MATS University

MATS SCHOOL OF SCIENCES

SYLLABUS

FOR

Three Year Full Time Bachelor Degree Program

BACHELOR OF SCIENCE

B. Sc. Biotechnology

SEMESTER PATTERN

(2025 - 2028)

Programme: Bachelor of Biotechnology (B.Sc) Sem: I										
NHEQF Level: 5 | Courses				Teaching Scheme				Evaluation Scheme		Total Marks
Course Category	Course Sub Category	Course Name	Code	Hours			Credits			
				Theory	Tutorial	Practical		CIA	ESE	
Discipline Specific Core Course (DSCC)	Major	Biotech-I: General Biotechnology	BSC DSC – 009	3	0	0	3	70	30	100
	Major	Bioscience-I: Plant Diversity	BSC DSC - 010	3	0	0	3	70	30	100
	Major	Fundamental Chemistry - I	BSC DSC - 011	3	0	0	3	70	30	100
Discipline Specific Core Practical (DSCCP)	Major	Biotechnology Lab - I	BSC DSC - 012	0	0	2	1	35	15	50
	Major	Bioscience Lab – I	BSC DSC - 013	0	0	2	1	35	15	50
	Major	Chemistry Lab – I	BSC DSC - 014	0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Nutrition for Health	GE 005	4	0	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Communication Skill	AEC 001	2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Instrumentation and System Biology	SEC 005	2	0	0	2	35	15	50
Value Added Course (VAC)	VAC	Yoga and Human Consciousness	VAC 001 T	1	0	0	1	35	15	50
Value Added Course (VAC)	VAC	Yoga and Human Consciousness	VAC 001 P	0	0	1	1	35	15	50
Total				**18**	**0**	**7**	**22**	**525**	**225**	**750**

Programme: Bachelor of Biotechnology (B.Sc) Sem: II										
NHEQF Level: 5 | Courses				Teaching Scheme				Evaluation Scheme		Total Marks
Course Category	Course Sub Category	Course Name	Code	Hours			Credits			
				Theory	Tutorial	Practical		CIA	ESE	
Discipline Specific Core Course (DSCC)	Major	Biotech-II: General Biochemistry	BSC DSC - 044	3	0	0	3	70	30	100
	Major	Bioscience-II: Animal Kingdom	BSC DSC – 045	3	0	0	3	70	30	100
	Major	Fundamental Chemistry - II	BSC DSC - 046	3	0	0	3	70	30	100
Discipline Specific Core Practical (DSCCP)	Major	Biotechnology Lab - II	BSC DSC - 047	0	0	2	1	35	15	50
	Major	Bioscience Lab - II	BSC DSC - 048	0	0	2	1	35	15	50
	Major	Chemistry Lab – II	BSC DSC - 049	0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Intellectual Property Rights (IPR)	GE 014	3	1	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Science Communication Skills	AEC 002	2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Vermicomposting and Organic Farming	SEC 019	2	0	0	2	35	15	50

Value Added Course (VAC)	VAC	Environmental Studies & Disaster Management	VAC 002	2	0	0	2	35	15	50
Total				**18**	**1**	**6**	**22**	**490**	**210**	**700**

Programme: Bachelor of Biotechnology (B.Sc) Sem: III										
NHEQF Level: 5 | Courses				Teaching Scheme				Evaluation Scheme		Total Marks
Course Category	Course Sub Category	Course Name	Code	Hours			Credits			
				Theory	Tutorial	Practical		CIA	ESE	
Discipline Specific Core Course (DSCC)	Major	Biotech-III: Cell and Molecular Biology (SWAYAM)	BSC DSC – 312/ BSC DSC – 312M	3	0	0	3	70	30	100
	Major	Bioscience-III: Structure, Development and Reproduction in Flowering Plants	BSC DSC - 313	3	0	0	3	70	30	100
	Major	Inorganic and Physical Chemistry - I	BSC DSC - 314	3	0	0	3	70	30	100
Discipline Specific Core Practical (DSCCP)	Major	Biotechnology Lab – III	BSC DSC - 315	0	0	2	1	35	15	50
	Major	Bioscience Lab – III	BSC DSC – 316	0	0	2	1	35	15	50
	Major	Chemistry Lab - III	BSC DSC – 317	0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Food Toxicology and Adulteration	GE 311	3	1	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Hindi Bhasha	AEC 301	2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Computational Biology and Bioinformatics	SEC 304	2	0	0	2	35	15	50
Value Added Course (VAC)	VAC	Ayurvedic Biology	VAC 311	2	0	0	2	35	15	50
Total				**18**	**1**	**6**	**22**	**490**	**210**	**700**

Programme: Bachelor of Biotechnology (B.Sc) Sem: IV										
NHEQF Level: 5 | Courses				Teaching Scheme				Evaluation Scheme		Total Marks
Course Category	Course Sub Category	Course Name	Code	Hours			Credits			
				Theory	Tutorial	Practical		CIA	ESE	
Discipline Specific Core Course Core (DSCC)	Major	Biotech-IV: Industrial Biotechnology	BSC DSC - 412	3	0	0	3	70	30	100
	Major	Bioscience-IV: Medical Biotechnology (SWAYAM)	BSC DSC – 413/ BSC DSC – 413M	3	0	0	3	70	30	100
	Major	Organic and Physical Chemistry-I	BSC DSC - 414	3	0	0	3	70	30	100
Discipline Specific Core Practical (DSCCP)	Major	Biotechnology Lab - IV	BSC DSC – 415	0	0	2	1	35	15	50
	Major	Bioscience Lab - IV	BSC DSC – 416	0	0	2	1	35	15	50
	Major	Chemistry Lab - IV	BSC DSC - 417	0	0	2	1	35	15	50
Discipline Specific Elective Course (DSEC)	Minor	Plant Pathology/Microbial Diseases	BSC DSE - 407/BSC DSE - 408	3	1	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Society, Culture & Human Behaviour	AEC 309	2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Computer Application	SEC 404	2	0	0	2	35	15	50
Value Added Course (VAC)	VAC	Presentation Skills	VAC 314	2	0	0	2	35	15	50
Total				**18**	**1**	**6**	**22**	**490**	**210**	**700**

FIRST SEMESTER
BIOTECHONOLOGY I: GENERAL BIOTECHNOLOGY

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To provide fundamental knowledge of cell biology, including cell theory, cell organelles, and the structural differences between prokaryotic and eukaryotic cells.
2. To introduce the origin, development, and scope of biotechnology with emphasis on applications across agriculture, medicine, industry, and environmental sustainability.
3. To develop an understanding of microbial taxonomy, cultivation, growth, and control methods essential for microbiology research and applications.
4. To impart knowledge of basic genetics, including Mendelian principles, chromosomal structures, and inheritance patterns, as a foundation for advanced molecular biology.
5. To foster analytical and practical skills required to study biological systems, microorganisms, and genetic materials for problem-solving in applied sciences.

Course Outcomes:
Skills that students obtain after completion of the course:

1. **Explain** the principles of cell theory, cellular organelles, and the structural differences between prokaryotic and eukaryotic cells.
2. **Describe** the origin, history, and global trends of biotechnology along with its applications in agriculture, medicine, environment, and industries.
3. **Demonstrate** knowledge of microbial taxonomy, cultivation, growth, and methods of controlling microorganisms.
4. **Apply** fundamental genetics concepts including Mendelian laws, inheritance patterns, and chromosomal structures to biological problems.
5. **Integrate** concepts of cell biology, biotechnology, microbiology, and genetics to analyze biological systems and their technological applications.

Module I: Cell Biology

- **Cell Theory**
- **Cell Organelles:** Structure and Functions of Endoplasmic Reticulum, Ribosome, Golgi Complex, Lysosomes, Nucleus, Mitochondria, Chloroplast, Cytoskeleton and Vacuoles.

- **Prokaryotic & Eukaryotic cell structure**: Function and ultra-structure of cell (Gram positive and Gram negative Bacteria), Fungi, Virus, Yeast.

Module II: Fundamental Biotechnology

- **Introduction to Biotechnology :** Origin and definitions, history of biotechnology- ancient, classical and modern, major scientific discoveries in biotechnology, Biotechnology in India and its global trends, Major biotechnology institutes and companies in India.
- **Biotechnology and its application**: Applications of biotechnology in Agriculture, medicine, environment, veterinary sciences, food industry, chemical industry, pharmaceutical industry forensic science; Bioremediation and waste treatment biotechnology.

Module III: General Microbiology

- **Introduction to Microbiology:** History and Evolution of Microbiology, Microbial taxonomy, Classification of bacteria.
- **Cultivation and Maintenance of microorganisms:** Nutritional requirements and nutritional types of micro-organisms, methods of isolation, Purification and preservation.
- **Control of Microorganisms:** Concept of sterilization. Sterilization by physical, chemical and chemotherapeutic Agents
- **Microbial growth:** Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Module IV Genetics

- **Introduction to genetics:** Beginning of genetics as a science.
- **Mendel and Genetics:** Mendel's laws of genetics.
- **Chromosome**: Structure and types.

SUGGESTED READINGS:

1. Gereld Karp - Dell and molecular biology, 4th Edition (2005)
2. C.B. Powar- Cell biology, First Edition (2005), Himalaya Publishing House.
3. Biotechnology Fundamentals and Application by S. S. Purohit
4. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference,
5. Laboratory security: http://ehs.uky.edu/ohs/labsecurity.html

6. Basic Laboratory Methods for Biotechnology, by Lisa A. Seidman & Cynthia J. Moore. Prentice Hall
7. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
8. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR.General Microbiology. 5thedition. McMillan.
9. Prescott, Harlyey and Klein - Microbiology, Third Edition, Wm. C. Brown Publishers (1996).
10. R.C. Dubey and D.K. Maheshwari,Microbiology (2006). S.Chand Publication.
11. Elements of Human Genetics. I.I. cavalla-Sfoeza, WA Benjamin Advanced Book Program.
12. R.C. Dubey and D.K. Maheshwari: Practical Microbiology. S.Chand Publication.

BIOSCIENCE I: PLANT DIVERSITY

Credit: 3

Total Marks: 100 (70+30)

Course Objectives:

1. To provide a comprehensive understanding of lower groups of organisms (Bacteria, Viruses, Fungi, Algae, Bryophytes, and Pteridophytes) with respect to their structure, reproduction, and classification.
2. To familiarize students with the ecological and economic importance of microorganisms, fungi, algae, bryophytes, and pteridophytes.
3. To enable students to identify and compare representative genera across different groups based on morphological and reproductive features.
4. To develop skills in analyzing life cycles and adaptive strategies of lower plants and microbes.
5. To lay a foundation for advanced studies in taxonomy, plant pathology, applied microbiology, and evolutionary biology.

Course Outcome:

Skills that students obtain after completion of the course:

1. **Explain** the general structure, nutrition, reproduction, and significance of bacteria, cyanobacteria, viruses, and mycoplasma.
2. **Differentiate and classify** major groups of fungi and describe the life cycle of selected representatives along with their economic importance.
3. **Analyze and interpret** the morphological and reproductive features of algae, with emphasis on their classification, life cycles, and economic roles.

4. **Demonstrate knowledge** of bryophytes by describing their classification, structure, reproduction, and ecological significance.
5. **Compare and evaluate** the characteristics, structure, and reproduction of various pteridophytes and discuss their role in plant evolution.

Module-I

Bacteria and Viruses: General account of bacteria structure; nutrition, reproduction and economic importance; general account of cyanobacteria. General account of viruses and mycoplasma.

Module–II

Fungi: General characters, classification, important features and life history of Mastigomycotina – Phytophthora; Zygomycotina – Mucor; Ascomycotina – Saccharomyces; Basidiomycotina – Puccinia; Deuteromycotina – Colletotrichum; general account of Lichens. Economic importance of fungi.

Module-III

Algae: General characters, classification, important features and life history of Chlorophyceae – Volvox, Oedogonium; Xanthophyceae – Vaucheria; Phaeophyceae – Ectocarpus; Sargassum Rhodophyceae – Polysiphonia. Economic importance of algae.

Module-IV

Bryophyta: Outlines of classification and importance of bryophytes. Structure, reproduction and classification of Hepaticopsida (e.g. Riccia Marchantia); Anthocerotopsida (Anthoceros), Bryopsida (Funaria).

Module-V

Pteridophyta: Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in Rhynia, Lycopodium, Selaginella, Equisetum and Marsilea.

SUGGESTED READINGS:

1. Introduction to Botany – Bendre & Kumar
2. Botany for Degree Students – Algae: Vashishtha et al.
3. Botany for Degree Students – Bryophyta: Vashishtha et al.
4. An Introduction to Pteridophyta – A. Rashid
5. Angiosperms: G. L. Chopra
6. Plant Taxonomy: O. P. Sharma

FUNDAMENTAL CHEMISTRY I

Credit: 3

Total Marks: 100 (70+30)

Course Objectives:

1. To understand the historical development of chemistry in ancient India and recognize the contributions of Indian chemists to modern science.
2. To explain atomic structure, quantum mechanical concepts, and periodic properties of elements.
3. To study different types of chemical bonding and weak interactions that govern molecular structures and stability.
4. To analyze the chemistry of s- and p-block elements, their compounds, and anomalous behavior.
5. To develop knowledge of organic reaction mechanisms, electronic effects, and stereochemistry for predicting reactivity and isomerism.

Course Outcomes:

Skills that students obtain after completion of the course:

1. Describe the contributions of ancient Indian chemists, traditional practices, and modern pioneers like P.C. Ray in the development of chemistry.
2. Explain atomic structure, quantum numbers, electronic configurations, and periodic properties of elements with their significance.
3. Apply concepts of ionic, covalent, VBT, VSEPR, and MO theories to predict molecular geometry, bond order, stability, and magnetic properties, along with recognizing weak intermolecular forces.
4. Analyze the chemistry of s- and p-block elements, their anomalies, oxides, hydrides, nitrides, halogens, interhalogens, and complexes.
5. Interpret electronic effects, bond cleavage, reaction intermediates, and stereochemical concepts (chirality, optical activity, geometrical isomerism) to predict organic reactivity and isomerism.

Module I

Chemistry in Ancient India: Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry. e.g. Metallurgy dyes, pigments cosmetics, Ayurveda, Charak Sanhita. Ancient Indian Chemist: Their contribution and Books –Rishi Kanad, Acharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar Ramchadra, Somadava, Gopalbhatta. etc. Indian Chemistry of 19th centuary –Aacharya Prafulla Chandra RayHis Contribition and work for the Indian Chemistry.

(B) Atomic Structure and Periodic Properties: (i) Review of Bohr's theory and its limitation. Dual nature of particle and waves, de Broglie's equation, Heisenberg Uncertainty principle and its significance, (ii) Quantum numbers and its significance, Rules for filling electrons in various orbitals, Pauli Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations (iii) Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic & Ionic radii. Ionization energy and

factors affecting ionization energy. Electron affinity. Electronegativity----Pauling's /Milliken's electronegativity scales. Relation of electronegativity with hybridization.

Module II

Chemical Bonding I

Ionic Bonding: General characteristics of ionic bonding. Ionic bonding& Energy: Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds, Born-Haber cycle and its Applications: Covalent character in ionic compounds, polarizing power & polarizability. Fajan's rules.

Covalent Bonding: Lewis structure, Valence bond theory, Hybridization, dipole moment and percentage ionic character, Valence shell electron pair repulsion (VSEPR).

Chemical Bonding II

MO Theory: LCAO method –criteria of orbital overlapping, types of molecular CHEMISTRY Theory orbitals σ-, π- and δ-MOs; formation of σ- and π- MOs and their schematic illustration: qualitative MO energy diagram of homo and hetro-diatomic molecules, magnetic properties, bond order and stability of molecules and ions.

Weak Chemical Forces: Vander Waals forces, ion- dipole forces, dipole-diploe interactions, ion-induced dipole interactions dipole–induced dipole interactions. Repulsive forces, Hydrogen bonding.

Module III

Chemical Properties of s-Block metals: Reaction with water, air, and nitrogen, Anomalous behaviour of Li and Be, Compounds of s- block metals: Oxides, Hydroxides, peroxides and superoxides. Complexes of s- block metals, Complexes with Crown ethers

Chemistry of p -Block Elements: Boron group: Hydrides, Diboranes, Borazine, Carbon groups: Carbides, Silicates, Nitrogen Groups: Hydrides of Nitrogen, Structure of oxides of nitrogen, Structure of oxyacids of nitrogen, Nitrides, Structure of Oxides and oxoacids of Phosphorus. Halogen: Hydrides, Oxides and oxyacids of halogens - Interhalogen compounds and pseudo halogens

Module IV-Electronic Effects in Organic Compounds

Bond Cleavage: Homolytic and heterolytic cleavage, bond energy, bond length and bond angle. Electron Displacement Effects: Inductive, inductomeric, electrometric, mesomeric, hyper conjugation, and steric effects. Tautomerism. Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne.

Stereochemistry of Organic Compounds

(i) Optical Isomerism: Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereo genic centres, Erythro & Threo, Diastereomers and meso compounds, Inversion, retention and racemization, relative configuration (D/L), and absolute configuration (R/S) nomenclature: sequence rules). (ii) Geometrical Isomerism: Geometric isomerism (cis-trans isomerism) in alkenes, E/Z system of nomenclature.

SUGGESTED READINGS:

1. Basic Inorganic Chemistry, F.A Cotton, G. Wilkinson and P.L Gauss, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and JAlexander, John Wiley.
4. Inorganic Chemistry, W. W. Porterfield, Addison- Wesley.
5. Inorganic Chemistry, A.G. Sharp, ELBS.
6. Inorganic Chemistry, G.L. Missiles and D.A. Tarr, Prentice Hall.
7. Advanced Inorganic Chemistry, Satyas Prakash.
8. Advanced Inorganic Chemistry, Agarwal & Agarwal.
9. Introduction to Organic Chemistry, Struiweisser, Heathock and Kosover, Macmillan.
10. Advanced Inorganic Chemistry, Satyas Prakash.
11. Advanced Inorganic Chemistry, Agarwal & Agarwal.
12. Advanced Inorganic Chemistry, Puri & Sharma, S. Naginchand.
13. Organic Chemistry, P.L. Soni.
14. Organic Chemistry, Bahl & Bahl
15. Organic Chemistry, EA. Carey, MC Graw HiII
16. Organic Chemistry, Vol. I, II & III, S.M. Mukherjee, S.P. Singh and R.P. Kapoor,Wiley-eastern (New-Age).

LAB COURSE: BIOTECHNOLOGY I

Credit: 1
Total Marks: 50 (35+15)

Course Objectives

1. To provide hands-on training in basic biotechnological laboratory operations, safety, and documentation practices.
2. To familiarize students with the preparation of culture media and cultivation techniques for microbial growth.
3. To develop practical skills in smear preparation and staining methods for microbial identification.
4. To impart knowledge and technical ability in different methods for isolating and maintaining pure microbial cultures.
5. To enhance students' competence in recording, analyzing, and reporting experimental results systematically.

Course Outcomes:
Skills that students obtain after completion of the course:

1. Demonstrate proficiency in fundamental laboratory techniques, safety protocols, and proper documentation of experiments.
2. Prepare and differentiate between basic liquid and solid culture media, and apply cultivation techniques to study microbial growth.
3. Perform smear preparation and implement differential staining methods to distinguish Gram-positive and Gram-negative microorganisms.
4. Apply various culture isolation techniques (streak, spread, pour, and broth methods) to obtain pure microbial cultures.
5. Analyze, interpret, and present experimental results with scientific accuracy in the form of lab reports and practical records.

1. Biotechnological Techniques

(a)Basic operations in laboratory

(b) Documentation: The Lab Notebook & Lab Report

(c) Lab Equipment & Reagent Orientation

2. Preparation of media and cultivation Techniques

(a) Basic liquid media (broth)

(b) Basic Solid media

(c) Isolation and enumeration of micro organisms from air, water and Soil

3. Smears and Staining Methods

(a) Preparation of bacterial smear

(b) Gram Negative & Positive staining

4. Methods of obtaining pure cultures

(a) Streak plate method

(b) Pure plate method

(c) Spread plate method

(d) Broth cultures

LAB COURSE: BIOSCIENCE I (PLANT DIVERSITY)

Credit: 1
Total Marks: 50 (35+15)

Course Objectives:

1. To develop skills in preparing and interpreting microscopic slides for the study of microorganisms and plant groups.
2. To familiarize students with the identification of disease symptoms and application of Gram's staining technique in microbiology.
3. To provide hands-on experience in studying algae, fungi, bryophytes, and pteridophytes using permanent slides and sections.
4. To understand the structural diversity, classification, and adaptations of lower plants through laboratory observation.
5. To enhance scientific observation, documentation, and interpretation skills in practical botany and microbiology.

Course Outcomes:
Skills that students obtain after completion of the course:

1. Demonstrate proficiency in preparing and interpreting Gram's staining and recognize microbial structures.
2. Identify and describe key structural features of algae, fungi, bryophytes, and pteridophytes from permanent slides and sections.
3. Differentiate among plant groups based on their morphological and anatomical characteristics.
4. Apply microscopic techniques to analyze disease symptoms and plant tissues effectively.
5. Record, analyze, and present laboratory findings with scientific accuracy.

1. Disease Symptoms/Gram's Staining
2. Study of different algae, with the help of permanent slides and also by cutting sections
3. Study of different Fungi, with the help of permanent slides and also by cutting sections
4. Study of different Bryophytes, with the help of permanent slides and also by cutting sections.
5. Study of different Pteridophyta, with the help of permanent slides and also by cutting sections.

LAB COURSE: FUNDAMENTAL CHEMISTRY I

Credit: 1
Total Marks: 50 (35+15)

Course Objectives

1. Develop practical skills in qualitative analysis of inorganic cations and anions using semi-micro techniques.
2. Acquire the ability to identify, separate, and analyze common inorganic ions systematically.
3. Learn calibration and accurate determination of physical properties (melting and boiling points) of organic compounds.
4. Apply mixed melting point techniques to assess purity and composition of organic substances.
5. Cultivate safe and precise laboratory practices, including observation, recording, and interpretation of experimental data.

Course Outcomes:
Skills that students obtain after completion of the course:

1. Identify and separate common inorganic cations and anions with accuracy using semi-micro methods.
2. Calibrate laboratory instruments and determine melting and boiling points of organic compounds.
3. Assess purity and composition of organic mixtures using mixed melting point analysis.
4. Record, analyze, and interpret experimental data effectively.
5. Demonstrate safe and systematic laboratory practices in both inorganic and organic chemistry experiments.

1. Inorganic Chemistry

Semi micro Analysis-cations analysis separation and identification of ions from Pb2+, Bi3+, Cu2+, Cd2+, Sb3+, Sn2+,4+, Fe3+, AI3+, Cr3+. Ni2+, C02+, Zn2+, Mn2+, Ba2+, Sr2+, Ca2+, Mg2+, NH4+ and Anions CO2/ 3- , SO2/ 3- , S 2- , SO2/ 4- , NO2 - , NO3, Cl- ,Br- ,I- , CH3COO- , C2O2/4- , BO3/ 5- , F- .

2. Organic Chemistry

i. Calibration of Thermometer 800-82° (Naphthalene), 113.50-1140 (Acetanilide), 132.50- 1330 (Urea), 1000(Distilled Water)

ii. Determination of Melting Point 80° -82° (Naphthalene), Benzoic and 121.50 -122°, Urea 132.5° -133°, Succinic acid 184.50-1850, Cinnamic acid 132.50-1330, Salicylic acid 157.50- 1580 Acetanilide 113.50-1140, m-Dinitrobenze 900, p-Dichlorobenzene 520Aspirin 1350.
iii.Determination of boiling points Ethanol = 780, Cyclohexane 81.40, To 110.60, Benzene 800

iv. Mixed meting point Determination- Urea- Cinnamic acid mixture of various compositions (1: 4, 1: 1, 4: 1)

SUGGESTED READINGS

1. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta & K.S. bajpai, TataMc Graw Hill
2. Vogel's text book of practical organic chemistry, B.S. Furnis A.J. Hannaford, V. Rogers, P.W.G. Smith & Ar. Tatchel, ELBS
3. Experiments in general chemistry, CNR Rao & U.C. Agarwal
4. Experiments in physical chemistry, R. C. Das & B. Behara Tata Mc Graw Hill
5. Advanced practical physical chemistry, J.B. Yadav, Goel publishing house.

NUTRITION FOR HEALTH

Credit: 4
Total Marks: 100 (70+30)

Course Objectives

1. Understand the basic principles of nutrition and the role of nutrients in human health.
2. Analyze the relationship between diet, lifestyle, and non-communicable diseases.
3. Apply nutritional knowledge to assess dietary habits and suggest modifications for different age groups and health conditions.
4. Evaluate current nutritional guidelines and food-based recommendations.
5. Design balanced diet plans for individuals considering age, gender, physiological status, and health needs.

Course Outcomes:

Skills that students obtain after completion of the course:

1. Understand the basic principles of nutrition
2. Analyze the relationship between diet and disease
3. Apply nutritional knowledge to assess and modify diets
4. Evaluate nutritional guidelines and recommendations
5. Design balanced diet plans

MODULE I Basic concepts in food and nutrition

- Basic terms used in study of food and nutrition.
- Understanding relationship between food, nutrition and health.
- Balanced diets, micro and macro nutrients.
- Functions of food-physiological, psychological and social.

MODULE II Nutrients

- Functions, dietary sources and clinical manifestations of deficiency/efficiency of the following nutrients: Carbohydrates, Lipids, Proteins, Milk & Milk products and Food Groups.
- Hypertension
- Obesity
- CHD
- Type 2 Diabetes
- Fat soluble vitamins-A, D, E and K.
- Water soluble vitamins- Thiamin, Riboflavin, Niacin, Pyridoxine, Folate, Vitamin B12 and Vitamin C, Minerals – Calcium, Iron, Iodine and Zinc.

MODULE III: Food Adulteration

- PFA definition of food adulteration.
- Adulterants in commonly consumed food items.
- Accidental contamination: botulism, staphylococcal and aflatoxin intoxication.

- Importance of food labels in processed foods and nutritional labeling.
- Food laws, regulations and standards- Codex Alimentarius - Prevention of Food Adulteration (PFA) Act - Agmark - Fruit Products Order (FPO) - Meat Products Order (MPO) - Bureau of Indian Standards (BIS) - MMPO – FSSAI.

MODULE IV: Nutritional problems, and related nutrition programmes

- Etiology, prevalence, clinical features and preventive strategies of Under nutrition.
- National Nutrition Policy and Programmes- Integrated Child Development Services (ICDS) Scheme, Mid day Meal Programme (MDMP), National Nutrition for Health programmes for prevention of Anaemia, Vitamin A deficiency, Iodine Deficiency Disorders.

SUGGESTED READINGS:

1. **Bamji, M. S., Krishnaswamy, K., & Brahmam, G. N. V.** (2009). *Textbook of Human Nutrition*. Oxford & IBH Publishing.
2. **Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C.** (2011). *Nutritive Value of Indian Foods*. National Institute of Nutrition (NIN), ICMR.
3. **Srilakshmi, B.** (2022). *Nutrition Science*. New Age International Publishers.
4. **Srilakshmi, B.** (2021). *Dietetics*. New Age International Publishers.
5. **Srilakshmi, B.** (2022). *Food Science*. New Age International Publishers.
6. **Swaminathan, M.** (2007). *Handbook of Food and Nutrition*. The Bangalore Printing and Publishing Co.
7. **Manay, N. S., & Shadaksharaswamy, M.** (2014). *Foods: Facts and Principles*. New Age International.
8. **Whitney, E., & Rolfes, S. R.** (2022). *Understanding Nutrition*. Cengage Learning.
9. **Wardlaw, G. M., & Smith, A.** (2021). *Contemporary Nutrition: A Functional Approach*. McGraw Hill.
10. **Sharma, H. K., & Singh, S.** (2015). *Food Processing and Preservation*. International Book Distributors.
11. **Park, K.** (2021). *Park's Textbook of Preventive and Social Medicine*. Banarsidas Bhanot Publishers.

12. **Rao, B. S. N., & Deosthale, Y. G.** (1998). *Nutrition and Health*. National Institute of Nutrition (NIN).
13. **Gopalan, C.** (2007). *Nutrition in Developmental Transition in South-East Asia*. National Institute of Nutrition (NIN), ICMR.

INSTRUMENTATION & SYSTEM BIOLOGY

Credit: 2
Total Marks: 50 (35+15)

Course objectives

1. To introduce students to the fundamental principles, terminology, and classifications of modern biochemical instrumental methods.
2. To develop understanding of microscopy techniques and their applications in biological research.
3. To explain the principles, types, and applications of chromatographic techniques for separation and analysis of biomolecules.
4. To familiarize students with electrophoretic methods for analyzing macromolecules.
5. To provide knowledge on spectroscopic techniques, including absorption spectroscopy, and their use in quantitative and qualitative biochemical analysis.

Course Outcome:
Skills that students obtain after completion of the course:

1. Define key terms and concepts associated with biochemical analysis and classify different instrumental techniques.
2. Explain the principles, instrumentation, and applications of various microscopy techniques including light, fluorescence, phase contrast, TEM, and SEM.
3. Describe the theory, techniques, and applications of chromatography, including TLC, HPLC, GLC, ion-exchange, gel, and affinity chromatography.
4. Demonstrate understanding of electrophoresis principles, instrumentation, and techniques for gel and paper electrophoresis.
5. Apply the Beer-Lambert law and explain factors affecting light absorption by molecules in absorption spectroscopy.

MODULE I: An introduction to instrumental methods: Terms associated with Biochemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation.

MODULE II: Microscopy – Instrumentation, Technique & Principle of Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase contrast microscopy, TEM & SEM.

MODULE III: Chromatography - Concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography).

MODULE IV: Electrophoresis - Instrumentation, Technique & Principle of Gel Electrophoresis & Paper Electrophoresis.

MODULE V: Spectroscopy - Absorption 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 properties of a Chromophore.

SUGGESTED READINGS:

1. **Douglas A. Skoog, F. James Holler & Stanley R. Crouch** – *Principles of Instrumental Analysis* (6th Edition, Thomson Brooks/Cole, 2006).
2. **Willard, Merritt, Dean & Settle** – *Instrumental Methods of Analysis* (7th Edition, CBS Publishers, 2004).
3. **C.N. Banwell & E.M. McCash** – *Fundamentals of Molecular Spectroscopy* (4th Edition, McGraw-Hill, 1994).
4. **Robert A. Day & Barbara H. Gray** – *Microscopy and Microanalysis* (Cambridge University Press).
5. **R. K. Sharma & Shashi Bala** – *Chromatography: Concepts and Applications* (Pearson, 2013).
6. **R. Hames & D. Rickwood** – *Gel Electrophoresis of Proteins: A Practical Approach* (Oxford University Press, 1998).
7. **Donald L. Pavia, Gary M. Lampman, George S. Kriz & James A. Vyvyan** – *Introduction to Spectroscopy* (5th Edition, Cengage, 2015).

YOGA & HUMAN CONSCIOUSNESS

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. Understand the meaning, historical evolution, and multidimensional importance of Yoga as an art, science, and philosophy.
2. Comprehend the philosophical perspectives of Yoga, including insights from the Bhagavad Gita and Yoga Sutras, and apply its principles in daily life.
3. Develop practical skills in yogic practices such as Asanas, Pranayama, Kriya, Mudra, and Bandha to promote physical and mental well-being.
4. Analyze the concept of human consciousness and explore meditation techniques for personal growth, mental clarity, and stress management.
5. Integrate Yoga philosophy and practices to enhance overall health, wellness, and self-awareness.

Course Outcomes:
Skills that students obtain after completion of the course:

1. **Define and explain** the meaning, history, and significance of Yoga, including its role as art, science, and philosophy.
2. **Describe and differentiate** the key Yoga philosophies, including Karma, Raja, Jnana, and Bhakti Yoga, along with the significance of Yoga Sutras and the concept of Ishwara.
3. **Demonstrate** various yogic practices, including Asanas, Pranayama, Kriya, Mudra, and Bandha, and explain their effects on health and wellness.
4. **Compare and contrast** Yoga and conventional physical exercise in terms of benefits to body and mind.
5. **Explain the concept of human consciousness** and apply meditation techniques like Japa, Ajapajapa, Yoga Nidra, and Trataka for mental balance and personal development.

Module I: Introduction to Yoga
i. Meaning and definitions of Yoga
ii. History of Yoga
iii. Importance of Yoga as art, science and philosophy
iv. Yogic Diet

Module II: Philosophical Perspective of Yoga
i. Yoga in Bhagavad Gita: Karma Yoga, Raja Yoga, Jnana Yoga and Bhakti Yoga
ii. The 'Yoga Sutras' in general; its significance in life.

iii. Limbs/parts of yoga (Astanga Yoga) according to the 'Yoga Sutras'
iv. Concept of Ishwara; Ishwara in Yoga Philosophy

Module III: Yogic Practices for Health & Wellness
i. Asana, its classification and effects
ii. Pranayama, its types and effects
iii. Kriya, Mudra and Bhandha: Procedure and Effects
iv. Yoga Vs Physical Exercise

Module IV: Human Consciousness & Meditation
i. Meaning & Definition of Human Consciousness.
ii. Need for Study of Human Consciousness.
iii. Current Crisis of Human Consciousness & Measures for meaningful solution.
iv. The Theory of Meditation- Japa Meditation, Ajapajapa Meditation, Yoga Nindra, Tratak.

PRACTICAL

i. Suryanamskara – (12 counts)
ii. Asana a) Standing: -Tadasana, Ardhakatichakrasana, Ardhachakrasana, Trikonasana, Vrikshasana.
b) Sitting: - Vajrasana, Padmasana, Goumukhasana, Paschimottanasana, Shashankasana.
c) Lying Supine Position: - Shavasana, Setubandhasana, Chakrasana, Sarvangasana, Halasana.
d) Lying Prone Position - Makarasana, Bhujangasana, Shalabhasana, Dhanurasana, Naukasana.
iii. Pranayama Nadishodhana, Suryabhedana, Chandrabhedana, Shitali, Bhastrika, Bhramari.
iv. Bandh & Mudra: Jalandharabandha, Uddiyanbandha, Moolabandha, Yogamudra, Viparitkarnimudra,

Shambhavimudra.
v. Dhyana and its forms.

SUGGESTED READINGS:

1. *The Bhagavad Gita* – with commentaries by Swami Vivekananda / Swami Prabhupada / Paramhansa Yogananda.
2. *Yoga Sutras of Patanjali* – with commentary by Swami Satchidananda or Swami Vivekananda.
3. *Hatha Yoga Pradipika* – by Swatmarama, translated with notes by Swami Muktibodhananda.
4. *Gheranda Samhita* – traditional text on yogic practices.
5. Swami Vivekananda – *Raja Yoga*.
6. Georg Feuerstein – *The Yoga Tradition: Its History, Literature, Philosophy and Practice*.
7. Mircea Eliade – *Yoga: Immortality and Freedom*.

Practical Guides (Asana, Pranayama, Mudra, Bandha, Kriya)

8. B.K.S. Iyengar – *Light on Yoga* and *Light on Pranayama*.
9. Swami Satyananda Saraswati – *Asana Pranayama Mudra Bandha*.
10. Swami Vishnudevananda – *The Complete Illustrated Book of Yoga*.
11. Swami Niranjanananda Saraswati – *Prana and Pranayama*.

SECOND SEMESTER
BIOTECHNOLOGY II: GENERAL BIOCHEMISTRY

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of biochemistry.
2. To train the students to pursue further education.
3. Become familiar with biochemical tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Biochemistry and key principles of Biochemistry.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

Module I

Carbohydrates: General Properties, Types (Monosaccharide, Oligosaccharide and Polysaccharide) and Biological Importance**.**

Monosaccharide: Structure, Occurrence, Reactions and Biological importance of Monosaccharide. **Isomerism**: Stereoisomerism and Optical isomerism, Ring Structure and Anomeric forms, Mutarotation. **Derivatives**: Derivatives of Monosaccharide, Di and Tri-saccharide.

Important Polysaccharide: Glycogen, Starch and Cellulose.

Module II

Lipids: General Properties and Classification.

Fatty acids: Nomenclature, Classification, Structure and Properties of Saturated and Unsaturated fattyacids. Essential Fatty Acids.

Triacylglycerols: Properties and Characterization of Fats, Hydrolysis, Saponification value, Acid value,Rancidity of fats and Functions.

Biological Significance of Glycerophospholipids, Sphingomyelins and Glycolipids.

Module III

Amino acids: Definition, Classification and Properties of Amino acids.

Peptide bond: Definition, Structure, Solid phase Protein Synthesis in brief, C – terminal and N – terminal

Amino acid determination.
Protein: Structure, Types (Primary, Secondary, Tertiary and Quaternary) and Functions.

Module IV

Nucleic Acids: Definition, Structure, Phosphodiester bond and Properties.
Purine and Pyrimidine Bases: Structure and Types, Composition of DNA and RNA, Nucleosides andNucleotides.

DNA double helix: Watson - Crick Model, Complementary base- pairings, Base staking, Chargaff's rule. Different forms of DNA structure (A, B & Z DNA), Major and Minor groove, Denaturation and Annealingof DNA
RNA: Types of RNA, Secondary and Tertiary structure of t-RNA.

Module V
Porphyrin: General Properties, Structure of Nucleus and Classification.
Metalloporphyrins: Structure of Haemoglobin, Myoglobin, Chlorophyll, Cyanocobalamin and their Biological Importance.

SUGGESTED READINGS:

1. Biochemistry: J M Berg, J L Tymoczko and L Stryer.
2. Lehninger Principles of Biochemistry: David L Nelson and Michael M Cox.
3. Biochemistry: D Voet, J Voet and C W Pratt.
4. Biochemistry: U Satyanarayana and U Chakrapani.
5. Textbook of Biochemistry: Edward S West.
6. Fundamentals of Biochemistry: J L Jain, Sunjay Jain and Nitin Jain
7. Harpers Illustrated Biochemistry: Robert K Murray, Daryl K Garner and Peter A Mayes

BIOSCIENCE-II: ANIMAL KINGDOM

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of animal kingdom.
2. To train the students to pursue further education.
3. To be familiar with taxonomic study.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Animal Kingdom and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Introduction to Animal kingdom, Major and Minor phyla

Protozoa: General characters, type study: *Plasmodium*; Protozoa and diseases

Porifera: General characters, type study: *Sycon*- Morphology, Different types of cells in *Sycon*, canal system in Porifera.

Coelenterate: General characters, type study: *Obelia* -Morphology of *Obelia* colony, life history.

Helminthes, type study: Liver fluke - Structure, Life cycle

Module II

Annelida: General characters, type study: *Nereis* - Morphology; Digestive, Excretory and Reproductive systems.

Arthropoda: General characters, type study: Cockroach - Morphology; Digestive, Respiratory and Reproductive systems. Economic importance of insects.

Mollusca: General characters; type study: *Pila* - Morphology; Respiratory system.

Echinodermata: General characters, Type study: Star fish - Morphology; Respiratory and Canal system

Module III

General characters of Hemichordate, Chordate and Protochordates;

Origin and classification of chordate.

Module IV

Fishes: General characters, Skin and scales, Migration, Parental care;
Amphibia: General characters parental care, Neoteny;
Reptiles: General characters, Extinct reptiles, Poisonous and non poisonous snakes; Poison apparatusand snake venom

Module V

Birds: General characters, migration, Flight adaptation
Mammals: General characters, aquatic, prototheria and affinities.

SUGGESTED READINGS:

- Biological Sciences: Taylor, Green & Stout.
- Concepts in Biology; Enger & Ross.
- Chordate Zoology: Dhami & Dhami.
- Invertebrates: R. L. Kotpal.
- Modern Text Book of Zoology – Vertebrates: R. L. Kotpal

FUNDAMENTAL CHEMISTRY-II

Credit: 3

Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To gain experience with standard chemical tools.
5. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I Acid, Base and Solvent System

Theories of Acids and Bases : Arrhenius, Bronsted-Lowry, conjugate acids and bases, relative strengths of acids and bases, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

HSAB Concept: Classification of Acids and Bases according to HSAB Theory (Hard, Borderline, Soft). Applications of HSAB Theory in Inorganic Reactions-Solubility, Selectivity, Redox Reactions.

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, Liquid ammonia as a solvent. Acid-base, precipitation and complex formation reactions.Solutions of alkali and alkaline earth metals in ammoniaapplication.

Module II Gaseous State Chemistry of C-C o-Bonding

Alkanes : Preparation (Wurtz reaction, reduction/hydrogenation of alkenes, Corey-House method). Reactions (mechanisms):halogenation, free radical substitution.
Cycloalkanes : Preparation (Dieckmann's ring closure, reduction of aromatic hydrocarbons), Reactions (mechanisms) : substitution and ring-opening reactions. Stability of cycloalkanesBaeyer's strain theory, Sachse and Mohr predictions, Conformational structures of ethane, n-butane and cyclohexane.
Chemistry of C-C π-Bonding
Alkenes: Preparation methods (dehydration, dehydrohalogenation,dehydrogenation, Hoffmann and Saytzeff rules, cis and trans eliminations), Reactions (mechanisms) : electrophilic and free radical addition (hydrogen, halogen, hydrogen halide, hydrogen bromide, water, hydroboration, ozonolysis, dihydroxylation

with KMnO). Dienes : 1, 2- and 1, 4-additions, Diels-Alder reactions.
Alkynes: Preparation (dehydrohalogenation, dehydrogenation),
Reactions: Acidity, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation, ozonolysis, hydroboration/oxidation.
Aromatic hydrocarbons: Aromaticity : Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and FriedelCraft's alkylation/acylation with their mechanism. Directive effects of the groups.

Module III
Behavior of Ideal Gases : Kinetic theory of gases postulates and derivation of the equation, PV = 1/3 mnc and derivation of the gas laws, Maxwell's distribution of molecular velocities, effect of temperature, types of molecular velocities, degrees of freedom. Principle of equipartition of energy.
Behaviour of Real Gases: Deviation from ideal behavior, derivation of vander Waals equation of state and critical constants. Liquid State Chemistry : Structure of liquids (Eyring Theory),Properties of liquids, viscosity and surface tension.
Liquid State Chemistry: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Crystal defects.

Module IV
Colloids and Surface Chemistry: Classification, Optical,Kinetic and Electrical Properties of colloids, Coagulation,Hardy-Schulze law, flocculation value, Protection, Gold number,Emulsion, micelles and types, Gel, Syneresis and thixotropy,Physical adsorption, chemisorption.

Chemical Kinetics: Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, Methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, Collision theory, demerits of collision theory, Non-mathematical concept of transition state theory.
Catalysis: Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristics of catalyst, Enzyme catalyzed reactions,Industrial applications of catalysis.

SuggestedReadings:

1. Physical chemistry,G. M. Barrow,International student edition,McGrawHill
2. Basic programming with application,V.K.Jain,Tata McGraw-Hill.
3. Computers &Common sense.,R Hunt & Shelly,Prentice-Hall
4. University general chemistry,C.N.R.Rao,Macmillan.
5. Physical Chemistry,R.A.Alberty,Wiley Eastern.
6. The elements of Physical Chemistry, P.W.Atkin,Oxford.
7. Physical Chemistry thought problems, S.K Dogra& Dogra,WileyEastern.
8. Physical Chemistry, B.D. Khosla
9. Physical Chemistry, Puri &Sharma
10. Basic Inorganic Chemistry,F.A Cotton,G.Wilkinsonand, P.LGauss,Wiley.
11. Concise Inorganic Chemistry,J.D.Lee,ELBS.
12. Concepts of models of Inorganic Chemistry, B. Douglas, D. McDaniel and JAlexander,JohnWiley.
13. Inorganic Chemistry, D.E.Shriver,P.W.AtkinsandC.H.L.Angford,Oxford.

Lab Course: Biotechnology II

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge,
2. To train the students to pursue further education.
3. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. Molisch's test for Carbohydrate.
2. Benedict's test- distinguishes between reducing and non-reducing sugars.
3. Barfoed's test- distinguishes between monosaccharides and disaccharides.
4. Iodine test for starch.
5. Ninhydrin test for amino acids.
6. Thiol group test using sodium nitroprusside.
7. Test for indole group using Ehlrich's reagent.
8. Test for hydroxyphenylaniline using Million's test.
9. Iodine value of oil and wax.
10. Acid value of oil and wax.
11. Saponification value of oil and wax.

LAB COURSE: BIOSCIENCE II

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge
2. To train the students to pursue further education.
3. Be familiar with tools.
4. Gain experience with standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. Study of Protozoa.
2. Study of Porifera.
3. Study of Coelenterate.
4. Study of Helminths
5. Study of Annelida.
6. Study of Mollusca.
7. Study of Echinodermata.
8. Study of Arthopoda.
9. Study of Fishes.
10. Study of Amphibia.
11. Study of Reptiles.
12. Study of Birds.

LAB COURSE: FUNDAMENTAL CHEMISTRY II

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge.
2. To train students to pursue further education.
3. Become familiar with chemical science tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. **Distribution Law**
   To study distribution of iodide between water & CCl_4
   To study distribution of benzoic acid between benzene & water.

2. **Colloids**
   To prepare arsenious sulphide sol & compare the precipitating power of mono- bi & tri valent anions.

3. **Viscosity &. Surface Tension**
   To determine the of % composition of a given mixture (Non interacting system) by viscosity method.
   To determine the viscosity of amyl alcohol in water at different concentrations & calculate the excess viscosity of these solutions.
   To determine the % composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

4. Inorganic Chemistry

Semi micro Analysis-cations analysis separation and identification of ions from Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sb^{3+}, $Sn^{2+,4+}$, Fe^{3+}, AI^{3+}, Cr^{3+}. Ni^{2+}, $C0^{2+}$, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH^{4+} and Anions $CO2/3^{-}$, $SO2/3^{-}$, S^{2-}, $SO2/4^{-}$, NO_2^{-}, NO_3, Cl^{-} ,Br^{-},I^{-}, CH_3COO^{-}, $C_202/4^{-}$, $BO3/5^{-}$, F^{-}.

GENERIC ELECTIVE
IPR, BIOETHICS & BIOSAFETY

Credit: 4

Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of IPR, Bioethics & Biosafety.
2. To be familiar with laws and application of IPR, Bioethics & Biosafety.
3. Become familiar with IPR, Bioethics & Biosafety rules and regulation.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of IPR, Bioethics & Biosafety and key principles of it.
2. Awareness of its major application.
3. Ability to use or apply IPR, Bioethics & Biosafety related guidelines.

Module I

History of IPR in India, Introduction to Intellectual Property; Types of IP; Forms of IPR, Protection of IPR, Benefits and Problems of IPR.

World Trade Organization (WTO), GATT, TRIPS, World Intellectual Property Rights Organization (WIPO).

Module II

History of Indian Patent System and Law; Patent Authorities, Patent: Requirements, Types, Patentable and Non-Patentable items; Patent file procedures; Patents in India.

Plant Breeder's Right (PBR), Requirements of PBR, Farmer's Privilege, Farmer's Right, Need for PBR, Advantages and disadvantages of PBR, ITPGRFA.

Module III

Patent: Living organisms, Biological materials, Importance in biology and biotechnology, Social issues, Controversies.

Module IV

Introduction to bioethics, Bioethics and its relation to other branches, Application, Genetically modified food and crops, possible health outcomes, Regulation of GM foods.

Cloning: Animal and Human Cloning, Reproductive and Therapeutic cloning, Problems and applications, Ethical and legal aspects of cloning.

Module V

Clinical trials, Benefits and risks, Ethical issues involving human participation; Ethical implications of Human Genome project.

Biosafety: Introduction, Need, Applications, Levels of biosafety, Biosafety guidelines and regulations framework in India.

Hazardous materials: Handling and Disposal; Good Laboratory Practices, Good Manufacturing Practices.

SUGGESTED READINGS:

- Bioethics and Biosafety: M K Satheesh
- Biotechnology and Patent Protection: Beier FK, Crespi RS and Straus
- Intellectual Property Rights on Biotechnology: Singh K
- Biotechnology Expanding Horizons: B D Singh
- Textbook of Biotechnology: R C Dubey
- Bioethics and Biosafety: M K Satheesh
- A Textbook of biotechnology: R C Dubey
- Biotechnology: Expanding Horizons: B D Singh.
- Regulatory Framework for GMOs in India: Ministry of Environment and Forest, Govt. of India
- Cartagena Protocol on Biosafety: Ministry of Environment and Forest, Govt. of Inida

- Bioethics: Shaleesha A Stanley

SCIENCE COMMUNICATION SKILLS

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. Introduce the students to the norms of formal academic writing.
2. Develop in students the ability to comprehend and utilize various scientific information resources.
3. Train students to create original literature while avoiding plagiarism.
4. Enable students to plan and write various types of academic assignments

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the science communication skills and key principles of it.
2. Awareness of its major applications.
3. Will be able to create original literature, plan and write various types of academic assignments.

Module I: Norms of Academic Writing

1. Significance of scientific communication in academics and research
2. Choice of words in academic writing
3. Conventions in academic writing – tone, style, structure of an academic write-up
4. Assessing credibility of an information resource – facts versus opinions
5. Note-taking – methods and tools to aid note-taking in a class

Module II: Avoiding Plagiarism

1. Plagiarism – definition and types

2. Self-plagiarism
3. Methods to avoid plagiarism a. Summary writing b. Paraphrase c. Quotations d. Citations
4. Software for similarity and plagiarism checks – TURNITIN, VIPER

Module III: Types of Scientific Literature
1. Modes of scientific communication - news article, editorial, scientific report, review article, original research article, thesis, poster, oral presentation in a conference
2. Primary and Secondary Literature – Definition, distinguishing features and examples
3. Structure and format of specific examples – news article, review article, research paper, thesis, poster
4. Use of PUBMED, Google Scholar to conduct a literature search

Module IV: Planning and Writing Academic Assignments
1. Writing an experiment for lab journal
2. Project Report

3. Writing an essay/assignment
4. Constructing Statement of Purpose

Module V: References and Bibliography
1. In-text citations
2. Reference writing in APA style a. Textbook/book chapter as source b. Research paper/Journal article as source c. Websites d. Citations
3. Constructing a bibliography
4. Reference management tools – ZOTERO, ENDNOTE

Suggested Readings:
1. Day RA, Gastel B, (2012) “How to Write & Publish a Scientific Paper” 7 th Edition, Cambridge University Press.
2. Booth V, (2006) “Communicating in Science: Writing a Scientific Paper and Speaking at Scientific Meetings” 2 nd Edition Reprinted, Cambridge University Press.
3. Matthews JR., Matthews RW, (2008) “Successful Scientific Writing: A Step-By-step Guide for the Biological and Medical Sciences” 3 rd Edition, Cambridge University Press.
4. Yousuf A, Sidiq M, Acharya S, (2018) “Publish and Cherish – The Art and Craft of Publishing Scientific Research” 1st Edition, Sara Book Publication.

VERMICOMPOST AND ORGANIC FARMING

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To impart basic knowledge related to vermicomposting & organic farming.
2. To train the students to pursue further education.
3. Become familiar with vermicomposting & organic farming.
4. Gain experience with standard tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of vermicomposting & organic farming and key principles of its.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

1. Organic farming: Introduction and status.
2. Organic farming and its components.

3. Organic farming - Concepts and principles.
4. SWOT Analysis of Organic Farming.

Module II

1. Sustainable Agriculture.
2. Key indicators of sustainable agriculture.
3. Organic farming and climate change.
4. Principles of compost production.

Module III

1 Vermicomposting : Introduction and Scope.
2 Types of Earthworm and Classification Epigeic, Endogeic, Diageic.
3 Life history of Earthworms (Earthworm Species Eisenia foetida).

Module IV

1 Objectives of Vermicompost.
2 Vermicompost Production : Establishment of Vermicomposting and Vermiwash unit.
3 Different Methods of Vermicomposting: Small and large scale Bed method, Pit method .
4 Harvesting the Compost.
5 Storing and packing of vermicompost.

Module V

1 Precautions while Vermicomposting.
2 Physico- chemical analysis of vermicompost.
3 Physical Parameters of vermicompost.
4 Nutrient content of vermicompost and their role in agriculture.
5 Benefits of vermicompost.

Environmental Studies & Disaster Management	
Learning Objectives	**Credit: 2** **Marks: 50 (35+15)**

On successful completion of the course students will be able to:

1. Identify the historical origins of destructive attitudes and practices towards the natural environment.
2. Know the compatibility of human and environment/ecological values.
3. Know the nature resources available on earth and how to concern and manage them.
4. Understand the disaster and pandemic they are facing and empower the new generation to face the new challenges.

Module-I (Environment)

The Atmosphere, Lithosphere, Hydrosphere, Biosphere. Ecosystem: Energy flow in the ecosystem Biogeochemical Cycle: Water Cycle, Carbon Cycle, Nitrogen Cycle Pollution: Water Pollution, Air Pollution, Soil Pollution, Radiation Pollution, Industrial Pollution, Light Pollution, Sound Pollution. Environmental Laws: (Water Act 1974, Air act 1981, The Wildlife Protection Act 1972, The Environment Protection Act 1986), The Forest Conservation Act 1980.

Module-II (Climate Change & Sustainable Development)

Population Ecology: Individuals, Species, Population, Community (01 Period) Human Population Growth, Population Control Methods (01 period) Urbanization and its effect on society (01 Period) Climate Change: Cause, Effect, Global Warming, Carbon Footprint and environmental protection (05 Periods) Step taken towards Sustainable Development: Ban of single-use plastic automobile Scrapping Policy, Promotion of Electrical Vehicles, Brief idea on Sustainable Development Goals (SDGs), Agenda 21 of Rio Earth Summit.

Module -III (Disaster Management)

Disaster Management: Types of Disasters (Natural and Man-made and their cause and effect)Vulnerability Assessment and Risk Analysis: Vulnerability to various disasters (Flood, Cyclone,Earthquake, Heat waves and Lightning) Institutional Framework: Institutional arrangements for disaster management (National Disaster Management Authority (NDMA), Chhattisgarh State Disaster Management Authority (CSDMA), District Disaster Management Plan-(DDMP) Raipur. Preparedness Measure and Survival skills adopted during and after disaster

Module–IV (Public Health Management)

Brief idea on Epidemics and Pandemics Non-Communicable Diseases with special reference to cardiovascular diseases, Cancer, Hypertension and Obesity and their prevention.

Communicable Diseases with special reference to Covid-19, Flu, Hepatitis, AIDS and Tuberculosis and their transmission Dynamics of Disease Transmission: Mode of transmission (Direct/Indirect), Events after infection: Immunity (Active vrs Passive, Innate vrs Acquired, Herd Immunity), Incubation Period. Prevention of Epidemics/Pandemics Disease: Preventing Measures (Quarantine, Sanitization, Personal Protective measures such as Hand Washing and use of protective devices, Vaccination); Control Measures (Surveillance, Isolation, Contact Tracing) Life Style Management (Diet, Physical Exercise, Yoga and sleeping habit)

Suggested Readings:

- Environment and Disaster Management Ecology Climate Change Biodiversity, 3rdEdition, by D.R Khullar
- An Introduction to Disaster Management Natural Disasters and Man Made Hazards, 3rd Edition by S. Vaidyanathan
- Environment, Disaster Management Climate Change, by Dr. Y. K. Sharma & P. Jain.

- Environmental Studies and Disaster Management by Rajneeta Soni

THIRD SEMESTER
BIOTECH III: CELL & MOLECULAR BIOLOGY

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Cell and Molecular Biology.
2. To train the students to pursue further education.
3. To be familiar with molecular biology tools.
4. To gain experience of standard molecular tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Cell and Molecular Biology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Discovery of cell, The Cell theory. Prokaryotic and Eukaryotic cell – Plant and Animal cell. Cell Membrane, Cellular Reproduction. Techniques in Cell Biology.

Module II

Cell Organelles: Structure and Functions of Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus and Chromosomes.

Module III

Cell Division - Cell cycle, Amitosis, Mitosis and Meiosis. Regulation of cell cycle. Central Dogma: Brief introduction of Structure and Functions of DNA, RNA and proteins.

Module IV

DNA Replication: Prokaryotic and Eukaryotic – Mechanism, Enzymes and accessory proteins involved. DNA Repair.

Module V

Prokaryotic and Eukaryotic Transcription and Translation, Genetic code, Recombination in prokaryotes.

Suggested Readings:

- Cell & Molecular Biology : Gerald Karp
- Cell Biology : C.B. Powar

- Essential Cell Biology : An introduction: Bruce, Alberts, Dennis
- The Cell: A Molecular Approach: Geoffrey M. Cooper
- Cell & Molecular Biology: SC Rastogi
- Cell & Molecular Biology: Robertis & Robertis
- Cell Biology & Genetics: Starr & Taggart
- Molecular Cell Biology: Lodish
- Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Sons publications
- Stem Cells and Cancer by Rebecca G. Bagley, Beverly A. Teiche
- Elements of Human Cancer By Geoffrey M. Cooper

BIOSCIENCE III: STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Structure, Development and Reproduction in Flowering Plants.
2. To train the students to pursue further education.
3. To be familiar with plant biology tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Structure, Development and Reproduction in Flowering Plants.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

The basic body plan of a flowering plant: modular type of growth.
The root system: root apical meristem; differentiation of tissues; modification of roots.

Module II

The shoot system: shoot apical meristem; Anatomy of primary shoot in monocotyledons (*Zea mays*) and dicotyledons (*Helianthus anus*); Secondary Growth, characteristics of growth rings, sapwood and heart wood; secondary phloem; periderm.

Module III

Leaf: origin, development, Structure, arrangement and diversity in size and shape, senescence and abscission.
Flower: Structure and function of anther and pistil. Development of male and female gametophytes.

Module IV

Pollination, self incompatibility, double fertilization, formation of seed, endosperm and embryo; fruit: development and maturation, Seed dormancy, vegetative propagation.

Module V

Diversity of flowering plants: General account of the families Brassicaceae, Fabaceae, Apocynaceae,

Asclepiadaceae, Solanaceae, Lamiaceae, and Poaceae.

Suggested Readings:

1. The Embryology of Angiosperms: Bhojwani and Bhatnagar.

2. Anatomy of Seed Plants: Esau, K. John Wiley and Son, USA.
3. Embryology of Angiosperms: Johri, B.M. Springer-Verleg, Berlin.
4. Pollination biology: Kapil, R.P. Inter India Publishers, New Delhi.
5. An Introduction to Embryology of Angiosperms: Maheswari.P
6. Botany for Degree Students: Pandey, B.P. -Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd., New Delhi.

CHEMISTRY III
INORGANIC & PHYSICAL CHEMISTRY I
(Chemistry of d & f-block elements)

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To gain experience with standard chemical tools.
5. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

MODULE-I. Chemistry of d & f- block elements

A. d-block elements

(i) Chemistry of elements of first transition series: Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radi, Ionization potential, Variable oxidation states, Magnetic properties, Color, Complex formation tendency and catalytic activity.

(i) Chemistry of elements of second and third transition series: Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3danalogous (Group Cr- Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior.

B. f-block elements

Chemistry of Lanthanide & Actinides: Electronic structure, oxidation states, ionic radii, magnetic, and spectral properties. Lanthanide contraction and its consequences, complex formation, occurrence and isolation, Separation of lanthanides: solvent extraction and ion exchange method. General features and chemistry of actinides, Transuranic elements, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.

MODULE-II. Oxidation and reduction

Various definitions of oxidation and reduction, Balancing of redox reaction by ionelectron method, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Pourbaix diagrams of Iron. Predicting disproportionation and comproportionation phenomena.

Coordination Chemistry

A. Coordination compounds: Distinction among simple salts, double salts, andcoordination [compounds. Terminology and nomenclature of Coordination compounds. Types of ligands based on denticity. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples. Electroneutrality principle, Valence Bond Theory of transition metal complexes. Determination of structures and magnetic properties of complexes based on V'BT. Chelates: Classification and their application.

B. Isomerism in coordination compounds: Structural isomerism and Stereoisomerism (Geometrical and optical) in coordination compounds with four and six coordination numbers.

MODULE-III

Thermodynamics-I

A. Basic concept of thermodynamics: System, surrounding, types of system (closed, open & isolated). Intensive & extensive properties. Thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible &irreversible. State function & path functions and their differentiation, concept of heat &work. Zeroth law of thermodynamics, First law of thermodynamics. Definition of internal energy & enthalpy. Concept of heat capacity, heat capacity at constant volume & at constant pressure, and their relationship.

Joule-Thomson experiment, Joule-Thomson coefficient (no derivation) & inversion temperature. Calculations of w, q, E & H for expansion of gases for isothermal &adiabatic conditions for reversible process.

B. Thermochemistry

Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralization, Hess's law of constant heat of summation & its applications. Variation of enthalpy change of reaction with temperature (Kirchoffs equation).

C. Thermodynamics II

Second law of thermodynamics: Limitations of first law and need for the second law. Statements of second law. Carnot cycle & Efficiency of heat engine. Thermodynamic principle of working of a refrigerator (Carnot theorem). Concept of entropy: entropy change in a reversible and irreversible process; entropy change in isothermal reversible expansion of an ideal gas. Physical significance of entropy.Gibbs free energy, Gibbs -Helmholtz equation

D. Third law of thermodynamics

Statement of third law, Nernst heat theorem, Absolute entropy of solids, liquids, and gases.

MODULE-IV Electrochemistry-1

Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law,application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations.

Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage.

Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's (DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions; Transport number-definition and determination by Hittorf method and moving boundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional Representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of AG, AH and A S for cell reaction, polarization, Over potential and hydrogen overvoltage.

SUGGESTED READINGS:

1. Moudgil, H. K. (2010). Textbook of physical chemistry. PHI Learning Pvt. Ltd.
2. Adamson, A. (2012). A textbook of physical chemistry. Elsevier.
3. Finglgkrmc61923). Practical physical chemistry. Longmans, Green.

Online Resources-

- e -Resources / e-books and e-learning portals
- https:/tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-
- Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf
- https://byjus.com/chemistry/conductometric-titration/
- https://chem.libretexts.org/Courses/University_of Californin Davis/Chem 4B Lab%3A Ge
- neral Chemistry for Majors IV1%3A Thermochemistry (Experiment)
  https:/www.ulm.edu/chemistry/courses/manuals/chem1010/experiment 10.pdf

LAB COURSE: BIOTECHNOLOGY III

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart students practical knowledge
2. To train the students to pursue further education.
3. Become familiar with biotechnological tools

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. Study of Parts of Microscope
2. To measure the length and breadth of the given cell sample by using micrometer.
3. To prepare permanent slides using the given sections like Stem, Root and Leaf.
4. Study of Mitosis.
5. Study of Meiosis.
6. Preparation of Blood Smear and study of blood cells.
7. Differential counting of white blood cells using Micrometer.
8. Identification of Barr Body in Buccal smear.
9. Identify the different types cells present in the leaf cross section.
10. Extraction of DNA from plants.
11. Extraction of DNA from animal tissues.
12. Extraction of DNA from fungus.
13. Estimation of DNA using Diphenyl amine.

LAB COURSE: BIOSCIENCE III

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart students practical knowledge
2. To train the students to pursue further education.
3. Become familiar with plant biology tools.
4. Gain experience with standard molecular biology tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

1. Study of different Angiosperms.
2. Study of commonly occurring dicotyledonous plants to understand the body plan and modular type of growth.
3. Anatomy of primary and secondary growth in monocots and dicots using hand sections or prepared permanent slides.
4. Study of diversity in leaf shape, size, thickness and surface properties and internal structure.
5. Structure of anther, microsprogenesis and pollen grains.
6. Study of *In vitro* pollen germination
7. Simple experiments to study vegetative propagation in plants.
8. Germination of non dormant and dormant seeds.

LAB COURSE: CHEMISTRY III

(INORGANIC & PHYSICAL CHEMISTRY I)

Credit: 1

Total Marks: 50 (35+15)

Course Objectives:

1. To impart students practical knowledge
2. To train the students to pursue further education.
3. Become familiar with chemical tools

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents forexperiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.

Transition Temperature

1) Transition temperature of a salt hydrate-determination of molecular weight.

2) Determination of the transition temperature of the given substance by thermometric dialometric method (eg. $SrBr_2$. $2H_2O$ or $MnCl_2$, $4H_2O$)

Thermochemistry

A. Determination of solubility:

1) To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution processes

B. Calorimetry:

1) To determine the enthalpy of neutralization of hydrochloric acid (strong acid) by sodium hydroxide (strong base) solution.

2) (a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong hase (sodium hydroxide) and determine enthalpy of ionization of weak acid.

(b) To determine the enthalpy of neutralization of a weak base (ammonium hydroxide) versus strong acid (hydrochloric acid) and determine enthalpy of ionization of weak base.

3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy

Conductometry

1) Conductometry-Determination of limiting molar conductance of a strong Electrolyte (KCI).

2) To determine the strength of the given acid (HC) or CH3COOH) conductometrically using standard alkali (NaOH)solution.
3) To determine the strength of strong acid and a weak acid in the given mixture conductometrically against a standard alkali solution

4) To determine the ionization constant of weak acid conductometrically.

Solubility Product
1) To detertmine the solubility and solubility product of a sparingly soluble salt conductometrically.
2) Potentiometry- Determination of solubility product of a sparingly soluble substance.

SUGGESTED READINGS:
1. Vishwanathan, B. & Raghavan, P. S. (2017). Practical Physical Chemistry. Viva books originals publishing.
2. Yadav, J. B. (2006). Advanced Practical Physical Chemisty. Krishna Prakashan Media.
3. Sahu, D. P.& Bapat, K. N. (2022) Unified practical chemistry, Navbodh Prakashan.

FOOD TOXICOLOGY & ADULTERATION

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To develop basic understanding regarding food toxicology & adulteration.
2. To create awareness regarding food adulteration practices.
3. To identify the adulterants present in the sample and compare it with standard products.
4. To protect public from poisonous and harmful products.
5. To teach the students to determine quality of food in day to day life.

Course Outcomes:

Skills that students obtain after completion of the course:

1. Students will have basic understanding of food toxicology & adulteration
2. Students will be identify the adulterants present in the sample and compare it with standard products.
3. Students will learn to determine quality of food in day to day life.
4. Students will be able to create awareness regarding food adulteration practices.

MODULE I: FOOD ADDITIVES & ADULTERATION

A. Food adulteration: Definition, incidental and intentional adulteration, common adulterants in food, health hazards and risks.
B. Introduction to quality to quality aspects related to food and food products.
C. Food Additives: Antioxidants, preservatives, nutrient supplements, emulsifiers, thickening agents, sweetners, colouring and flavouring agents.

MODULE II: FOOD LAWS AND STANDARDS

A. Food Laws: voluntary and mandatory- national and international.
B. Role of voluntary agencies and legal aspects of Consumer Protection, Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP).
C. Food Standards: PFA, FPO, AGMARK, ISI, Role of Food and Drugs Administration (FDA), Food Inspector & Others

MODULE III: Introduction to Food Toxicology

Introduction to Food Toxicology: Classification of toxins in food, dose, determination of toxins in food, naturally occurring toxins from animals, bacterial and fungal and sea food sources.
Food Additives as Toxicants: Artificial Colors, Preservatives, Sweeteners

Toxicants Formed During Food Processing: Nitrosomines, Maillard Reaction products Acrylamide, Benzene, Heterocyclic Amines and Aromatic Hydrocarbons, Irradiation.
Risk of Genetically Modified Food, Food Supplements, Persistant Organic Pollutants (POPs).

MODULE IV: Agricultural and Industrial Contaminants in Foods
Pesticides residues in fruits and vegetables, Metal contaminants in foods and their toxicity in human body, Animal drug residues in food and water, dioxins and related compounds in food.

SUGGESTED READINGS:

1. Warner, J.M. 1976. Principles of Dairy Processing. Wiley Eastern Ltd. New Delhi.
2. Srilakshmi. Food Science. New Age International Pvt. Ltd. New Delhi.
3. Frazier. Food Microbiology. McGraw Hill, New York.
4. ISI Publications
5. Joslyn. Methods in Food Analysis.

HINDI BHASHA

Credit: 2
Total Marks: 50 (35+15)

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MODULE I
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MODULE IV
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MODULE V
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SUGGESTED READINGS:
1. ekSfyd fgUnh Hkk'kk & MkW- ljLorh oekZ
2. jpukRed fgUnh Hkk'kk & MkW- ljLorh oekZ
3. Hkkjrh;rk ds vej Loj & MkW- /kuat; oekZ
4. fgUnh O;kdj.k & gjnso okgjh

COMPUTATIONAL BIOLOGY & BIOINFORMATICS

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:
1. To impart basic knowledge of Computational Biology and Bioinformatics
2. To be familiar with Computational biology and bioinformatics.
3. To have experience of virtual world.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Computational Biology and Bioinformatics and key principles of it.
2. Awareness of its major application.
3. Ability to use Computer for biological applications or related problems.

MODULE I

Scope of Biostatistics, variables in biology, collection, classification, tabulation of data. Frequency distribution, Diagrammatic and graphical presentation of statistical data, Sampling techniques.

MODULE II

Measures of central tendency: Mean, Median, Mode, Standard Deviation and Standard Error, probability

MODULE III

Concepts of Database, Biological Database: Introduction and Types; Sequence Database: Introduction and Types.

MODULE IV

Introduction to bioinformatics, Importance of Bioinformatics, Introduction to biological databases: EMBL, DDBJ, NCBI, Swiss Prot & PDB, Useful sites for researchers.

MODULE V

Introduction to sequence alignment, pairwise similarity searching, Introduction to BLAST and FASTA programmes.

SUGGESTED READINGS:

1. Bioinformatics: C. S. V. Murthy
2. Introduction to Bioinformatics: Indian Institute of Bioinformatics, New Delhi
3. Bioinformatics: Baxavanis
4. Bioinformatics: Higgins and Taylors.
5. Fundamentals Concepts of Bioinformatics: Dan E. Krane and Michael L. Raymer.
6. Fundamentals of Biostatistics by Khan and Khanum
7. Fundamentals of statistical by S.P Gupta
8. Statistical Methods by Snedecor and Cochran(8/e)
9. Applied statistics by S.C Gupta and V.K Kapoor

AYURVEDIC BIOLOGY

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

To introduce the basic principles of Ayurveda in the context of modern biology.
To understand the Ayurvedic concept of life (Jeeva) and its components.
To explore correlations between Dosha-Dhatu-Mala theory and modern physiology.
To understand health, disease, and treatment from both Ayurvedic and biological perspectives.
To promote interdisciplinary thinking by linking traditional knowledge with modern scientific frameworks.

Course Outcome:

Skills that students obtain after completion of the course:
Describe the foundational principles of Ayurveda in relation to biological sciences.
Compare and contrast Ayurvedic concepts like Tridosha, Panchamahabhuta, and Dhatus with modern anatomy and

physiology.
Interpret Ayurvedic views on health, disease, and treatment with respect to biological processes.
Demonstrate an understanding of the physiological basis of Prakriti (body constitution).
Apply integrated knowledge in assessing health and lifestyle from a traditional-modern perspective.

Module I: Introduction to Ayurveda and Basic Concepts

- Definition and aim of Ayurveda
- Panchamahabhuta (Five elements) theory
- Concept of Purusha and Prakriti
- Triguna (Sattva, Rajas, Tamas) and their biological implications
- Comparison with basic biological elements

Module II: Tridosha Theory and Biological Correlates

- Vata, Pitta, Kapha: definitions, properties, functions
- Biological roles of Doshas in body functioning
- Diurnal and seasonal variation of Doshas
- Homeostasis and Dosha balance

Module III: Dhatu, Mala, and Srotas

- Sapta Dhatu: types and biological parallels (e.g., tissues, fluids)
- Malas (excretory products): their role and types
- Srotas (body channels): correlation with organ systems and circulation

Module IV: Prakriti and Modern Genetics

- Concept of Prakriti and its types (Vataja, Pittaja, Kaphaja, etc.)
- Methods of Prakriti analysis
- Relationship of Prakriti with phenotypic and genotypic traits
- Research insights into genome-Prakriti correlation

Module V: Health, Disease, and Immunity in Ayurveda and Biology

- Ayurvedic definition of health (Swasthya)
- Concepts of Agni, Ama, Ojas – immunity and metabolism
- Nidana Panchaka (five factors of disease causation)
- Preventive health and Dinacharya/Ritucharya (daily/seasonal regimen)

SUGGESTED READINGS:

- Lad, Vasant. *Textbook of Ayurveda* (Vol. I & II)
- Charaka Samhita – English translation by P.V. Sharma
- Sushruta Samhita – Translation by Kaviraj Kunjalal
- Patwardhan B., *Ayurveda and Integrative Medicine*
- Ross, M.H., Pawlina, W. *Histology: A Text and Atlas* (for biological comparison)