Programme: Bachelor of Science (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	Botany I: Introduction to Plant diversity		3	0	0	3	70	30	100
	Major	Zoology I: Diversity of Invertebrate		3	0	0	3	70	30	100
	Major	Chemistry I: Fundamental Chemistry I		3	0	0	3	70	30	100
Discipline Specific Core Course Practical (DSCCP)	Major	Botany I Lab		0	0	2	1	35	15	50
	Major	Zoology I Lab		0	0	2	1	35	15	50
	Major	Chemistry I Lab		0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Nutrition for Health		4		0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Communicative English		2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Instrumentation and System Biology		2	0	0	2	35	15	50

Value Added Course (VAC)	VAC	Yoga and Human Consciousness		1	0	1	2	35	15	50
Total				**18**	**0**	**7**	**22**	**490**	**210**	**700**

Programme: Bachelor of Science (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	Botany II: Cell Biology & Genetics		3	0	0	3	70	30	100
	Major	Zoology II: Vertebrates Physiology		3	0	0	3	70	30	100
	Major	Chemistry II: Fundamental Chemistry II		3	0	0	3	70	30	100
Discipline Specific Core Course Practical (DSCCP)	Major	Botany II Lab		0	0	2	1	35	15	50
	Major	Zoology II Lab		0	0	2	1	35	15	50
	Major	Chemistry II Lab		0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Intellectual Property Rights (IPR)		3	1	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Science commuication Skills		2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Vermicomposting and Organic Farming		2	0	0	2	35	15	50
Value Added Course (VAC)	VAC	Environmental Studies & Disaster Management		2	0	0	2	35	15	50
Total				**18**	**1**	**6**	**22**	**490**	**210**	**700**

Programme: Bachelor of Science (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	Botany III: Diversity of Seed Plants & their Systematics		3	0	0	3	70	30	100
	Major	Zoology III: Anatomy & Physiology		3	0	0	3	70	30	100
	Major	Chemistry III: Inorganic & Physical Chemistry I		3	0	0	3	70	30	100
Discipline Specific Core Course Practical (DSCCP)	Major	Botany III Lab		0	0	2	1	35	15	50
	Major	Zoology III Lab		0	0	2	1	35	15	50
	Major	Chemistry III Lab		0	0	2	1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	Food Toxicology & Adulteration		3	1	0	4	70	30	100
Ability Enhancement Course (AEC)	AEC	Hindi		2	0	0	2	35	15	50
Skill Enhancement Course (SEC)	SEC	Computational Biology and Bioinformatics		2	0	0	2	35	15	50
Value Added Course (VAC)	IKS	Ayurvedic Biology		2	0	0	2	35	15	50

Total				**18**	**1**	**6**	**22**	**490**	**210**	**700**

Programme: Bachelor of Science (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 (DSCC)	Major	Botany IV: Structure Development & Reproduction in Flowering Plants		3	0	0	3	70	30	100
	Major	Zoology IV: Chordates & Comparative Anatomy		3	0	0	3	70	30	100
	Major	Chemistry IV: Inorganic & Physical Chemistry II		3	0	0	3	70	30	100
Discipline Specific Core Practical (DSCP)	Major	Botany IV Lab		0	0	2	1	35	15	50
	Major	Zoology IV Lab		0	0	2	1	35	15	50
	Major	Chemistry IV Lab		0	0	2	1	35	15	50
Discipline Specific Elective Course (DSEC)	Minor	Botany A (Plant Tissue Culture)/ Zoology A (Wild Life Conservation & Management)/ Chemistry A (Basic Analytical Chemistry)		4		0	4	70	30	100
Ability Enhancement Course	AEC	Society, Culture, and Human		2	0	0	2	35	15	50

(AEC)		Behaviour								
Skill Enhancement Course (SEC)	SEC	Computer Application		1	0	1	2	35	15	50
Value Added Course (VAC)	VAC	Presentation Skills		1	1	0	2	35	15	50
Total				**17**	**1**	**7**	**22**	**490**	**210**	**700**

FIRST SEMESTER
BOTANY I: INTRODUCTION TO PLANT DIVERSITY

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

Course Objectives:
1. To impart basic knowledge of plant diversity.
2. To train the students to pursue further education.
3. Become familiar with bioscience tools.

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Describe the structure, nutrition, reproduction, and economic importance of bacteria, cyanobacteria, viruses, and mycoplasma.	Understand (2)
CO2	Explain the general characters, classification, and life cycles of major fungal groups and evaluate their ecological and economic significance.	Understand (2), Evaluate (5)
CO3	Describe the general characteristics, classification, and life cycles of representative algal groups and relate them to their economic importance.	Understand (2), Analyze (4)
CO4	Explain the structural features, reproduction, and classification of major bryophyte groups.	Understand (2)
CO5	Describe the characteristics, structure, and reproduction of selected pteridophytes and analyze their evolutionary advancement.	Understand (2), Analyze (4)

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

ZOOLOGY I: DIVERSITY OF INVERTEBRATE

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

Course Objectives:
1. To explain the basic structural & functional aspects of Animal diversity–Invertebrates
2. To increase expertise of the course

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Describe the general characters and classification of Protozoa & Porifera and explain the structure of *Paramecium* and canal systems in sponges.	Understand (2)
CO2	Explain the classification of Coelenterata & Platyhelminthes, polymorphism in Hydrozoa, and the life cycle of *Fasciola hepatica*.	Understand (2)
CO3	Analyze parasitic adaptations in helminths and evaluate evolutionary significance of coelom & coelomoducts in Annelida.	Analyze (4)
CO4	Describe adaptive features of Arthropods & Molluscs, including insect mouth parts, Peripatus affinities, and torsion/detorsion.	Understand (2), Analyze (4)
CO5	Explain the classification & functional systems of Echinodermata & Hemichordata, including larval forms and affinities of *Balanoglossus*.	Understand (2)

Module I

Brief history of Invertebrates- Kingdom Animalia; General characteristics of Invertebrates. Protozoa - General characters; Classification up to classes with examples; Type study– Paramecium, protozoa and diseases. Porifera -General characters; Classification of Porifera up to classes with examples, Type study–Types of Canal system in sponges and Spicules.

Module II

Coelenterate- General characteristics and Classification of Coelenterate up to classes with examples, Type study- Obelia; Polymorphism in hydrozoa; Corals and coral reef formation. Platyhelminthes- General characteristics and Classification of Platyhelminthes up to classes with examples; Life cycle and pathogenicity of Fasciola hepatica

Module III

Nemathelminthes- General characters; Classification of Nemathelminthes up to classes with examples; Type study – Dracunculus medinensis; Parasitic Adaptations in Helminthes. Annelida: General characters; Classification of Annelida up to classes with examples; Type study- Hirudinaria granulose; Evolutionary significance of Coelome and Coelomoducts; Metamorphism

Module IV

Arthropoda- General characters; Classification of Arthropoda up to classes with examples, Type study- Prawn; Mouth parts of Insects; Peripatus- Structure and affinities Mollusca- General characters; Classification of Mollusca up to classes with examples, Type study- Pila; Pearl formation; Torsion and detorsion in gastropods

Module V

Echinodermata- General characters; Classification of Echinodermata up to classes with examples; Water vascular system in star fish; Echinoderm larvae and their significance Hemichordata - General characters; Classification of Hemichordata up to classes with examples; Balanoglossus - Structure and affinities

SUGGESTED READINGS:

1. L.H. Hyman „The Invertebrates" Vol I, II and V. – M.C. Graw Hill Company Ltd.
2. Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. E.L. Jordan and P.S. Verma „Invertebrate Zoology" S. Chand and Company.
4. R.D. Barnes „Invertebrate Zoology" by: W.B. Saunders CO., 1986.
5. Barrington. E.J.W., „Invertebrate structure and Function" by ELBS.
6. P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.
7. Parker, T.J. and Haswell „A text book of Zoology" by, W.A., Mac Millan Co. London.
8. Barnes, R.D. (1982). Invertebrate Zoology, V Edition"

FUNDAMENTAL CHEMSITRY I

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. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

Course Outcomes		Bloom's Taxonomy Level
CO1	Explain the chemical knowledge of ancient India, contributions of Indian chemists, and modern concepts of atomic structure.	Understand (2)
CO2	Apply the principles of ionic, covalent, and molecular orbital theories to chemical compounds.	Apply (3)
CO3	Analyze the chemical behavior, anomalous properties, and structural features of s-block and p-block elements	Analyze (4)
CO4	Interpret electronic effects, reaction intermediates, and stereochemical principles of organic molecules.	Evaluate (5)

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: BOTANY I

Credit: 1
Total Marks: 50

(35+15)

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Apply microscopy, staining, and slide-preparation techniques to identify disease symptoms and differentiate plant groups	Apply (3)
CO2	Analyze morphological and anatomical features of lower plant groups using permanent and hand-cut sections	Analyze (4)

BOTANY I: PLANT DIVERSITY LAB

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.

CO–PO–PSO Attainment Matrix

LAB COURSE: ZOOLOGY I

Credit: 1
Total Marks: 50

(35+15)

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Identify and classify major invertebrate groups using museum specimens, including their diagnostic morphological features, adaptive structures, and insect mouthparts.	Understand (2)
CO2	Examine, interpret, and differentiate microscopic protozoan and metazoan organisms using permanent slides.	Apply (3)

ZOOLOGY I: DIVERSITY OF INVERTEBRATE LAB

1. Museum Specimen invertebrate –
   - Spongilla, Taenia solium, Hirudinaria granulose, earthworm, Pila, Prawn, Balanoglossus, Starfish, Dranunculus onedensis, Octopus, Lobsters, Scorpions
   - Mouth parts of insects- Physalia, Ascaris lumbricoids
   - Spicules in sponges.
2. Slides
   - Amoeba proteus
   - Paramecium
   - Euglena
   - Trypanosoma
   - Plasmodium
   - Entamoeba histyolytica
   - Cycon
   - Obelia colony
   - Fasciola hepatica

- Hydra with bud

LAB COURSE: FUNDAMENTAL CHEMISTRY I

Credit: 1
Total Marks: 50

(35+15)

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Apply qualitative inorganic analysis techniques to systematically separate and identify cations and anions.	**Apply (3)**
CO2	Analyze the thermal properties of organic compounds to assess purity and identity.	**Analyze (4)**

FUNDAMENTAL CHEMISTRY I LAB

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, CI- ,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:

Course Outcomes		Bloom's Taxonomy Level
CO1	Explain basic concepts of food, nutrition, and health	Understand (2)
CO2	Analyze the functions, dietary sources, and deficiency/excess manifestations of macronutrients, micronutrients, and vitamins	Analyze (4)
CO3	Identify common food adulterants, accidental contaminations, and interpret food labels; understand relevant food laws and regulatory standards	Apply/Analyze (3/4)
CO4	Examine the causes, prevalence, and preventive strategies of undernutrition and assess national nutrition programs	Analyze/Evaluate (4/5)

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:

- Mahan, L. K., & Raymond, J. L. (2017). *Krause's Food & the Nutrition Care Process* (14th Edition). Elsevier
- Srilakshmi, B. (2020). *Food Science* (6th Edition). New Age International Publishers.
- Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (2017). *Nutritive Value of Indian Foods*
- Swaminathan, M. (2019). *Essentials of Food and Nutrition* (7th Edition). Bangalore: Bangalore Printing & Publishing Co.
- Sood, S. (2016). *Textbook of Nutrition and Dietetics* (3rd Edition). Jaypee Brothers Medical Publishers

INSTRUMENTATION & SYSTEM BIOLOGY

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

Course objectives

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

Course Outcome:

Skills that students obtain after completion of the course:

Course Outcomes		Bloom's Taxonomy Level
CO1	Explain the basic principles, classifications, and functional components of biochemical analytical instruments.	Understand

CO2	Compare different microscopy techniques based on their principles, instrumentation, and applications.	Analyze
CO3	Illustrate the principles and procedural differences among major chromatographic techniques.	Apply
CO4	Demonstrate the principles and instrumentation of gel and paper electrophoresis for biomolecule separation.	Apply
CO5	Interpret absorption spectra using Beer–Lambert law and evaluate factors influencing chromophore absorbance.	Evaluate

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

- Sawhney, S. K., & Singh, R. (2008). *Biochemical methods*. New Age International Publishers.
- Gupta, S. P. (2019). *Instrumental methods of chemical analysis* (2nd ed.). Pragati Prakashan.
- Chatwal, G. R., & Anand, S. K. (2015). *Instrumental methods of chemical analysis* (5th ed.). Himalaya Publishing House.
- Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). *Principles of instrumental analysis* (7th ed.). Cengage Learning.
- Pavia, D. L., Lampman, G. M., & Kriz, G. S. (2015). *Introduction to spectroscopy* (5th ed.). Cengage Learning.

YOGA & HUMAN CONSCIOUSNESS

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

Course Objectives:
1. To increase the knowledge of the students about Yoga and to make students aware about the holistic development through Yoga.
2. To provide a practical knowledge on different yogic practices.
3. To give a glimpse of ancient Yoga Philosophy.
4. To impart some knowledge about the healing power of Yoga.
5. To increase the professional efficiency in the field of Yoga.

Course Outcomes:
Skills that students obtain after completion of the course:
1. Students gain good knowledge on the concept of yoga.
2. Students know about the scientific benefits of various yogic practices.
3. Students can perform practical skills proficiently.
4. Students gain an awareness about the value of health & wellness through yoga.
5. Makes the students more enthusiastic about further study/research in the field of Yoga.

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.

SECOND SEMESTER
BOTANY II: CELL BIOLOGY & GENETICS

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

Course Objectives:

1. To impart basic knowledge of Cell Biology & Genetics.
2. To train the students to pursue further education.
3. To be familiar with concepts of Cell Biology & Genetics.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Cell Biology & Genetics 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 The cell envelope: Plasma membrane; bilayer lipid structure; functions; the cell wall. Ultra structure and function of nucleus: nuclear membrane; nucleolus and other organelles: Golgi bodies, ER, peroxisomes, Vacuoles.

Module-II Chromosome organization: Morphology; centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions; variations in chromosome number aneuploidy, polyploidy; sex chromosomes. Cell division : Mitosis; meiosis

Module-III DNA the genetic material: DNA structure; replication; DNA- protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA. Extranuclear genome: Presence and function of mitochondrial and plastid DNA; plasmids.

Module-IV Gene expression: Structure of gene; transfer of genetic information; transcription, translation, protein synthesis; tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D, 2D and 3D structure.

Module-V Genetic Variations: Mutations, spontaneous and induced; transposable genetic,DNA damage and repair.

SUGGESTED READINGS:

- Cell & Molecular Biology : Gerald Karp
- Cell Biology : C.B. Powar
- Cell & Molecular Biology: SC Rastogi
- Cell & Molecular Biology: Robertis & Robertis
- Molecular Cell Biology: Lodish
- Genetics: Strickberger
- Genetics: From Genes to Genomes: Reynolds
- Stryer L (1995) Biochemistry, 4 th edition, W. H. Freeman & company, NewYork.
- Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M. (1988) Molecular biology of the gene, 4th edition, The Benjamin/Cummings publishing companies, inc, California.
- Benjamin Lewin (1999) Genes VII, Oxford University Press, Oxford.
- Weaver R. F. (1999) Molecular biology, WCB McGraw-Hill companies, Inc,New York.
- Brown T A (1995) Essential molecular biology, vol. I, A practical approach,IRL press, Oxford.
- Genes and Genomes Maxine Singer and Paul Berg
- Principle of Genetics by Simmons

ZOOLOGY II: VERTEBRATES PHYSIOLOGY

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

Course Objectives:

1. To impart basic knowledge of Vertebrates & Embryology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Vertebrates & Embryology.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Vertebrates & Embryology 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

Origin and classification of Chordates. Protochordata - type sutdy Amphioxus. A comparative account of Petromyzon & Myxine.

Module-II

Fishes - Skin and scales Migration in fishes Parental care Amphibia - Parental careNeoteny Reptilia - Poisonous & non poisonous shakes, Poison apparatus, snake venom.

Module-III

Aves - Flight adaptation in birds Discuss - Birds are glorified reptiles Mammals- comparative account of prototheria, metatheria & Eutheria and Affinities.

Module-IV

Gametogenesis, Fertilization & Parhenogenesis. Development of frog upto formation of three germ layers.

Module-V

Development of Chick upto formation of three germ layer, Extra embryonicmembranes. Placenta in mammals. Embryonic induction organisers & differentiation.

SUGGESTED READINGS:

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

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.

SUGGESTED READINGS:

1. Physical chemistry, G. M. Barrow, International student edition, Mc Graw Hill
2. Basic programming with application, V. K. Jain, Tata Mc Graw-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, Wiley Eastern.
8. Physical Chemistry, B.D. Khosla
9. Physical Chemistry, Puri & Sharma

10. Basic Inorganic Chemistry, F.A Cotton, G. Wilkinson and P.L Gauss, Wiley.
11. Concise Inorganic Chemistry, J.D. Lee, ELBS.
12. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J Alexander, John Wiley.
13. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H.L. Angford, Oxford

LAB COURSE: BOTANY II

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

The practical work will, in general be based on the syllabus prescribed in theory and thecandidates will be required to show knowledge of the following.

1. Cytology- Mitosis, Meiosis

2. Permanent Slides

LAB COURSE: ZOOLOGY II

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

The practical work will, in general be based on the syllabus prescribed in theory and thecandidates will be required to show a knowledge of the following.

1. Osteology-Frog & Rabbit

2. Museum Specimen invertebrate & Vertebrate, frog embryology.

3. Slides-Chick embryology, Cytology, Mammal Histology, Bird feather Slides.

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 valentanions.

3. **Viscosity &. Surface Tension**
   To determine the of % composition of a given mixture (Non interacting system) by viscositymethod.
   To determine the viscosity of amyl alcohol in water at different concentrations & calculate theexcess 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, CI^{-} ,Br^{-},I^{-}, CH_3COO^{-}, $C_202/4^{-}$, $BO3/5^{-}$, F^{-}.

INTELLECTUAL PROPERTY RIGHTS (IPR)

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, Patentableand 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 modifiedfood 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 ofHuman Genome project.

Biosafety: Introduction, Need, Applications, Levels of biosafety, Biosafety guidelines and regulationsframework 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.

SUGGESTED READINGS:

- **"Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management"**
  By Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman
- **"Earthworms and Vermiculture"**
  By M.C. Dash
- **"Vermicomposting for Sustainable Agriculture"**
  By S.K. Sinha, S.P. Singh
- **"Organic Farming for Sustainable Agriculture"**
  By P. Bhattacharyya and D.K. Chakraborty
- **"A Handbook of Organic Farming"**
  By S.P. Palaniappan and K. Annadurai
- **"Organic Farming: Concepts, Applications and Extensions"**
  By Dilip Nandwani

ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT	
Course 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.

SEMESTER III
BOTANY III
DIVERSITY OF SEED PLANTS AND THEIR SYSEMATICS

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

Course Objectives:

1. To impart basic knowledge of Diversity of seed plants and their systematics.
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:

Course Outcomes		**Bloom's Taxonomy Level**
CO1	Explain the characteristics, evolution, and diversity of gymnosperms and angiosperms	Understand (2)
CO2	Describe and compare the morphology, anatomy, reproductive structures, and life cycles of Gymnosperms	Apply (3)
CO3	Analyze the origin and evolution of angiosperms	Analyze (4)
CO4	Evaluate major angiosperm classification systems	Evaluate (5)
CO5	Identify and differentiate major flowering plant families	Apply (3)

MODULE-I.

Characteristics of seed plants; evolution of the seed habit; seed plants with (angiosperms)and without (gymnosperms) fruits; fossil and living seed plants. General features of gymnosperms and their classification; evolution and diversity of gymnosperms; geological time scale, fossilization and fossil gymnosperms.

MODULE-II

Morphology of vegetative and reproductive parts ; anatomy of roots, stem and leaf, reproduction and life cycle of Pinus, Cycas and Ephedra.

MODULE -III

Angiosperms: origin and evolution, some examples of primitive angiosperms. Angiosperms taxonomy: brief history, aims and fundamental components; identification, keys taxonomic literature. Botanical nomenclature: Principles and rules; taxonomic ranks; type concept; principle of priority.

MODULE -IV

Classification of angiosperms; salient features of the systems proposed by Bentham and

Hooker and Engler and Prantl. Major contributions of cytology, phytochemistry and taximetrics to taxonomy.

MODULE -V

Diversity of flowering plants: General account of the families Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae and Poaceae.

SUGGESTED READINGS:

- B P Pandey: Botany for Degree Students -II (B. Sc. II Year), 1/e S. Chand Publishing.
- Dr Nupur Bhowmick *: Diversity of Seed Plants and Their Systematics.*
- Michael G Simpson*: Plant Systematics* .
- Dr. V. Singh, Dr. P.C. Pande & Dr. D.K. Jain: A Text *Book* of Botany *Diversity* And Systematics of *Seed Plants*.
- Esha Agarwal, S. B. Agarwal: B.Sc. Practical Botany Second Year

ZOOLOGY III

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

Course Objectives:

1. To impart basic knowledge of Anatomy & Physiology.
2. To train the students to pursue further education.
3. To be familiar with standard tools.

Course Outcome:

Skills that students obtain after completion of the course:

Course Outcomes		Bloom's Taxonomy Level
CO1	Compare the anatomy of major vertebrate organ systems	Understand / Analyze (2,4)
CO2	Describe the evolution and structural organization of the vertebrate endoskeleton	Understand / Apply (2,3)
CO3	Explain the organization of the vertebrate nervous system and endocrine system and relate structure with function.	Understand / Analyze (2,4)
CO4	Illustrate the processes of digestion, absorption, cardiac function, blood coagulation, and respiratory physiology.	Apply/ Understand (Level 2–3)
CO5	Analyze the physiology of excretion, osmoregulation, muscle contraction, nerve impulse transmission, and sensory organs.	Analyze (4)

MODULE-I

Comparative Anatomy of various organ systems of vertebrates. Integument and its derivatives: structure of scales, hair and feathers. Alimentary canal and digestive glands in vertebrates. Respiratory Organs Gills and lung, Air-Sac in bird.

MODULE -II

Endoskeleton-Limbs, girdles and vertebrae. Circulatory System - Evolution of heart and aortic arches. Urinogenital System - Kidney and excretory ducts.

MODULE -III

Nervous System- General plan of brain and spinal cord. Endocrine glands - classificationand histology. Gonads and genital ducts.

MODULE -IV

Digestion and absorption of dietary components. Physiology of heart, Cardiac cycle andECG. Blood Coagulation. Respiration-Mechanism and control of breathing.

MODULE -V

Excretion-Physiology of excretion, Osmoregulation. Physiology of Muscle contraction. Physiology of nerve impulse, Synaptic transmission. Ear and Eye - structure and function.

SUGGESTED READINGS:

1. Conn, Stumpy RK, Bruening and D.C.:Outlines of Biochemistry.
2. Gaviong : Review of Medical Physiology.
3. Eckest, R. : Animal Physiology (W.H. Freeman)
4. Hildbrand : Analysis of Vertebrate structure
5. Kingsley : Outlines of Comparative Anatomy (Central Book Depot)
6. Rouer & Parsons : The Vertebrate Body, (Saunders)
7. Walta & Gyles : Biology of the Vertebrates (Macmillan)

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:

Course Outcomes		Bloom's Taxonomy Level
CO1	Explain the electronic configuration, oxidation states, magnetic behavior, spectral characteristics, and complex-forming ability of d- and f-block element	Understand / Analyze (2,4)
CO2	Apply redox concepts and diagrammatic tools (Latimer, Frost, Pourbaix)	Apply / Analyze (3,4)
CO3	Apply laws of thermodynamics to calculate thermodynamic parameters	Apply / Analyze (3,4)
CO4	Interpret the second and third laws of thermodynamics	Understand / Evaluate (2,5)
CO5	Analyze conductance, electrode potentials, electrochemical series, ion transport, and EMF of galvanic cells	Analyze / Apply (3,4)

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

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
- General Chemistry for Majors IV1%3A Thermochemistry (Experiment) https:/www.ulm.edu/chemistry/courses/manuals/chem1010/experiment 10.pdf

COURSE: BOTANY III

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

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

Course Outcomes		Bloom's Taxonomy Level
CO1	Apply anatomical and morphological techniques to study dicot plant body plans, growth forms, shoot apex zonation, branching patterns, and primary–secondary growth using microscopic and field-based observations.	3 (Apply)
CO2	Analyze structural variations in wood, stems, and leaves (T.S., T.L.S., R.L.S.), compare growth forms of flowering plants (cycads, bamboos, bananas, conifers, dicots), and interpret developmental patterns such as leaf primordia origin and modular growth.	4 (Analyze)

ANGIOSPERMS
Embryology, Anatomy and Vegetative Propogation etc.

1. Study of commonly occuring dicotyledonous plant (for example ***Solanum nigrum*** or Kalanchoe) to understand the body plan and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden), study of tree like habit in cycads, bamboos, banana, traveller's tree (*Ravenala madagasariensis*) or yucca and comparison with ture trees as exemplified by conifers and dicotyledons.
3. L.S. shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and Sympodial types of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using hand sections (or prepared slides), structure of secondary phloem and xylem, Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.

LAB COURSE: ZOOLOGY III

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

Course Outcomes		Bloom's Taxonomy Level

CO1	Apply microscopic, taxonomic, and histological techniques to study chordate groups, identify key characteristics, and examine prepared and permanent slides.	Apply (3)
CO2	Analyze skeletal structures, including limb girdles and vertebrae of selected vertebrates (frog, varanus, fowl, rabbit), to interpret functional and evolutionary differences.	Analyze(4)

The practical work in general shall be based on the syllabus prescribed in theory.
Thestudents will be required to show the knowledge of the following.
1. Study of the representative examples of the different chordates (Classification andcharacter)
2. Simple microscopic technique through unstained or stained permanent mounts.
3. Study of prepared slides histological, as per theory papers.
4. Study of limb girdles and vertebrae of frog, varanus, fowl and Rabbit.

LAB COURSE: INORGANIC & PHYSICAL CHEMISTRY I

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

Course Outcomes		**Bloom's Taxonomy Level**
CO1	Apply thermometric, solubility, and calorimetric methods to determine transition temperatures, molecular weight, solubility, and various enthalpy changes.	3 (Apply)
CO2	Analyze electrolytic, acid strength, ionization constants, and solubility products using conductometric and potentiometric techniques.	4 (Analyze)

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.

(a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong base (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:

To develop basic understanding regarding food toxicology & adulteration.
To create awareness regarding food adulteration practices.
To identify the adulterants present in the sample and compare it with standard products.
To protect public from poisonous and harmful products.
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:

Course Outcomes		Bloom's Taxonomy Level
CO1	Describe types of food adulteration, common adulterants, associated health hazards, and basic food quality aspects.	Understand (2)

CO2	Explain the functions, categories, and applications of major food additives	Understand (2)
CO3	Interpret national and international food laws, standards, regulatory bodies, and consumer protection frameworks.	Apply (3)
CO4	Classify and evaluate food toxins and assess risks associated with GM foods and persistent organic pollutants.	Analyze (4)
CO5	Identify agricultural and industrial contaminants and drug residues in food systems.	Analyze (4)

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

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

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MODULE III
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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:

Course Outcomes		Bloom’s Taxonomy Level
CO1	Organize biological data through collection, classification, tabulation, sampling, and graphical/diagrammatic representation	Apply (3)
CO2	Calculate and interpret basic statistical parameters.	Apply (3)
CO3	Describe concepts of databases and distinguish different types of biological and sequence databases.	Understand (2)
CO4	Explain the importance of bioinformatics and identify major biological databases	Understand (2)
CO5	Perform basic sequence alignment and pairwise similarity searches using tools such as BLAST and FASTA.	Analyze (4)

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:

Course Outcomes		Bloom's Taxonomy Level
CO1	Describe the foundational concepts of Ayurveda including Panchamahabhuta, Purusha–Prakriti, and Triguna, and relate them to basic biological principles.	Understand (2)
CO2	Explain the Tridosha theory and analyze its association with biological functions, homeostasis, and physiological rhythms	Analyze (4)
CO3	Identify Dhatu, Mala, and Srotas and compare them with modern biological tissues, excretory processes, and circulatory pathways.	Understand (2)
CO4	Interpret Prakriti classifications and evaluate their connections with phenotypic traits and emerging genetic research.	Understand (2)
CO5	Examine Ayurvedic concepts of health, disease, immunity, and metabolism and correlate them with biochemical and physiological mechanisms.	Analyze (4)

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)

FOURTH SEMESTER
BOTANY IV: STRUCTURE DEVELOPMENT & REPRODUCTION IN FLOWERING PLANTS

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

Course Objectives:

1. To impart basic knowledge of Structure, Development & Reproduction in flowering plants.
2. To train the students to pursue further education.
3. To be familiar with concepts of Structure, Development & Reproduction in flowering plants.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Structure, Development & Reproduction in flowering plants 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

The basic body plan of a flowering plant: modular type of growth. Diversity in plant form in annuals, biennials and perennials; convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons; trees-largest and longest-lived organisms.

MODULE-II

The shoot system : the shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; formation of internodes, branching pattern; monopodial and sympodial growth; canopy architecture; cambium and its functions; formation of secondary xylem, a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood ; role of woody skeleton; secondary phloem- structure-function relationships, periderm.

MODULE-III

Leaf: origin, development, arrangement and diversity in size and shape; internal structurein relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

The root system: the root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

MODULE-IV

Flower: a modified shoot ; structure, development and varieties of flower, functions, structure of anther and pistil, the male and female gemetophytes; types of pollination; attractions and rewards for pollinators; pollen-pistil inter-action, self incompatibility, double fertilization, formation of seed-endosperm and embryo; fruit development and maturation.

MODULE-V

Significance of seed: suspended animation; ecological adaptation; unit of genetic recombination and replenishment, dispersal strategies. Vegetative reproduction: vegetative propagation, grafting, economic aspects.

SUGGESTED READINGS:

1. V. Singh , P.C. Pande , D.K. Jain: A Textbook of Botany: Structure, Development and Reproduction in Angiosperms
2. N. K. Soni: Fundamentals Of Botany:, Volume 2
3. B P Pandey:Botany for Degree Students -II (B. Sc. II Year), 1/e S. Chand Publishing.

Esha Agarwal, S. B. Agarwal: B.Sc. Practical Botany Second Year

ZOOLOGY IV: CHORDATE & COMPARATIVE ANATOMY

Credit: 3

Total Marks: 100 (70+30)

MODULE-I: Origin of chordates- Fishes, Amphibia, Reptiles, Aves & Mammals. General characteristics and Classification of Fishes, Amphibia, Reptiles, Aves & Mammals.

MODULE-II: Pisces: Accessory respiratory organs, Parental care in fishes.Amphibia: Parental Care in Amphibia. Reptilia: Difference between Poisonous and Non-poisonous snakes. Aves: Migration of birds, Flight adaptation in birds.

MODULE-III: Vertebrate integument and its derivatives- Development, general structure and function of skin and its derivatives, glands, scales, horns, claws, feathers & hairs. General plan of circulation in various groups- Structure and function of blood, Evolution of heart, evolution of aortic arches and portal system.

MODULE-IV: Comparative account of digestive system in vertebrates**.** Respiratory system in Vertebrates- Comparative account of respiratory organs in vertebrates, Skeletal system- Comparative account of Skull, vertebrae, limbs and girdles. Evolution of Urinogenital system in vertebrates.Comparative account of urinogenital system in vertebrates

MODULE-V: Sense organs- receptors, organs of olfaction and taste, lateral line system and electroreception. Nervous system- Comparative account of the brain in relation to its function, Comparative anatomy of spinal cord, Nerves- cranial, peripheral and Autonomic nervous system.

SUGGESTED READINGS:

1. Life of the vertebrate- J.Z. Young
2. Vertebrate body- A.S. Romer
3. Evolution of vertebrate-E.H. Colbert
4. Comparative anatomy of Vertebrate- C.G. Kent
5. Life of the mammals- J.Z. Young
6. Modern Text Book of Zoology – Vertebrates: R. L. Kotpal
7. Chordate Zoology: Dhami & Dhami.

CHEMISTRY IV
ORGANIC & PHYSICAL CHEMISTRY I

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

MODULE-I
A. Halides
(i) Alkyl Halides: Preparation: from alkenes and alcohols. Reactions: Nucleophilic substitution reactions of alkyl halides (alcohol, ester, nitrile & isonitrile formation,Williamson's ether synthesis), mechanism and stereochemistry of nucleophilic substitution reactions (SN1 and SN2), factors affecting SNI and SN2 reactions.
(ii) Aryl Halides: Chlorobenzene: Preparation by aromatic halogenation and Sandmeyer reaction. Aromatic nucleophilic substitution involving Benzyne Mechanism: KNH_2/NH_3(or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl and aryl,Vinyl halides.

B. Alcohols & Phenols
(i) Alcohols
(a) Monohydric-nomenclature, methods of formation, Properties & chemical reactions distinction between primary, secondary & tertiary alcohols.
(b) Dihydric alcohols: Nomenclature, methods of formation of ethylene glycol (from ethylene, epoxide, ethylene dibromide and ethylene diamine). Chemical reactions of vicinal glycols: with carbonyl compounds, dehydration, oxidative cleavage with Pb(OAc)4 and HIO4 and Pinacol-Pinacolone rearrangement (with mechanism).
(c) Trihydric alcohols: Nomenclature and methods of formation (from hydrolysis of fats and oils, propene and acrolein), chemical reactions of glycerol (with PCI5, HI, oxidation, and dehydration) and uses/applications.

(ii) Phenols
Nomenclature and methods of formation, physical properties, and acidic character. Resonance stabilization of phenoxide ion. Comparative acidic strength of alcohols and phenols. Electrophilic aromatic substitution, acetylation, and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, and Reimer-Tiemann reaction.

MODULE-II Aldehydes/Ketones and acid/its derivatives
A. Aldehydes and Ketones
Nomenclature and structure of the carbonyl group, synthesis of aldehydes and ketones Acidity of alpha hydrogens and formation of enolate, Concept of reactive methylene group, Keto-enol tautomerisim in Acetoacetic ester. Oxidation of aldehydes by KMnO4, and Tollen's reagent, Reduction of aldehydes by $LiAlH_4$ and $NaBH_4$.
Mechanism of nucleophilic additions to carbonyl group with particular emphasis on aldol,

Perkin, and Knoevenagel reactions. Wittig and Mannich reaction (without mechanism), Baeyer-Villiger oxidation of Ketones (without mechanism), Cannizaro reaction (with mechanism), MPV, Clemmensen, and Wolf-Kishner reaction.

B. Acid & its derivatives

(i) Carboxylic Acids

Nomenclature, structure, physical properties, acidity of carboxylic acids, effect of substituent on acid strength, method of preparation and chemical reaction. Hell-Volhard-Zeilinsky (HVZ) reaction, Reduction of carboxylic acids, Mechanism of decarboxylation. Di carboxylic acids: - Methods of formation and chemical reactions.effect of heat and Dehydrating agents.

(ii) Carboxylic Acid Derivatives

Structure, method of preparation & physical properties of acid chlorides, esters, amides (Urea) and acid anhydrides. Relative stability of acyl derivatives.

MODULE-III Equilibrium

A. Chemical Equilibria

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constants and their quantitative dependence on temperature, pressure, and concentration, factors affecting equilibrium - Le Chatelier's principle.

B. Ionic Equilibria

lonization of acids and bases, Strong and weak electrolytes, degree of ionization, ionization constant and ionic product of water. lonization of weak acids and bases, pH scale, common ion effect and solubility product (with illustrative examples), Salt hydrolysis - calculation of hydrolysis constant and degree of hydrolysis for salt of strong acid and weak base, Buffer solutions - Introduction, Henderson-Hasselbalch equations for acidic and basic buffer.

C. Phase Equilibrium

(A)Gibbs phase (no derivation), phase, component and degree of freedom, Application of phase rule to one component system (water system and Sulphur systems), Reduced phase rule. Application of phase rule to two component systems: Pb-Ag system. CongruentFerric chloride system.

MODULE-IV Photochemistry and liquid-liquid mixtures

A) Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical reactions, Laws governing absorption of light, laws of photochemistry, Jablonski diagram depicting various processes, quantum yield, determination of quantum yield of reactions, reasons for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2). Photosensitization and Quenching,Photosensitized reactions.

B) Liquid-Liquid mixtures

Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law and its applications, Nernst distribution law, limitations, and applications (association and dissociation - No derivation).

BOTANY IV LAB COURSE

Credit: 1

Total Marks: 50 (35+15)

ANGIOSPERMS

1. Field study of diversity in leaf shape, size, thickness, surface properties, internal structure of leaf, structure and development of stomata (using epidermal peels of leaf).
2. Anatomy of the root, Primary and secondary structure.
3. Examination of a wide range of flowers available in the locality and methods of theirpollination.
4. Structure of anther, microsporogenesis (using slides) and pollen grains (using wholemounts), pollen viability using in vitro pollen germination.
5. Structure of ovule and embryo sac development (using serial sections)
6. Test of self-incompatibility (using Petunia axillaris, Brassica campestris, B. olderacea orsuitable available material) using field pollinations.
7. Nuclear and cellular endosperm, embryo development in monocots and dicots (usingslides/dissections).
8. Simple experiments to show vegetative propagation (leaf cuttings in Bryophyllum,Sansevieria, Begonia, stem cuttings in rose, salix, money plant, sugarcane and Bougainvillea).
9. Germination of non-dormant and dormant seeds

ZOOLOGY IV LAB COURSE

Credit: 1

Total Marks: 50 (35+15)

1. Study of museum specimens of chordate (from protochordate to mammal).
2. Study of histological slide (from protochordate to mammal).
3. Osteology of Fishes, Amphibia, Aves, Reptiles and Mammals, skull of dog, cattle, and man.
4. Alternative methods of dissection- cranial nerves of vertebrates

CHEMISTRY IV LAB COURSE
ORGANIC & PHYSICAL CHEMISTRY I

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

Lab./Field - Organic Analysis
Systematic identification of organic compounds:

a) Test for aliphatic and aromatic nature of substances
b) Test for saturation and unsaturation.
c) Detection of elements (N, S, and halogens) in organic compounds.
d) Identification of functional groups:
i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones, v) Esters, vi) Carbohydrates vii) Amines vii) Amides, ix) Halogen compounds
e) Determination of melting and boiling points.
f) Preparation of solid derivatives.

pH determination

1. Determination of pH of soil, water.
2. To measure the pH of various solutions using pH indicators and pH meter.
3. To determine the value of Ka for an unknown acid.
4. To prepare and study the properties of buffer solutions.

Phase Equilibrium:

I) To determine the critical solution temperature of two partially miscible liquids (phenol-water systems).
2) To study the effect of solute such as (i) sodium chloride (NaCl), (ii) succinic acid (HOOC-Ci-CH-COOH) on the critical solution temperature of two partially miscible liquids (e.g. phenol - water system).
B) To construct the phase diagram of two components (e. g. diphenylamine-benzophenone system) by cooling curve method.

Nernst Distribution Law

I) To determine the partition coefficient of iodine between water and carbon tetrachloride/Kerosene.
2) To determine the partition coefficient of benzoic acid between water and benzene.
3) To determine the equilibrium constant of the reaction, $KI + l_2 = KI_3$ by distribution method.

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.

BOTANY A
PLANT TISSUE CULTURE

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

COURSE OBJECTIVE:

1. To equip the students to pursue a career in Agriculture or Environment Sector.
2. Encourage students to carry out research related to Biotech industries and plant products.
3. Enhance the knowledge of techniques required in Plant tissue culture.
4. Comprehend beginning entrepreneurship ventures in plant-based products

COURSE OUTCOME:

Skills obtained on successful completion of this paper

1. Understand basic terms and acquire a critical knowledge on sterilization techniques.
2. Demonstrate skills related to callus culture through hands on experience
3. Understand the biotransformation technique for production of secondary metabolites.
4. To understand the possibility for the production of elite plants through protoplast culture.
5. Comprehend the applications of plant tissue culture.

Module I

Plant Tissue Culture: Introduction, Terms and definitions. Types of culture, Aseptic Techniques, Tissue culture media and importance of growth regulators (Auxins, Cytokininis and Gibberellins)

Module II

Callus culture, cell suspension culture, Organogenesis and Somatic Embryogenesis – Techniques and applications: Micropropagation, axillary bud, shoot-tip and meristem culture.

Module III

Haploid Production- Ovary and Anther culture, Somaclonal variation and their significance, In-Vitro production of secondary metabolites (biotransformation)

Module IV

Protoplast Culture – isolation, regeneration and viability test, somatic hybridization, protoplast fusion, practical Introduction of somatic hybridization: Various methods for fusing protoplasts,chemical and electrical. Cybrids- definition and application.

Module V

Production of Transgenic plants: Technique of transformation – Physical, Chemical & Biological (Agrobacterium mediated) methods. Applications of plant tissue culture in horticulture, agriculture. Edible Vaccines.

SUGGESTED READINGS:

1. Kalyan Kumar De (2001) An Introduction to Plant Tissue Culture, New Central Book Agency (P) Ltd., Calcutta
2. Razdan, M.K. (2005) Introduction to Plant Tissue Culture, Oxford & IBH Publishers, Delhi

3. Bhojwani, S.S. (1990) Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.
4. Vasil, I.K. and Thorpe, T.A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.

ZOOLOGY A
WILD LIFE CONSERVATION & MANAGEMENT

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

Course Objective:

1. To create awareness about Wildlife, its Conservation and Management.
2. To provide graduates in Biology a specialization in the field of Biodiversity, Conservation and Wildlife Management.
3. To generate skilled graduates who can undertake research in the field of Wildlife biology and Nature conservation.
4. To generate qualifiedgraduates who can be part professional organizations working in the fieldof conservation and environment protection.

Course Outcomes:

Skills obtained on successful completion of this paper

1. Students will have a basic understanding of wildlife and it's conservation in India.
2. Students will have basic idea about remote sensing and its application.
3. Students will be able to analyse and appraise wildlife threats
4. Students will able to apply scientific method in wildlife conservation issues.

MODULE-I: Ecological basis of wildlife management, concept of carrying capacity, home range and territory, Management of rangelands (Types of rangeland, Characteristics, Rangeland carrying capacity, Forests and wildlife corridors, rangeland conditions). Conservation Schemes: Project Tiger (Initiation, Finance, Objective, Management, Status, Threats), Gir Lion Sanctuary Project (Threats, Management, Work plan and achievements), Conservation of Sea Turtle in India.

MODULE-II: Introduction to Remote Sensing, Electromagnetic Spectrum, Radiation Laws (Plank's Law, Stefan Boltzman Law, Wien's Displacement Law), Types of Remote Sensors.

MODULE-III: Population genetics and conservation. Application of genetics for wildlife conservation; Genotyping; characterizing genetic difference between populations, importance of genetic diversity, Loss of genetic diversity, Resolving taxonomic uncertainties; Foundational population genetic concepts, population genetic information needed to manage threatened species, Genetic drift, Gene flow and the structuring of populations.

MODULE-IV: Environmental Impact Assessment (EIA): Aim, Types, Organizations Responsible, Contents, Prediction of changes and impacts (on air, water, soil, noise, biological, cultural and socio-economic environment), Factors. EIA in India, Components of EIA (Purpose, Screening and IEE, Scoping, Preparation of Terms of reference, EIA report, Assessment of methodologies, Review, Impact, Evaluation, Overall assessment).

SUGGESTED READINGS:

1. Introduction to Wildlife Management, by P.R.Krausman, Prentice Hall Pearson Educ. Inc. New Jersey.
2. Genetics: A Conceptual Approach by Benjamin A. Pierce
3. Wildlife Management, by R.H.Giles Jr. The wildlife scri.
4. Wildlife Ecology and Management, by W.L.Robinson & E.G.Bolen. Mc.Millan Publ. Comp. New York.
5. Managing Protected Areas in Tropics, by J.K. Mackinnon, Natraj Publ. Dehradun.
6. Environmental Impact Assessment and Management, Ed. By B.B. Hosetti and A. Kumar, Daya Publishing House, Delhi.
7. Introduction to Remote Sensing: - J. B. Cambell – Rawat Publication.

CHEMISTRY A
BASIC ANALYTICAL CHEMISTRY

Credit: 4
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: Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of Significant figures.

MODULE-II: Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. Determination of pH of soil samples. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.
Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity and alkalinity of a water sample. Determination of dissolved oxygen (DO) of a water sample.

MODULE-III: Analysis of food products: Nutritional value of foods, idea about food processing and food preservationsand adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.

MODULE-IV: Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+). To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

MODULE-V: Analysis of cosmetics: Major and minor constituents and their function. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zincoxide and Calcium carbonate by complexometric titration.

SUGGESTED READINGS:

1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers.
2. Skoog & Lerry. Instrumental Methods of Analysis, Saunders College Publications, NewYork.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed.,Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA(1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

SOCIETY, CULTURE & HUMAN BEHAVIOUR

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To explore the relationship between Society, Culture and Human Behaviour.
2. To analyse the impact of social norms, values and beliefs on individual and collective behaviour.
3. To examine the cultural diversity and its influence on social interactions and perceptions.

Course Outcomes:

Skills obtained on successful completion of this paper:

1. Students will be able to understand and demonstrate the interplay between society, culture and diversity.
2. To know about caste system, unemployment and poverty.
3. Critically assess theories and concept related to human behaviour.

MODULE-I

Indian Society and culture: Society and its types, Culture–Features, Characteristics and Diversity. Differences with Western Culture.

MODULE-II

Social Stratification: Caste System, Class System, Communities, Ethnic Groups, Weaker Section and Minorities, Constitutional Provisions for Scheduled Castes, Scheduled Tribes and other Backward Classes.

MODULE-III

Socio-Economic Problems: Poverty, Illiteracy, Unemployment, Housing, Child Labor, Migration, Occupational Diseases, Insurgency, Terrorism, Crime, Project Affected People, Social Destitute, Beggary, Aged Population, Juvenile Delinquency, Problems in Family Life.

MODULE-IV

Introduction to Human Behavior: Overview of human behavior, Importance of studying human behavior, determinants of human behavior.

SUGGESTED READINGS:

1. Schriver, J. M. (2010). Human Behavior and the Social Environment: Shifting Paradigms in Essential Knowledge for Social Work Practice. (5th ed.). Boston: Allyn and Bacon.
2. American Psychological Association. (2009). Publication manual of the American Psychological Association (6th ed.). Washington, DC:
3. Barker, Robert (Ed.). Social Work Dictionary. Washington, D. C.: National Association of Social Workers, Current edition or edition purchased for Introduction to Social Work.

COMPUTER APPLICATION

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

Course Objectives:

1. To impart basic knowledge of computer.
2. To be familiar with computer hardware and software.
3. To have experience of virtual world.

Course Outcome:

Skills that students obtain after completion of the course:

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

MODULE-I

Computer basics (history, generation, components, I/O devices, memory of computer), Introduction tocomputer network (LAN, MAN, WAN), Network topologies.

MODULE-II

Internet and it's applications, Email, video conferencing, chatting, blogs, Usenet. Internet protocols (FTP, HTTP). Website, search engines. Advantages and threats in Internet communications.

MODULE-III

MS office, MS word (tools and menus, paragraph, alignment, font, editing). MS PowerPoint (tools and menus, creating slides, transition and custom animation). MS Excel (tools and menus, creating spreadsheet, use of function).

MODULE-IV

Database, Database management system (Introduction, types, functions and features). Introduction tocomputer graphics, color model, graphic file format.

MODULE-V

Use of computer in biological science, Introduction to bioinformatics, bioinformatics database,importance and use of bioinformatic.

SUGGESTED READINGS:

1. Chetan Shrivastava, Introduction to IT, Kalyani Publishers, Delhi.
2. Jaiswal, Fundamental of Computer IT Today, Wiley Dreamtech

PRESENTATION SKILLS

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To let the students learn the importance of good presentation skills.
2. To make students understand the different dimensions of skilled presentation.
3. To inculcate the spirit of effective presentation in students and make them efficient enough.
4. To develop the skills of communication is a requirement for a good professional.

Course Outcomes:

1. Deal with nerves and think more positively about public speaking.
2. Consider ways of grabbing the listener's attention, holding their interest, and concluding strongly.
3. Use body language and tone of voice to enhance their presentations.
4. Use slides and visual aids effectively.
5. Deliver an enthusiastic and well-practiced presentation.

MODULE-I

Preparation of presentation – 1st part – what, how, for whom, structure, principles and presentation technique, business presentation specifications, Report Writing, Developing Effective Presentation Skills.

Oral Presentation: Principles of oral presentation, factors affecting presentation, sales presentation, training presentation, conducting surveys, speeches to motivate, effective presentation skills.

Slide Presentation: Craft your message, Make a visuals, Include proper Content of your presentation.

MODULE -II

Verbal communication – jawbreakers, argumentation, usable and unsuitable phrases Communication skills – listening, empathic reaction, how to question, stealing the show, opening door question Conflict situation solving, attack from the audience – communication skills as a work experience, vicious circle of attack and defense.

Nonverbal communication during presentation – how to manage stress, what to do with hands, legs, activating the audience with nonverbal communication, body language.

MODULE -III

Work with audience – ice-breaking, get them in the mood, work with emotions, visualization tools, nonstandard situations Improvisation and unprepared presentations Personal typology, professional typology, social aspect, man-woman view.

MODULE -IV

Feedback – appreciation and critique, Paradigm of human cooperation – why there could be problems to start the communication and what to do with it – Defense against manipulation, how to say NO, stress management, Image and etiquette.

SUGGESTED READINGS:

1. Effective Presentation Skills – Robert Dilts, Meta Publication
2. Business Communication Today - Bovee and Thill: Tata McGraw Hill,
3. Presentation Skills 2011