro Media
20. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications
21. Wagner K.D., 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

Communication Skills

Contact hours per week - 03

Total Lectures Required - 45

Unit Name	No. of lectures	To be completed by
Vocabulary-building (Technical)	6	2nd mid-term
Grammar	9	1st Mid-term
Phonetics	9	2nd mid-term
Literature (Drama) *Kanyadaan* by Vijay Tendulkar	10	end-term
Composition	6	1st Mid-term
Buffer stock of lectures	5	end-term
	45	

Semester-I

G1004 **Credit(s): 3**

Unit-I
Stepping Stones (Vocabulary Building)

Vocabulary development, Use of different words in different contexts, Technical Vocabulary, Scientific Vocabulary and Terms in daily use. Foreign words in use, Abbreviations. Introduction of Synonyms through the use of dictionary, vocabulary related to description. Phrasal verbs and its usage in sentence. Affixation- Prefix and Suffix. Conversion of one word to other- Noun to Verb, Verb to Noun, Adjective to Noun, Verb to Adverb, Adjective to Adverb, Common Noun to Abstract Noun. Synonyms, Antonyms. Words often confused.

Unit-II

Constructing Sentences

Parts of Speech- Noun, its types, Pronouns, Adjectives, Verbs, Adverbs, prepositions, Conjunctions, Interjection. Sentence Patterns- SVOCA, Subject, Verb, Object, Complement, Adverbial/ Adjunct. Construction of Sentences and their types- Types of Sentences based on sense: Assertive or Declarative Sentences, Negative Sentences, Interrogative Sentences, Imperative Sentences, Exclamatory Sentences. Types of Sentences based on structure: Simple, Compound and Complex. Subject – Verb Agreement: Concord. Modals- Notions and Perceptions. Conveying Messages- Direct and Indirect Speech (Narration). Passivization (Active- Passive Voice)

Activities: Role Plays, Dialogue Speaking, Skit, Pictures Description.

Unit- III

Speak Well (Speech Mechanism)

Phonetics
Organs of Speech- The Respiratory System, The Phonatory System, The Articulatory System. Vowel Sounds- Pure Vowel Sounds (Monophthongs), Diphthongs, Consonant sounds and Symbols. Phonetic Transcription of some Common English Words.

Activities: Self- Introduction, Practicing through video and audio clippings, Reading and comprehending through various channels like newspaper and magazines.

Unit- IV

Composition

Business Letter Writing- Structure, Format, Parts of Letter, Various Styles of Letter Writing, Floating Enquiry, Quotations, Quarry for Product specification, Price and other details, Placing the orders and their Execution, Handling Complaints, Sales Letters, Job Applications and their Cover Letters, Letters to Editors. Technical Proposal Writing.

Unit-V

Drama

Indian Drama- *Kanyadaan* by Vijay Tendulkar.

Suggested Books

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning Pvt. Ltd. (New Delhi)
2. English Grammar and Composition, Gurudas Mukherjee, Ane Books Pvt. Ltd.(New Delhi)
3. Current English Grammar and Usage with Composition, R.P. Sinha, Oxford University Press (New Delhi)
4. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw Hill (New Delhi)
5. Business Communication, Meenakshi Raman & Prakash Singh, Oxford University Press (New Delhi)
6. Professional Communication, Aruna Koneru, Tata McGraw Hills, New Delhi.
7. A Practical Course for Developing Writing Skills in English, J.K. Gangal, PHI Learning Pvt. Ltd., New Delhi.
8. "Communicative English for Engineers and Professionals", by Nitin Bhatnagar & Mamta Bhatnagar, Pearson (New Delhi).
9. "The Ace of Soft Skills", by Gopalswamy Ramesh & Mahadevan Ramesh, Pearson (New Delhi)
10. Communication Skills for Engineers and Scientists, Sangeeta Sharma & Binod Mishra, PHI Learning Pvt. Ltd.
11. *Kanyadaan* ,Vijay Tendulkar. Oxford University Press.

II Semester

G2004

Contact Hours- Per Week- 3 hrs.

Unit-I

Vocabulary related to Processes and Projects
Phrasal Verbs

Unit-II
Connecting sentences through coordination
Connecting sentences through subordination
Conditional Sentences
Passivization

Unit-III
Aspiration
Intonation
Extempore
Word Stress

Unit-IV
Short Story- How Much Land Does a Man Need? - Leo Tolstoy
Essay- The Gandhian Outlook- S. Radhakrishnan
Poem- The Unknown Citizen- W. H. Auden

Books Suggested

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning Pvt. Ltd. (New Delhi)
2. English Grammar and Composition, Gurudas Mukherjee, Ane Books Pvt. Ltd.(New Delhi)
3. Current English Grammar and Usage with Composition, R.P. Sinha, Oxford University Press (New Delhi)
4. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw Hill (New Delhi)
5. Business Communication, Meenakshi Raman & Prakash Singh, Oxford University Press (New Delhi)
6. Professional Communication, Aruna Koneru, Tata McGraw Hills, New Delhi.
7. A Practical Course for Developing Writing Skills in English, J.K. Gangal, PHI Learning Pvt. Ltd., New Delhi.
8. "Communicative English for Engineers and Professionals", by Nitin Bhatnagar & Mamta Bhatnagar, Pearson (New Delhi).
9. "The Ace of Soft Skills", by Gopalswamy Ramesh & Mahadevan Ramesh, Pearson (New Delhi)
10. Communication Skills for Engineers and Scientists, Sangeeta Sharma & Binod Mishra, PHI Learning Pvt. Ltd.

G5004: Communication in English (Technical Writing) Credit(s): 3

Unit- 1

Communication: Language and communication, differences between speech and writing, distinct features of speech, distinct features of writing.

Unit- 2

Writing Skills: Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing.

Unit- 3

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

Suggested Books

1. M. Frank. Writing as thinking: *A guided process approach, Englewood Cliffs,* Prentice Hall Reagents.
2. L. Hamp-Lyons and B. Heasely: Study Writing; *A course in written English.* For academic and professional purposes, Cambridge Univ. Press.
3. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: *A comprehensive grammar of the English language*, Longman, London.
4. Daniel G. Riordan & Steven A. Panley: *"Technical Report Writing Today"* - Biztaantra.

Additional Reference Books

1. Daniel G. Riordan, Steven E. Pauley, Biztantra: *Technical Report Writing Today*, (2004).
2. *Contemporary Business Communication*, Scot Ober, Biztantra, 5th Edition (2004).

G6004: Communication in English (Technical Writing) Credit(s): 3

Objectives: To help students develop skills and attributes necessary for successful transition in to professional life.

UNIT I

Personality Development: The concept personality - Dimensions of personality - Term personality development - Significance.

UNIT II

The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure - Do's and Don'ts regarding success and failure.

UNIT III

Self-esteem: Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low self-esteem - Positive and negative self-esteem.

UNIT IV

Interpersonal Relationships Interpersonal relationships - Teaming - Developing positive personality - Analysis of strengths and weaknesses.

UNIT V

The concept of Motivation & achievement: Concept of motivation - Significance – Intrinsic and extrinsic motives - Importance of self-motivation - Factors leading to motivation. What is achievement? - Obstacles in achieving a goal - Overcoming obstacles – Qualities of achievement oriented individuals.

Attitude: Meaning and formation of attitude; Positive attitude and ways to develop positive attitude. Prejudices and stereotypes, inter-group conflict and its management. Assertiveness,

Communication & Interpersonal relationships: Meaning**,** types and process of communication. Verbal & Non-verbal Communication ,Barriers in communication; Stages in Interpersonal Relationships, Types of Interpersonal relationships, Factors affecting Relationship, Role of Communication in Relationship, Interpersonal Relationship at Workplace, Managing Conflict in Relationship, Ways of improving Interpersonal Skills.

Creativity & Problem Solving Skills: Meaning of creativity, types of creativity. Problem solving skills and creativity. Steps in problem solving, Barriers & facilitators in problem solving.

Stress and its management: Meaning and assessment of stress, types and sources of stress, stress management techniques, Stress resistant personality, EQ, Physical health and its importance in personality.

UNIT VI

Topics prescribed for workshop

a) Group discussion

b) Presentation skill

c) Problem-solving

d) Decision-making

e) Creativity

f) Leadership

g) Time management

h) Body language

Suggested Books

1. Steven A. Beebe, Susan J. Beebe, &Diana K. Ivy, (2012).Communication: Principles for a Lifetime, 5/E. New Delhi: Pearson.
2. Edward De Bono (1999).Six Thinking Hats. Little Brown & Co.
3. Shiv Khera (2004). You Can Win - Macmillan India Limited
4. Daniel Goleman (1985). Emotional Intelligence

Current Affairs

Course Structure

Semester	Course Code	Paper	Contact Hours (Per Week)	Credits (Per Paper)
I	G1001	Indian Constitution	3	3
II	G2001	History	3	3
III	G3001	Geography	3	3
IV	G4001	English language & comprehension	3	3
V	G5001	Current events	3	3
VI	G6001	India's International interaction	3	3
		Total		18

I Semester

G1001: Indian Constitution **Credit(s)-3**

1. Making of Indian Constitution, Constituent Assembly: Composition and Working.
2. Preamble and Salient Features of Indian Constitution.
3. Fundamental Rights and Fundamental Duties, Directive Principles of State Policy.
4. President, Prime Minister & Parliament
5. Supreme Court, Judicial Review and Judicial Activism.
6. Governor, Chief Minister and State Legislatures.
7. Panchayati Raj and Municipal Governments
8. Nature of Federal System and Centre-State Relations.
9. Election Commission and Electoral Reforms, National Commission for Scheduled Castes, National Commission for Scheduled Tribes.
10. Indian Penal Code – Significant Sections

Suggested Books

1. A. G. Noorani, Constitutional Questions in India: The President, Parliament and the States, Delhi, Oxford University Press, 2000.
2. A.S. Narang, Indian Government and Politics, Geetanjali Publishing House, New Delhi, 1996 (Latest edition)
3. Bidyut Chakrabarty & Rajendra Kumar Pandey, Indian Government and Politics, SAGE, New Delhi, 2008
4. D.D. Basu, An Introduction to the Constitution of India, Prentice Hall, New Delhi. (Latest Edition)
5. G. Austin, The Indian Constitution: Corner Stone of a Nation, Oxford, Oxford University Press, 1966.
6. M.P. Singh & Rekha Saxena, Indian Politics: Contemporary issues and Concerns, Prentice Hall of India, Delhi, 2008.
7. M. V. Pylee, An Introduction to the Constitution of India, New Delhi, Vikas, 1998.
8. Nirja Gopal Jayal & Pratap Bhanu Mehta, The Oxford Companion to Politics in India, Oxford University Press, New Delhi, 2010.
9. Sunder Raman. Indian Government and Politics, Allied Publishers, New Delhi, 1988 10. Subhasn Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional law, national Book trust, India, New Delhi.

II Semester

G2001: History **Credit(s)-3**

1. A broad survey of Indian History, with emphasis on Culture and Civilisation.
2. Freedom Movement in India.
3. Elementary study of Indian Constitution and Administration.
4. Elementary knowledge of Five Year Plans of India.
5. Panchayati Raj, Co-operatives and Community Development.
6. Bhoodan, Sarvodaya, National Integration and Welfare State, Basic Teachings of Mahatma Gandhi.
7. Forces shaping the modern world; Renaissance, Exploration and Discovery; War of American Independence.
8. French Revolution, Industrial Revolution and Russian Revolution.
9. Impact of Science and Technology on Society. Concept of one World, United Nations, Panchsheel, Democracy.

10. Socialism and Communism. Role of India in the present world.

III Semester

G3001: Geography **Credit(s)-3**

1. The Earth, its shape and size. Latitudes and Longitudes, Concept of time. International Date Line. Movements of Earth and their effects.
2. Origin of Earth. Rocks and their classification; Weathering - Mechanical and Chemical, Earthquakes and volcanoes.
3. Ocean Currents and Tides
4. Atmosphere and its composition; Temperature and Atmospheric Pressure, Planetary Winds, cyclones and Anti-cyclones;
5. Humidity; Condensation and Precipitation; Types of Climate. Major Natural regions of the World.
6. Regional Geography of India - Climate, Natural vegetation.
7. Mineral and Power resources; location and distribution of agricultural and industrial activities.
8. Important Sea ports and main sea, land and air routes of India.
9. Main items of Imports and Exports of India.
10. Global warming

IV Semester

G4001: English language & comprehension **Credit(s) -3**

1. Grammar and usage
2. Vocabulary
3. Spot the error, fill in the blanks.
4. Synonyms, antonyms.
5. Spelling/ detecting miss-spelt words.
6. Idioms & phrases, one word substitution, improvement of sentences.
7. Active/ passive voice of verbs, conversion into direct/indirect narration.
8. Shuffling of sentence parts, shuffling of sentences in a passage.
9. Close passage & comprehension passage.
10. Comprehension and cohesion in extended text to test the candidate's proficiency in English.

V Semester

G5001: Current Events **Credit(s) -3**

1. Knowledge of Important events that have happened in India in the recent years.
2. Current important world events.
3. Prominent personalities - both Indian and International including those connected with cultural activities and sports.
4. Current National issues and topics of social relevance
5. The Indian economy and issues relating to planning, mobilization of resources, growth, development and employment.
6. Issues arising from the social and economic exclusion of large sections from the benefits of development.
7. Other issues relating to the development and management of human resource.
8. Health issues including the management of Public Health, Health education and ethical concerns regarding health-care, medical research and pharmaceuticals.
9. Issues relating to good governance and accountability to the citizens including the maintenance of human rights, and of probity in public life.
10. Environmental issues, ecological preservation, conservation of natural resources and national heritage.

VI Semester

G6001: India's international interaction **Credit(s) -3**

1. Foreign Affairs with special emphasis on India's relations with neighbouring countries and in the region.
2. Security and defense related matters.
3. Nuclear policy, issues, and conflicts.
4. The Indian Diaspora and its contribution to India and the world.
5. economic and trade issues such as foreign trade, foreign investment;
6. Economic and diplomacy issues relating to oil, gas and energy flows.
7. The role and functions of I.M.F.
8. The role and functions of World Bank
9. The role and functions of W.T.O.
10. The role and functions of WIPO which influence India's economic interaction with other countries and international institutions.

Value Education

G4004 **Credit(s): 3**

UNIT – I

How to be a better person and manager, Interpersonal relationship - how to co-exists with family and colleagues, Teamwork that facilitate productivity and interpersonal relations, Conflict with people in the Family and work place and its management.

UNIT – II

Social Issues – Corruption, Cyber Crime, AIDS Awareness, and Substance abuse concept, source, consequences and remedy, Impact of Mass Media.

Professional Ethics – Ethics and Values for person in the work place.

Seven Habits for being an Effective Professional – Be proactive, Begin with the end in mind, Put first things first , Think win – win, Seek first to understand than to be understood, Synergize, Sharpen the saw.

UNIT- III

Professionals with Social Responsibility – Poverty, Unemployment, Dowry system

Out of Box Thinking –Daring to Dream Different and Accomplish it.

Meaning of value education. Meaning of value. Meaning of education. Three Guna's, Nature of value. Kinds of value. List of values.

UNIT IV

Understanding value education

1. Self-exploration as the Process for value education
2. The Basic Human Aspirations –Continuous Happiness and Prosperity
3. The Program to ful-fill Basic Human Aspirations

UNIT V

Understanding The Harmony At Various Levels :

1. Understanding in the Human being as Co-existence of Self ('I') and Body
2. Harmony in the Self ('I') -Understanding Myself

3. Harmony with the Body
4. Harmony with the family
5. Harmony in the Society
6. Harmony in Nature
7. Harmony inexistence

UNIT VI

Implications of the Right Understanding:

1. Providing the Basis for Universal Human Values and Ethical Human Conduct
2. Professional Ethics in the Light of Right Understanding

Historical /Ideological Basis of Education in India

Suggested Books

1. Born To Fly, Dhinakaran Paul, G.L.B. Ernest publishers , Chennai, 1997
2. How to Win Over Depression, LaHaye Tim, Zondervan, Grand Rapids, MI, USA,1984
3. Leadership, C. Maxwell John, Riveroak Publishing, United States, 2001
4. Living With Honour, Khera Shiv, Mac Millan India Limited, New Delhi, 2003
5. Power of Leadership, USA: River Oak Publishing, Maxwell John. 2001.
6. Practical ways to a Powerful Personality, Weinberg George, Orient paperbacks,USA,2002
7. Resource for Value Education, New Delhi: Institute of Value Education Mani Jacob, ed., 2002.
8. Seven Habits of Highly Effective People, Covey Stephen, Free Press, United States, 1989.
9. The Power to be Your Best, Duncan Todd, Magna publishers limited, Mumbai, 2001
10. You Can Win, New Delhi: Mac Millan India Limited. Khera Shiv.1988.
11. R R Gaur, R Singhal and G P Bagaria: A foundation course in Human Values and professional Ethics, Excel Books, 2010