INVERTIS UNIVERSITY BAREILLY

Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

Scheme of Instruction & Syllabi

of

Bachelor of Science
(Zoology, Botany & Chemistry)

(Effective from the academic session 2016- 2017)

Department of Applied Science & Humanities

INVERTIS UNIVERSITY

Invertis Village, Bareilly-Lucknow NH-24, Bareilly

Program Outcome of B.Sc. (ZBC)

PO1. Ability to connect zoological phenomenon with chemical, botanical and environmental Science.
PO2. Designing the experiments for exploring the characteristics of biological samples.
PO3. Understand the scientific study of the physiology, structure, distribution, classification, and importance of plants.
PO4. Ability to understand chemical phenomenon using different principles, and chemical intuition to predict reactivity and reaction outcome along with discussing the scientific discovery with peers in the field.
PQ5. Design experiments for qualitative and quantitative analysis of a sample with precision and accuracy as well as an analytical mind to solve different problems related biological science.
PO6. Ability to apply biological perception to predict evolutionary and climatic changes.
PO7. Understanding of relationships between different organisms to one another and to their physical surroundings.
PQ8. This course is studied to understand the biological processes for industries especially the genetic manipulation of micro-organisms.

Scheme of Evaluation

I Year								
I Semester			**Teaching Scheme**			**Marks Distribution**		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT101	ANIMA DIVERSITY I – NONCHORDATE	3	1	0	70	30	100
Paper 2	ZYT102	CELL & MOLECULAR BIOLOGY	3	1	0	70	30	100
Paper 3	BOT101	DIVERSITY OF VIRUSES, BACTERIA & FUNGI	3	1	0	70	30	100
Paper 4	BOT102	DIVERSITY OF ALGAE, LICHENS, & BRYOPHYTES	3	1	0	70	30	100
Paper 5	BSR101	FUNDAMENTALS OF CHEMISTRY	3	1	0	70	30	100
Lab 1	ZBP151	LAB BASED ON ZOOLOGY AND BOTANY PAPERS	0	0	2	35	15	50
Lab 2	BSR151	CHEMISTRY LAB-I	0	0	2	35	15	50
Total			15	5	4	420	180	600
II Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 6	ZYT-201	EVOLUTION & DEVELOPMENTAL BIOLOGY	3	1	0	70	30	100
Paper 7	ZYT-202	ENVIRONMENTAL BIOLOGY	3	1	0	70	30	100
Paper 8	BOT-201	DIVERSITY OF PTERIDOPHYTES & GYMNOSPERMS	3	1	0	70	30	100
Paper 9	BOT-202	DIVERSITY OF ANGIOSPERMS: SYSTEMATIC, DEVELOPMENT & REPRODUCTION	3	1	0	70	30	100
Paper 10	BSR201	PHYSICAL CHEMISTRY- I	3	1	0	70	30	100
Paper 11	BSR202	ORGANIC CHEMISTRY- I	3	1	0	70	30	100
Lab 3	ZBP-251	LAB BASED ON ZOOLOGY AND BOTANY PAPERS	0	0	2	35	15	50
Lab 4	BSR251	CHEMISTRY LAB II	0	0	2	35	15	50
Total			18	6	4	490	210	700

II Year								
III Semester			**Teaching Scheme**			**Marks Distribution**		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT301	ANIMAL DIVERSITY-II : CHORDATA	3	1	0	70	30	100
Paper 2	ZYT302	COMPARATIVE ANATOMY & HISTOLOGY	3	1	0	70	30	100
Paper 3	BOT301	PHYSIOLOGY AND BIOCHEMISTRY OF PLANTS	3	1	0	70	30	100
Paper 4	BOT302	MOLECULER BIOLOGY AND PLANT BIOTECHNOLOGY	3	1	0	70	30	100
Paper 5	BSR301	PHYSICAL CHEMISTRY – II	3	1	0	70	30	100
Lab 1	ZYT351	LAB BASED ON ZOOLOGY(PAPER I & II)	0	0	2	35	15	50
Lab 2	BOT351	LAB BASED ON BOTANY(PAPER I & II)	0	0	2	35	15	50
Lab 3	BSR351	CHEMISTRY LAB – III	0	0	2	35	15	50
Total			15	5	6	455	195	650
IV Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 6	ZYT401	FUNDAMENTALS OF BIOCHEMISTRY	3	1	0	70	30	100
Paper 7	ZYT402	ENDOCRINOLOGY&ANIMAL BEHAVIOUR	3	1	0	70	30	100
Paper 8	BOT401	ECONOMIC BOTANY	3	1	0	70	30	100
Paper 9	BOT402	PLANT ANATOMY	3	1	0	70	30	100
Paper 10	BSR401	ORGANIC CHEMISTRY – II	3	1	0	70	30	100
Paper 11	BSR402	INORGANIC CHEMISTRY - I	3	1	0	70	30	100
Lab 4	ZYT451	LAB BASED ON ZOOLOGY(PAPER I & II)	0	0	2	35	15	50
Lab 5	BOT451	LAB BASED ON BOTANY(PAPER I & II)	0	0	2	35	15	50
Lab 6	BSR451	CHEMISTRY LAB IV	0	0	2	35	15	50
Total			18	6	6	525	225	750

III Year								
V Semester			**Teaching Scheme**			**Marks Distribution**		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	BOT501	Cytogenetics, Paleobotany, Evolution and Ecology	3	1	0	70	30	100
Paper 2	BOT502	Environmental Botany and Plant Pathology	3	1	0	70	30	100
Paper 3	BOT503	Cell-Biology-I	3	1	0	70	30	100
Paper 4	BSR501	Physical Chemistry –III	3	1	0	70	30	100
Paper 5	BSR502	Organic Chemistry-III	3	1	0	70	30	100
Paper 6	BSR503	Inorganic Chemistry-II	3	1	0	70	30	100
Lab 1	BOT551	Lab based on Botany(Paper I, II & III)	0	0	2	35	15	50
Lab 2	BSR551	Organic Chemistry Lab	0	0	2	35	15	50
Lab 3	BSR552	Inorganic Chemistry Lab	0	0	2	35	15	50
Total			18	6	6	525	225	750
VI Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	BOT601	Plant Resource Utilization, Palynology and Biostatistics	3	1	0	70	30	100
Paper 2	BOT602	Cell-Biology-II	3	1	0	70	30	100
Paper 3	BOT603	Genetics	3	1	0	70	30	100
Paper 4	BSR601	Physical Chemistry –IV	3	1	0	70	30	100
Paper 5	BSR602	Organic Chemistry-IV	3	1	0	70	30	100
Paper 6	BSR603	Inorganic Chemistry-III	3	1	0	70	30	100
Lab 1	BOT651	Lab based on Botany(Paper I, II & III)	0	0	2	35	15	50
Lab 2	BSR651	Physical Chemistry Lab	0	0	2	35	15	50
Lab 3	BSR652	Organic Chemistry Lab	0	0	2	35	15	50
Total			18	6	6	525	225	750

B.Sc. III yr (Zoology & Botany)
Scheme of Instruction

III Year								
V Semester			**Teaching Scheme**			**Marks Distribution**		
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT501	Economic & Applied Biology	3	1	0	70	30	100
Paper 2	ZYT502	Microbiology	3	1	0	70	30	100
Paper 3	ZYT503	Immunology	3	1	0	70	30	100
Paper 4	BOT501	Cytogenetic, Paleobotany, Evolution and Ecology	3	1	0	70	30	100
Paper 5	BOT502	Environmental Botany and Plant Pathology	3	1	0	70	30	100
Paper 6	BOT503	Cell-Biology-I	3	1	0	70	30	100
Lab 1	ZYT551	Lab based on Zoology (Paper I, II & III)	0	0	2	35	15	50
Lab 2	BOT551	Lab based on Botany(Paper I, II & III)	0	0	2	35	15	50
Total			18	6	6	490	210	700
VI Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT601	Physiology &Toxicology	3	1	0	70	30	100
Paper 2	ZYT602	Genetics	3	1	0	70	30	100
Paper 3	ZYT603	Biotechnology	3	1	0	70	30	100
Paper 4	BOT601	Plant Resource Utilization, Palynology and Biostatistics	3	1	0	70	30	100
Paper 5	BOT602	Cell-Biology-II	3	1	0	70	30	100
Paper 6	BOT603	Genetics	3	1	0	70	30	100
Lab 1	ZYT651	Lab based on Zoology (Paper I, II & III)	0	0	2	35	15	50
Lab 2	BOT651	Lab based on Botany(Paper I, II & III)	0	0	2	35	15	50
Total			18	6	6	490	210	700

B.Sc. III yr (Zoology & Chemistry)

Scheme of Instruction

III Year								
V Semester			**Teaching Scheme**				**Marks Distribution**	
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT501	Economic & applied Biology	3	1	0	70	30	100
Paper 2	ZYT502	Microbiology	3	1	0	70	30	100
Paper 3	ZYT503	Immunology	3	1	0	70	30	100
Paper 4	BSR501	Physical Chemistry –III	3	1	0	70	30	100
Paper 5	BSR502	Organic Chemistry-III	3	1	0	70	30	100
Paper 6	BSR503	Inorganic Chemistry-II	3	1	0	70	30	100
Lab 1	ZYT551	Lab based on Zoology (Paper I, II & III)	0	0	2	35	15	50
Lab 2	BSR551	Organic Chemistry Lab	0	0	2	35	15	50
Lab 3	BSR552	Inorganic Chemistry Lab	0	0	2	35	15	50
Total			18	6	6	525	225	750
VI Semester								
PAPER	**CODE**	**SUBJECT**	**L**	**T**	**P**	**ESM**	**MSM**	**Total**
Paper 1	ZYT601	Physiology & Toxicology	3	1	0	70	30	100
Paper 2	ZYT602	Genetics	3	1	0	70	30	100
Paper 3	ZYT603	Biotechnology	3	1	0	70	30	100
Paper 4	BSR601	Physical Chemistry –IV	3	1	0	70	30	100
Paper 5	BSR602	Organic Chemistry-IV	3	1	0	70	30	100
Paper 6	BSR603	Inorganic Chemistry-III	3	1	0	70	30	100
Lab 1	ZYT651	Lab based on Zoology (Paper I, II & III)	0	0	2	35	15	50
Lab 2	BSR651	Physical Chemistry Lab	0	0	2	35	15	50
Lab 3	BSR652	Organic Chemistry Lab	0	0	2	35	15	50
Total			18	6	6	525	225	750

L – Lecture, T – Tutorial, P – Practical, ESM – End Semester Marks

Semester-I

ZYT 101: ANIMAL DIVERSITY I- NON-CHORDATA	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To introduce variety of approaches to the study the diversity of non chordates and getting basic idea about the relationships among lower animals and to their environment.
2. To understand the major principles of evolutionary theory, and ranges from the origins of life, through the evolution of specific characters of simple animals.
3. To learn about the origins of advanced characters among non chordates.
4. To get an idea about basic constitution and physiology of non chordates.
5. To learn about by all biologists, whether their primary interests lie in molecular and cellular disciplines, physiology, psychology, or in ecology and evolution.
6. To learn about modern approaches of systematics and taxonomy.

UNIT1:
Distinguishing characters and classification of Phylum Protozoa, Porifera and Cnidaria up to order, **Protozoa-** type study of Paramecium with respect to: habit, habitat, structure and reproduction (binary fission and conjugation) **Porifera-** type study of Sycon- general organization, skeletal elements and reproduction (including development). **Cnidaria**-type study of Aurelia-structure, alternation of generation including development, polymorphism in Coelenterates, **Ctenophora-** structure and affinities.

UNITII: Distinguishing characters and classification of Phylum Platyhelminthes, Annelida and Arthropoda up to order, **Platyhelminthes-** Life history of Fasciola hepatica with special reference to larval stages, Parasitic adaptations in Helminthes, Helminthes parasites of Man, **Annelida-** Concept of Coelom, type study of Hirudinaria Granulosa-structure and excretion, **Arthropoda**-type study of Prawn-morphology and appendages, respiration in Arthropods-(Aquatic and terrestrial) Organ structures and mechanism, **Peripatus :** Structural affinities and systematic position, Sacculina: structure
UNIT III: Distinguishing characters and classification of Phylum Mollusca, Echinodermata and Hemichordata up to order, **Mollusca-**type study of Unio-structure, respiratory and reproductive system, structural organization of Sepia, **Echinodermata-** type study of Starfish-Structure and water vascular system, evolutionary significance of Echinoderm larvae, **Hemichordata-** Anatomical peculiarities of Balanoglossus and their phylogenetic position..

Suggested Readings:

1) Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
2) Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science Barrington, E.J.W.

Course Outcomes: After completing the course, the students will be able to:

1. Define or describe all kinds of lower invertebrates such as protozoan, sponges and helminths and higher invertebrates like annelids, arthropods and marine animals.
2. Understand the significance of rich diversity of invertebrates along with different species and their relationship with different evolutionary characteristics.
3. Apply the different methods for systematics, nomenclature and identification of unknown species of lower animals.
4. Analyse the role of various kinds of non-chordates in development of economy, ecological stabilisation and scientific growth.
5. Evaluate the comparative significance of taxonomic groups in ecosystem.
6. Create the basic knowledge of all kinds applications of non-chordates in daily life of human beings.

ZYT 102: CELL BIOLOGY & MOLECULAR BIOLOGY	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To learn about the basic organization of cells.
2. To study about different types of prokaryotic and eukaryotic cells.
3. To study structural components of cells and their functional roles.
4. To study the characteristic features and developmental cycles of common types of cells.
5. To study the multiplication of cells and various events of cell cycle.
6. To know about the details of physiological processes at cellular level.
7. To learn the economic importance of different microscopic groups.
8. To learn the role of microorganism in the environment and industrial development.

UNIT – I

Ultra structure of prokaryotic and eukaryotic cell, plasma membrane: Structure- Fluid Mosaic Model and functions, endoplasmic reticulum: types, ultra structure and functions, Golgi complex: ultra structure and Functions, ultra structure of mitochondria; oxidative phosphorylation – Glycolysis and Kreb's cycle, electron transport chain and terminal oxidation, lysosome: structure, polymorphism and functions

UNIT – II

Nucleus: Ultra structure of nuclear membrane, Structure and functions of nucleolus, Chromosome: Structure and types, structure of nucleosome, Giant chromosomes: Lamp-brush and polytene chromosome

UNIT - III Ribosome: Structure, types, Lake's model and functions, Somatic cell division: Cell cycle and Mitosis, Meiosis (different phases and significance), synaptonemal complex, Cellular ageing and cell death, Elementary idea of cancer and its causative agents

UNIT-IV Systematic position of microbes in biological world, classification of microorganisms and characteristics of different groups. Sterilization methods, culture media, pure culture methods. Bacteria: structure, nutrition and reproduction. Genetic recombination in bacteria: transformation, conjugation & transduction. Economic importance of bacteria.

UNIT-V General characteristics, properties, structure, chemistry and types of viruses. Life cycle of bacteriophage. Plant viruses -TMV, CMV. Diseases caused by Viruses (animal): HIV,

Hepatitis. Oncogenic viruses. General characteristics, properties of protozoa. Diseases caused by Protozoans: Entamoeba histolytica, Plasmodium species, Trypanosoma.

UNIT-VI Industrial microorganisms and product formation: Industrial microorganisms and their products, primary and secondary metabolism, characteristics of large-scale fermentation. Major industrial products for health industry: industrial production of Penicillin. Major industrial production for food and beverages: alcohol and alcoholic beverages, vinegar production, mushroom cultivation.

Suggested Readings:

1. The World of Cell – W. M. Becker, L. J. Kleinsmith, J. Hardin (Pearson)
2. Principles of Cellular and Molecular Biology – J, M. Austyn et al
3. Molecular and cell biology – W. D. Stansfield, J. S. colome and R. J. Cano. (Tata MaGraw-Hill Edition.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.
5. John Wiley and Sons. Inc. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).
6. Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London

Course Outcomes: After completing the course, the students will be able to:

1. Differentiate between prokaryotic and eukaryotic cells.
2. Evaluate the trend of evolution from unicellular to multi-cellular organisms.
3. Determine significance of cellular organization and differentiation of cells in different organisms.
4. Determine the affinities among different group of microorganisms.
5. Exploit different studied groups for various environmental and economic issues.
6. Evaluate the application of different cellular entities for several bio- prospection studies.

BOT 101: Diversity of Viruses, Bacteria & Fungi	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. The course introduces a variety of approaches to the study of the relationship between plants, animals and the environment.
2. To understanding the major principles of evolutionary theory, and ranges from the origins of life, through the evolution of plants and animals to the evolution of nutrition approaches.
3. To learn about the origins of cells and the evolution of lower organisms like viruses, fungi and bacteria.
4. To provides a broad base for studies across all of biology.
5. To learn about by all biologists, whether their primary interests lie in molecular and cellular disciplines, physiology, psychology, or in ecology and evolution.
6. To learn about a contemporary understanding of how integrated organisms function.

UNIT1: History, nature and classification of Viruses, Bacteria and Fungi, Whittaker's 5 kingdom classification, History of virology and bacteriology; prokaryotic and eukaryotic cell structure, structure, classification and nature of viruses; structure and classification (based on cell structure) of bacteria; classification, thallus organisation and reproduction in fungi; economic importance of fungi.

UNITII: Viruses: Symptoms of virus infection in plants; transmission of plant viruses; genome organisation, replication of plant virus (tobacco mosaic virus); structure and multiplication of bacteriophages; structure and multiplication of viroids and prions, Viruses and Medicines.

UNIT III: Bacteria: Nutritional types of bacteria (based on carbon and energy sources), metabolism in different nutritional types bacterial genome and plasmids; reproduction, variability in bacteria - mutation, staining; economic importance.

UNIT IV: Fungi: The characteristics and life cycles of the following:
Mastigomycotina: *Albugo, Pythium,;Phytopthora* **Ascomycotina:** *Aspergillus; Morchella*; **Basidiomycotina:** *Ustilago, Puccinia, Agaricus;* **Deuteromycotina:** *Alternaria.*

Suggested Readings:

1. An Introduction to Fungi: by Webster J (1985) Cambridge University Press, UK
2. Brock Biology of Microorganism: by Madigan, Mordinko and Parker (2000) Prentice Hall Publication
3. Introduction to Plant Viruses: by Mandahar CI (1978) Chand & Co, New Delhi
4. An Introduction to the Algae: by Morris I (1986) Cambridge University Press, UK

Course Outcomes: After completing the course, the students will be able to:

1. Define or describe all kinds of lower organisms such as viruses, bacteria and fungi
2. Understand the significance of rich diversity of fungi and bacteria along with different species and their relationship with different evolutionary era in which they evolved.
3. Apply the different methods for their extraction from the respective sources.
4. Analyse the role of various kinds of associations of them with higher category of plants and animals with different other kinds of plants and various animals as ecological relationship and address their value in nature for survival of life on this earth.
5. Evaluate the comparative significance of taxonomic aids in systematics, nomenclature and identification of newly evolved viruses' fungi and bacteria.
6. Create the basic knowledge of all kinds of hosts for viruses, fungi and bacteria like (mutualism and mycorrhiza) in daily life use as grains, fruits, spices, vegetables and nuts.

BOT-102: Diversity of Algae, Lichens & Bryophytes	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 Marks

Course Objectives:

1. To learn the general concept of organization in prokaryotic and eukaryotic cells.
2. To study the growth forms of different cryptogams.
3. To study in detail the classification of algae, lichens and bryophytes.
4. To study the characteristic features and life cycles of common algae and bryophytes.
5. To study the mode of reproduction in algae, lichens and bryophytes.
6. To know about the relationships among algae, bryophytes and higher plants.
7. To learn the economic importance of different studied groups.
8. To learn the role of cryptogams in the environment.

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

UNIT II: Characteristics and life cycles of the following:-

Cyanophyta: *Microcystis, Oscillatoria*
Chlorophyta: *Chlamydomonas, Volvox, Hydrodictyon, Oedogonium, Coleochaete, Chara*
Bacillariophyta: *Navicula*
Xanthopyta: *Vaucheria*
Phaeophyta*: Ectocarpus, Sargassum*
Rhodophyta: *Polysiphonia*

UNIT III: Bryophytes, general characters, classification, reproduction and affinities. Gametophytic and sporophytic organization of: **Bryopsida:***Sphagnum*; **Anthocerotopsida**: *Anthoceros.*

UNIT IV: Gametophytic and sporophytic organization of **Hepaticopsida** : *Riccia, Marchantia*.

Suggested Readings:

1. An Introduction of Lichens: Bhatnagar, S. and Moitra, A. (1996): New Age International Limited, New Delhi.
2. Introduction of Algae Taxonomy, Oliver and Boyd. (2004): London. Gifford, E.M. and Foster, A.
3. Morphology and Evolution of Non-vascular Plants, (2011): W.H. Freeman & Company, New York.
4. Text Book of Algae (2003): A.K. Awasthi, II edition. Vikas Publishing House, New Delhi, India.

Course Outcomes: After completing the course, the students will be able to:

1. Define the differences between primitive and advanced cells
2. Evaluate the trend of evolution from unicellular to multicellular organisms.
3. Determine significance of thallus organization and alternation of generation among cryptogams.
4. Determine the affinities among different group of studied organisms.
5. Exploit different studied groups for various environmental issues and assessments.
6. Evaluate different studied groups for several bio- prospection studies.

BSR 101: Fundamentals of Chemistry	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives

1. To learn and understand the basic concepts of organic chemistry
2. To learn IUPAC nomenclature of organic compounds and types of reactions they undergo.
3. To learn about the different methods of synthesis of saturated hydrocarbons
4. To learn about the aromatic compounds, their stability and the substitution reactions they undergo.
5. To learn about the different models of atomic structure, wave particle duality and quantization of energy.
6. To know about quantum number, shapes of orbitals and the electronic configuration of atoms
7. To learn about the periodical table and general trends in properties across and columns and rows.

Detailed Syllabus

Unit-1

Basic concepts of Organic Chemistry: Organic Compounds: their Classification, and Nomenclature according to IUPAC, Hybridization, Shapes of molecules. Electronic Displacements: Inductive, Electromeric, Resonance effects and Hyperconjugation. Homolytic and Heterolytic fission. Electrophiles and Nucleophiles. Introduction of organic reactions: Addition, Elimination and Substitution reactions.

Unit-2

Saturated Hydrocarbons: Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation.

Unit-3

Aromatic Hydrocarbons: Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations / carbanions and heterocyclic compounds. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation. Directing effects of the groups.

Unit-4

Atomic structure: Rutherford Model and it's limitations,Bohr's atomic model and its limitations,Wilsons-Sommerfeld's Quantization, Sommerfeld's Atomic Model, Wave Particle Duality : Einstein and De Broglie, Copenhagen Interpretention, Heisenberg uncertainty principle and its significance. Schrodinger wave equation, quantum numbers, shapes of orbitals (mathematical details excluded),Born'sInterpretentions, Aufbau and Pauli exclusion principles, Hund multiplicity rule, sequence of energy levels, electronic configuration of atoms, ground state term symbols of atoms and ions, X-Rays Analysis and Mosley's law.

Unit-5

Classification of Elements: Position of elements (*s, p, d&f* block) in the periodic table and general properties related to their electronic structures, oxidation states etc.

Unit-6

Periodic properties: Atomic and ionic radii, crystal radii, covalent radii, different electro negativity scales, ionization, enthalpy, electron attachment enthalpy and their periodic trends, screening effect, effective nuclear charge, Slater's rule, inert pair effect.

Suggested Readings:

1. Basic Inorganic Chemistry, F.A Cotton, G. Wilkinson, and Paul L. Gauss, 3rd Edition (1995), John Wiley & Sons, New York.
2. Concise Inorganic Chemistry J.D. Lee, 5th Edition (1996), Chapman & Hall, London.
3. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
4.Organic Chemistry, R. T. Morrison and R. N. Boyd, VI th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.

Course outcomes:

After the completing the course, the students will be able to:

1. Define Hybridization, Electrometric, Resonance effects and Hyperconjugation. Homolytic and Heterolytic fission. Electrophiles and Nucleophiles
2. Summarize the different types of hybridization, halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation
3. Determine significance of Heisenberg uncertainty principle. Schrodinger wave equation.

4. Differentiate among atomic, ionic radii, crystal radii and covalent radii, storage and structural lipids and among non-covalent interactions
5. Judge the significance of electro negativity scales, ionization, enthalpy, electron attachment enthalpy and their periodic trends.

6. Hypothesize Auf-bau and Pauli exclusion principles, Hund multiplicity rule, sequence of energy levels.

ZBP 151: Laboratory course-I	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To study the external features of animals specimens of phylum Protozoa to Echinodermata.
2. To observe internal details of organism through microscopic slides.
3. To dissect out the given animal to expose its circulatory and nervous system.
4. To learn about principles and methods of temporary mount preparation of given material or animal tissues.
5. To explore the structure of cell and its components through prepared slides.
6. To study the features of different phases of mitosis through a squash preparation of onion root tip.
7. Examine the sporophytes of different forms of plants.
8. Examine the gametophytes of different forms of plants.
9. To study the How a rich flora existing on our planet and their mode of survival on Earth.

Practical Work:

PROTOZOA

a) *Amoeba*: Examination of culture. Prepared slides of *Amoeba proteus* and *A. verrucosa*.
b) *Euglena*: Culture examination for *Euglena*. Prepared slides.
c) *Plasmodium*: Preparation of blood film (Leishmen's stain). Prepared slides of the parasites.
d) *Paramecium* Culture examination.
e) Examination of pond water for different kinds of protozoa with special reference to *Arcella* and *Vorticella*.

PORIFERA

a) *Sycon* General characters Spicules glycerine preparation or permanent mount. Prepared slides of transverse and longitudinal sections
b) Gemmule of *Spongilla* permanent preparation.
c) Different kinds of sponge spicules and sponging fibres of Euspongia-prepared slides.
d) *Euplectella* (Venus,s flower-basket), *Spongilla* (fresh-water sponge), *Euspongia* (bathsponge).

COELENTERATA

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

PLATHYHELMINTHES

b) *Fasciola* Specimens in situ and prepared slides. Transverse sections and prepared slides. Larval forms prepared slides.
c) *Taenia*: Prepared slides of scolex, mature and gravid proglottids and transverse section of mature proglottid.

NEMATHELMINTHES

(a) *Ascaris* External characters. Dissected specimens of male of female. Prepared slides of Transverse sections of male and female.
(b) *Ascaris lumbricoides* (from man) specimens, *Enterobius vermicularisi* (from man),.*Ancylostoma duodenale* (from man) prepared slides.

ANNELIDA

(a) *Nereis* external characters. Dissected specimens. Parapodium permanent preparation. Transverse sections-prepared slides.
(b) *Pheretima* external characters. Dissection. Glycerine preparations of setae in situ and brain. Permanent preparations of ovary and septal nephridia. Prepared slides of transverse section through various regions.
(c) *Heteronereis, Arenicola,* A*phrodite, Eutypoeus, Dero, Branchellion, Haemadipsa, Bonellia* (female).

ARTHROPODA

(c) *Periplaneta* external characters. Differences between nmale and female. Dissections. Circulation of blood in the wing of cockroach. Glycerin or preparation stained preparation of mouth appendages, salivary glands, trachea, Malpighian tubules, ovaries and testes.
(d) *Anopheles* and *Culex* glycerin or preparation stained preparation of mouth parts of male and female. Wings prepared slides. Life history-prepared slides. Difference between *Anopheles* and *Culex*
(e) *Musca* external characters

MOLLUSCA

(a) *Pila* External characters. Dissection of nervous system. Permanent preparations of gill ctenidium and osphradium.

ECHINODERMATA

(a) *Pentaceros*: external characters, dissected specimens. Pedicellaria and Transverse section of arm-prepared slide.
(b) *Echinus* (Sea urchin), *Ophiothrix* (brittle star), *Holothuria* (sea cucumber) and *Antedon* (feather star).

CYTOLOGY

a) Cell-Structure – Prepared slides

b) Cell Division – Prepared slides
c) Preparation of giant chromosomes
d) Preparation of onion root tip for the stages of mitosis.

Practical Work:

- Morphology (specimen study) of *Agaricus, Albugo, Aspergillus, Puccinia, Marselia, Cystopus, Morcella*, Fruiting bodies.
- Study of cell organelles in slides.
- Demonstration of the LAB.
- Morphology of *Chara, Ectocarpus, Polysiphonia, Oedogonium, Vaucheria, Volvox*
- Specimens and slides: *Anthoceros, Marchantia* and *Riccia* thallus
- To study the plant specimens of bryophytes (*Riccia, Marchantia, Pellia, Anthoceros*).

Course Outcomes: After completing the course, the student will be able to:

1. Learnt about the small and large structures of the flora existing in different habitats of land.
2. Understand the significance and method of developing a herbarium of the rabi/ kharif crops.
3. Learnt about features of the flora responsible to adopt them in various kinds of habitats.
4. Identify the external characters of animal specimens of phylum protozoa to echinodermata.
5. Explain internal structure of organ or tissue shown in microscopic slides of different animal groups.
6. Perform dissection of given animal material for exposing internal details of specimen.
7. Prepare a temporary mount of given material and observe it under microscope.
8. Identify and describe about the different types of cells and their components.
9. Observe and discuss about different stages of mitosis appeared in onion root tip.

BSR 151: Chemistry Lab-I	
Teaching Scheme Practicals: 2hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives

1. To use graduated cylinders and pipettes for volumetric measurement
2. To understand the common laboratory techniques like acid/base titration.
3. To estimate the carbonates, bicarbonates and hydroxides in mixtures.
4. To estimate the Fe(II) using $KMnO_4$ and $K_2Cr_2O_7$ in unknown solution of Mohr's salt.
5. To determine the boiling point of liquid compounds.

Detailed List of Experiments

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of Fe (II) and oxalic acid using standardized KMnO4 solution.
(iv) Estimation of Fe (II) with K_2Cr_2O7 using potassium ferricynide as external indicator.

Suggested Readings:

1. "Practical Organic Chemistry" (2009): **Vogel**, Pearson Education; VI Editions.

Course Outcomes: After the completing the course, the students will be able to:

1. Use and handle the common laboratory glassware's.
2. Understand the fundamentals of acid/base equilibria.
3.Apply techniques such as titration for estimation of unknown species in a solution
4. Calculate the boiling point of liquid compounds.

Semester- II

ZYT- 201: EVOLUTION & DEVELOPMENTAL BIOLOGY	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 Marks

Course Objectives:

1. To learn the basic concept of evolution and evidence in support of it.
2. To learn about the various natural evolutionary forces and mechanisms.
3. To learn about the various processes involved in development of individuals.
4. To understand the major principles of evolutionary theory ranges from the origins of life to mode of survival.
5. To learn about the advanced techniques and their applications in diagnostic and treatment of developmental defects.

UNIT-I Origin of life; evidences of organic evolution, Theories of evolution (Lamarckism/Neo-Lamarckism/Darwinism/Neo-darwinism/Mutation theory and synthetic theory)

UNIT-II Gametogenesis-Spermatogenesis and Oogenesis, ultra-structure of sperm and ovum Fertilization-Biochemical and physiological events, yolk content and types of animal eggs patterns of cleavage

UNIT-III Gastrulation (Amphioxus, Frog and Chick), extra-embryonic membranes, types and physiology of placenta, Regeneration in invertebrates (Hydra, Planaria) and vertebrates (Amphibia)

UNIT-IV Organiser concept organogenesis of heart, brain post embryonic development-metamorphosis of insects and amphibians, Ageing – concept, models and theories.

Suggested Readings:

1. Balinsky – Introduction to Embryology II edition. Vikas Publishing House, New Delhi, India.
2. Gilbert- Embryology III edition. APH Publishing House, New Delhi, India.
3. Jain – Embryology. I edition. CBS. Publishing House, New Delhi, India.

Course Outcomes: After completing the course, student will be able to:

1. Describe the evolutionary theories and arrival of organism of modern era.
2. Understand the basic information about the origin of life and its evolution on earth.
3. Describe the various types of processes and stages of development.
4. Analyse the impact of environmental changes in development of new adaptive features.
5. Evaluate the significance of evolutionary development in relation with human evolution.
6. Create the comparative knowledge of blast genesis and embryogenesis.

ZYT 202: ENVIRONMENTAL BIOLOGY	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 Marks

Course Objectives:

1. To learn about the basic constitution of environment.
2. To get basic idea of ecosystem and its functionality.
3. To understand the concept of biodiversity and its significance for survival of life on earth.
4. To discuss different environmental issues and their solutions.
5. To learn about various approaches to achieve a clean and healthy environment.
6. To get aware about various methods of conservation of natural resources.

UNIT – I Environmental structure and functions of environment, Components of Environment: Atmosphere, Hydrosphere, Lithosphere & Biosphere, Ecosystem - Definition and types (Pond, grassland and Forest Ecosystem), Food chain, food web and ecological pyramids , Energy flow in an ecosystem, Lindeman law of energy transfer

UNIT – II Biodiversity and its conservation, causes of reduction of biodiversity, wildlife conservation acts (1972 and 1984), National parks and sanctuaries: its extinctions, Vulnerable, Rare and Endangerour species, Hot spots of biodiversity in India

UNIT – III Environmental Pollution and its types: sources, effect and control measures (Air, Water, Soil, Noise and Thermal pollution, Global Environmental issues: Acid rain, green house effect, ozone depletion and global warming

UNIT-IV Forest resources and its types: Deforestation-its causes and effects, Chipko movement, appiko movement. Energy Resources: Renewable and non-renewable (Solar, wind, hydro, ocean-thermal, biogas, biomass, hydrogen, fossil fuel and nuclear energy) Suggested Readings:

Suggested Readings:

- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings, Germany.
- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks.
- Robert Leo Smith Ecology and field biology Harper and Row publishing.

- Ricklefs, R.E., (2000). Ecology. V. Edition. Chiron Pres.

Course Outcomes: After the completing the course, the students will be able to:

1. Describe the significance of various components of environment.
2. Evaluate the importance of biodiversity and its conservation.
3. Determine significance of natural resources.
4. Address and describe environmental issues.
5. Propose new methods and approaches for environmental safety.
6. Aware other people about environmental protection for sustainable growth.

BOT 201: Diversity of Pteridophytes & Gymnosperms	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To learn the basic information about the oldest known vascular plants on this planet.
2. To learn about the various types of life cycles, alternation of generation, conservative organs.
3. To learn about themedicinally important plants including gymnosperms and bryophytes.
4. To understand the introduction to the major principles of evolutionary theory, and ranges from the origins of life and mode of survival.
5. To learn a truly integrated view of Plant and environmental science which incorporates the molecular, cellular and ecological approaches to the subject?

UNIT I: Pteridophytes: General features, classification, stellar system and its evolution. Comparative study of morphology, anatomy, development, vegetative and reproductive systems of following: **Lycopsida** - *Lycopodium*, *Selaginella*, **Psilopsida**- *Rhynia*.

UNIT II: General and comparative account of gametophytic and sporophytic system in **Filicopsida** -*Pteridium*, *Marsilea*. Heterospory and seed habit.

UNIT III: Gymnosperms: General characters, classification. Comparative study of morphology, anatomy, development of vegetative and reproductive parts in: **Cycadales:***Cycas*, **Coniferales:***Pinus*

UNIT IV: Study of morphology, anatomy, development and reproductive parts in: **Coniferales** – *Pinus*
Gnetales - *Ephedra* Affinities and relationship of gymnosperms, evolutionary significance.

Suggested Readings:

1. A text book of Botany Vol-I. S.K. Panday and P.S.Trivedi. Vikas Publishing House, New Delhi.
2. An Introduction to Pteridophytes. A. Rashid, II edition. Vikas Publishing House, New Delhi, India.

3. An Introduction to Bryophytes. A. Rashid, II edition. Vikas Publishing House, New Delhi, India.

Course Outcomes: After completing the course, student will be able to :

1. Describe the all introductory terms concerned with vascular cryptogams like botanical snakes, zooidogamy, Cooksonia, lack of flowers, and their primitiveness etc.
2. Understand the basic information about the oldest known vascular plants so far and sporangium development type.
3. Describe the various types of life cycles, alternation of generation, conservative organs, presence of vessels and tracheids.
4. Analyse the behaviour of symbiotic and non-symbiotic pteridophytes and gymnosperms, medicinally important gymnosperms and bryophytes, autotrophic, heterotrophic and chemosynthetic gymnosperms and Pteridophytes, heterosporous and homosporous nature and dominancy of phase.
5. Evaluate the significance of the conservative organs, evolutionary development and relationship with the other higher group like angiosperms.
6. Create the comparative knowledge of pteridophytes, gymnosperms, angiosperms (dicotyledonous and monocotyledonous).

BOT 202: Diversity of Angiosperms: systematic, development & reproduction	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 Marks

Course Objectives:

7. To learn the general principal of taxonomy.
8. To introduce the terms classification, nomenclature, herbarium and botanical gardens.
9. To learn different types of proposed classification and their merits and demerits.
10. To study the taxonomy of common angiosperms.
11. To learn about meristematic tissues and cambium.
12. To study the mode of reproduction in flowing plants.
13. To learn about gametophytic and sporophytic development under the terms microsporogenesis microgametogenesis, megasporogenesis, and megagametogenesis.
14. To learn the different embryonic stages in angiosperm.

UNIT 1: Systematics: Principles of classification, nomenclature; comparative study of different classification systems, viz. Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist. Herbarium techniques and important Botanic Gardens.

UNIT II: Taxonomic study of following families and their economic importance: Dicots; Ranunculaceae, Malvaceae, Brassicaceae, Cucurbitaceac, Rosaceae, Fabaceae, Rutaceae, Apiaceae, Apocynaceae, Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Asteraceae, Rubiaceae and Euphorbiaceae, Monocots: Poaceae, Liliaceae.

UNIT III: External morphology of vegetative and floral parts; modifications – phyllodes, cladodes, and phylloclades. Meristems-kinds study of tissue system - epidermal, ground, and vascular (SAM) and (RAM). Anatomy of roots, stems, and leaves. Cambium - its function and anomalies in roots and stems.

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

Suggested Readings:

1. The Embryology of Angiosperms: S.S. Bhojwani, S.P. Bhatnagar and P.K. Dantu. The Embryology of Angiosperms.VI Edition. Vikas Publishing House, New Delhi, India.
2. A Text Book of Botany Volume-III. S.N. Pandey and A. Chadha.. Ist Edition. Vikas Publishing House, New Delhi, India.
3. An Introduction to Archegoniate Plants.A Rashid. Vikas Publishing House, New Delhi, India.

Course Outcomes: After the completing the course, the students will be able to:

1. Discriminate the plant hierarchy in the surroundings.
2. Evaluate the importance of taxonomy.
3. Determine significance of nomenclature in plants.
4. Identify flowering plants using floral formula and diagrams.
5. Determine the anatomical structures, primary and secondary growth in angiosperms.
6. Determine the different cellular organizations during the development of angiosperm from seed to embryo.
7. Know types of embryo sac and embryo development, parthenogenesis and their importance in angiosperms and human welfare.

BSR 201: Physical Chemistry-I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives

1. To know about the kinetic theory of gases and its various gas laws
2. To learn about the rates of chemical reaction and their dependence on temperature.
3. To know about the heat, enthalpy, work and energy; the laws of thermodynamics and its applications.
4. To learn about the different types of polymerization techniques
5. To know about preparation, structure and properties of different types of polymers.

Detailed Syllabus

Unit-1

Gaseous state: Kinetc theory of gases, ideal gas laws based on kinetic theory. State of matter, Behavior of real gases-the van der Waal's equation. Critical phenomena-critical constants of a gas and their determination.

Unit-2

Chemical Kinetics: Chemical kinetics and its scope, rate of a reaction, order and molecularity of reactions, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life. Arrhenius equation, concept of activation energy.

Unit-3

Thermodynamics: First law of thermodynamics and their applications, states and processes work, heat and internal energy, zeroth law of thermodynamics, various types of work done on a system in reversible and irreversible process, enthalpy changes in various physical and chemical process, second law of thermodynamics and its applications.

Unit-4

Polymers: Polymerization techniques; addition, condensation and co – ordination polymerization. Structure preparation, properties and application of Elastomers, plastomers, polyamides and Polyesters. Vulcanisation process.

Suggested Readings:

1. Physical Chemistry. **P. C. Rakshit**, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
2. Physical Chemistry. B. R. Puri, L. R. Sharma, and M. S. Pathania.37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.

Course Outcomes:

After the completing the course, the students will be able to:

1. Understand the behavior of real gases
2. Calculate the values of P, V and T using gas equations
3.Identify the chemical reaction as first, second and zero order
4. Calculate the reaction rate at different temperatures using Arrhenius equation
5. Calculate work done and enthalpy change of reversible and irreversible reactions
6. Identify the different polymers and analyze their properties.

BSR 202: Organic Chemistry-I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives

1. To understand the basic concepts of organic chemistry like shapes and names of organic molecules; electronic effects and various kinds of intermediate during reactions
2. To learn about the halogenated hydrocarbon; their preparation, properties and reactions
3. To learn about the preparation, properties and reactions of alcohols phenols and ethers
4. To know the structure, reactivity and properties of carbonyl compounds
5. To study the preparation, properties and reactions of carboxylic acids

Detailed Syllabus

Unit-1

General Organic Chemistry: Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules. Electronic Displacements: Inductive, Electromeric, Resonance effects and Hyperconjugation. Homolytic and Heterolytic fission. Electrophiles and Nucleophiles. Types, shape and relative stability of intermediates (Carbocations, Carbanions and Free radicals)

Unit-2

Chemistry of Halogenated hydrocarbons: Alkyl halides: Methods of preparation, Nucleophilic substitution reactions – SN1, SN2 mechanisms. Aryl halides: Preparations only

Unit-3

Alcohols, Phenols and Ethers:Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols. Phenols: preparation and properties, Acidity and factors affecting it, Ring substitution reactions, Ethers: Preparation, properties and reactions

Unit-4

Carbonyl Compounds: Structure, reactivity and preparation; Mechanisms of Aldol condensation, Cannizzaro reaction, Haloform reaction and Beckmann rearrangement

Unit-5

Carboxylic Acids: Preparation, physical properties and reactions of monocarboxylic acids

Suggested Readings:

1. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi
2. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi
3. Organic Chemistry, Paula Y. Bruice, 2nd Edition, (1998). Prentice-Hall, International Edition.

Course Outcomes: After the completing the course, the students will be able to:

1. Classify the organic compounds and predict their properties based on electronic effects
2. Predict the product in nucleo-philic substitution reaction of alkyl halides
3. Understand the reactivity of 1°, 2°, 3° alcohols
4. Analyze the various method of preparation of alcohols and phenols
5. Understand mechanisms of Aldol condensation and Cannizzaro reaction
6. Understand the properties and reactions of carboxylic acid

ZBP 251: LAB BASED ON ZOOLOGY AND BOTANY PAPERS	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To study the properties of water and soil of different areas.
2. To study the aquatic and terrestrial micro-flora.
3. To maintain a biodiversity record of a given area.
4. To learn the taxonomy and embryology of higher plants.

Practical Work:

a) Ecological methods:

1. Use of pH meter for estimation of pH in water and soil samples
2. Study of micro-organism of water and soil samples
3. Determination of dissolved O_2, free CO_2 of water
4. Zoo-plankton count by standard methods
5. Report on Environmental audit Local Biodiversity Record (in group/individual of a particular area) – at least two records of faunal diversity along with ecological notes and photographic documentations in two seasons should be done. For example: butterfly community or bird community of a particular area.
6. Field work assessment Submission of field study report on any two of the following
7. Ecosystem and its biodiversity assessment. (Any suitable ecosystem) (Various diversity indices with explanation must be presented)
8. b. Estuarine bheri/freshwater fish farm (species cultured/reared, whether exotic/ornamental fishes are cultured, viability of the farm, cost benefit accounts, impact on local people and prospect in the specific area)

b) Evolutionary Biology:

1. General discussion, distinguishing characters and classification of respective Phylum should be taken into consideration.
2. In Laboratory Note Book scheme of classification of all Phylum should be written before identification key making with the specimens both from non-chordate (e.g., insects) and chordates (e.g., fishes) identification with reasons of the following Museum specimens should be done.
3. Study of chick embryological slides in different phases of incubation.

Practical Work:

1. Specimens and slides of the *Marsilea* petiole, *Marsilia* sporocarp, *Seleginella* stem, *Seleginella* cone.
2. Specimens and slides of *Cycas* leaflet, *Pinus* needle, *Pinus* stem and *Ephedra* stem.
3. To study the plant specimens of pteridophytes (*Lycopodium, Seleginella*).
4. Plants studied: *Euphorbia hirta*, *Ocimum sanctum*, *Ageratum conyzoides*, *Thevetia peruviana*, *Calotropis procera*, *Ipomoea aquatica*, *Solanum nigram*.
5. Embryology of the pollen grains.
6. T.S. of anther of angiospermic flowers.

Course Outcomes: After completing the course, the students will be able to:

1. Test the alkalinity and acidity of soil and analyze the growth type in a particular landscape with causes and consequences.
2. Understand the methods used to evaluate biodiversity of macro and microorganisms and maintain a record for past and future environmental/biodiversity assessment.
3. Distinguish plants based on their hierarchy and taxonomical characteristics.
4. Understand the distinguished anatomical features of gymnosperms and angiosperms.
5. Determine the different cellular organizations during the development of angiosperm from seed to embryo.

BSR 251: Chemistry Lab-II	
Teaching Scheme Practicals: 2hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To determine the viscosity of given liquid
2. To determine the micelle concentration of given liquid
3. To determine the strength of given solution
4. To detect the functional groups in organic compounds

Detailed List of Experiments

1. To determine the viscosity of a given liquid at room temperature by using Ostwald's viscometer.
2. To determine the critical micelle concentration of given liquid.
3. To determine the strength of given solution phmeterically.
4. Detection of elements (X, N, S)
5. Detection of functional groups: PhOH, -COOH, C=O, -CHO, Ar-NH_2.

Suggested Readings:

1. Practical Organic Chemistry (2009): **Vogel**, Pearson Education; VI Edition.

Course Outcomes:

After the completing the course, the students will be able to:

1. Perform common laboratory techniques
2. Handle laboratory glassware, equipment, and chemical reagents
3. Characterize the organic molecules on the basis functional groups
4. Mechanism of some simple organic reactions
5. Basic understanding of the relative reactivity of functional groups

Semester- III

ZYT 301: ANIMAL DIVERSITY-II: CHORDATA	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course objectives:

1. To explore diversity of chordates ranging from protochordates to vertebrates.
2. To learn about the evolutionary significance of protochordates.
3. To explore basic characters of vertebrates and their adaptations to the different Environmental conditions.
4. To learn about wider context for importance of animals in human life.
5. This study underpins the broader issues covered in the taxonomy of animals.

UNIT-1 General characters and classification of Chordata upto orders, Origin of Chordates **Proto-chordates -** General features and affinities of Hemichordates (Balanoglossus), Cephalochordates (Amphioxus) and Urochordates (Herdmania), retrogressive metamorphosis, **Pisces-**classification of different classess upto orders with characters and examples, scales in fishes, comparative morphology of Chondrichthyes & Osteoicthyes.

UNIT-II Amphibia-General characteristics, classification and representative types, note on parental care in amphibians **Neoteny & Paedogenesis. Reptilia-** General characteristics, classification and representative types, poisonous and non-poisonous snakes, snake venom and biting mechanism, Extinct reptiles,

UNIT-III Aves- Characteristics, classification and representative types, flight adaptations, migration and economic importance of birds. **Mammalia-** characteristics, classification and representative types, Affinities of Prototheria & Metatheria, adaptive radiation in mammals, dentition in Mammals

Suggested Readings:

1. Chordate Zoology –E. L. Jordan and P. S. Verma .Ed.II, CBS Publishers, New Delhi.

2. Vertebrate Zoology – Vishwanath Ed.I, CBS Publishers, New Delhi.
3. Zoology of Chordates – Nigam H. C. Ed.III, APH Publishers, New Delhi.

Course Outcomes: After completing the course, the student will be able to:

1. Describe the all introductory terms concerned with diversity of chordates.
2. Understand the basic information about protochordates and their evolutionary Significance.
3. Describe the various types of vertebrate groups and their biology.
4. Analyse the usefulness of animals for human beings.
5. Create the comparative knowledge of different vertebrate groups

ZYT 302: COMPARATIVE ANATOMY & HISTOLOGY	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To introduce the different anatomical feature of animals and its significance.
2. To learn the comparative account of anatomy of vertebrates.
3. To explore the evolutionary background of different physiological advancement in different animal groups.
4. To study the anatomical adaptations of animals in relation to their habit and habitat.
5. To learn the workability of major organs and organ systems of animals.
6. To study the basic principles and methodology of histology.

UNIT-I Integument and its derivatives, Endoskeleton - Axial skeleton & Appendicular skeleton Digestive system – Alimentary canal and associated glands , Respiratory system – Cutaneous respiration, Gills and lungs, Air sacs in birds

UNIT-II Circulatory system – Evolution of heart and Aortic arches, Portal systems, Excretory system –kidney and its ducts, Nervous system – Comparative anatomy of Vertebrate brain , Sense organs – Comparative anatomy of ear and eye

UNIT-III Epithelial, connective, muscular, nervous and other specialized tissues, Tools in histology: Principle, and functioning of microtome, automated microtome, ,ultramicrotome, cryostat, Techniques in histology: Sample preparation, reagents, fixatives, processing of fixed samples, dehydration, embedding, block making, staining, dyes and dye-binding reactive groups, mordants .

Suggested Readings:

1. Carter, G.S. Structure and habit in vertebrate evolution – Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot. Allahabad
4. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
5. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.

Course Outcomes: After completing the course, the students will be able to:

1. Describe basic anatomy of different groups of animals.
2. Identify specific characteristics of individual group of animals.
3. Determine physiological significance of various organs and organ systems in animals.
4. Understand the origin and advancement of anatomical features of animals.
5. Discuss and compare the functioning of different organ system found in animals.
6. Apply histological principles and methodologies to analyze the internal structure of various organs of animals.

BOT 301: Physiology and biochemistry of Plants	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course objectives:

1. To learn the experimental approaches ranging from molecular
Physiology to ecological modeling.
2. To consolidate and extend your basic knowledge of how cells work, how they interact and how they differentiate.
3. To learn how our existence depends on plants converting solar energy into usable biochemical energy via photosynthesis and plants furnish almost all our food requirements.
4. To learn wider context for the material provided in the physiology of cells found in the body of plants.
5. This study underpins the broader issues covered in the stress physiology and biochemistry of cell.

UNIT I: Plant-water relations: Importance of water to plant life; physical properties of water; imbibitions, diffusion and osmosis; absorption and transport of water; transpiration; physiology of stomata. Mineral nutrition: Essential macro and micro elements and their role; mineral uptake; deficiency symptoms.

UNIT II: Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation. Photosynthesis : significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photo- phosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

UNIT III: Growth and development: Definitions; phases of growth and development; seed dormancy; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; physiology of senescence; fruit ripening;

UNIT IV: Plant hormones- auxins, gibberellins, cytokinins, abscissic acid and ethylene, history of their discovery, mechanism of action; photo-morphogenesis; Phytochromes and their discovery, physiological role and mechanism of action.

Suggested Readings:

1. Plant Metabolism (2nd Edition). Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell (eds.). 1997: Longman, Essex, England.
2. Life Processes in Plants. Galston, A.W. 1989: Scientific American Library, Springer-Verlag, New York, USA.
3. Introduction to Plant Physiology. Hopkins, W.G., 1995: John Wiley & Sons, Inc., New York, USA.
4. Plant Physiology. Mohr, H. and Schopfer, P. 1995: Springer-Verlag, Berlin Germany.

Course Outcomes: After completing the course, the student will be able to:

1.Describe the all introductory terms concerned with plant physiology and plant Biochemistry like osmosis, transpiration, diffusion and Imbibitions etc.

2. Understand the basic information about principles of physiology and biochemistry of plants, their application in daily life and industry.

3.Describe the various types of plant hormones and plant growth regulators and their origin, distribution, physiological description, brief idea of their action and economic uses of PGRs.

4. Analyse the behaviour of chemical processes of behind the plant movement and their significance for the crops belongs to various taxonomic families.

5.Evaluate the significance of the physiological processes involved in the manufacturing of the dyes, tannins, beverages, timber and rubbers in the body of plants.

6. Create the comparative knowledge of commercial application of the physiological and biochemical processes.

BOT 302: Molecular Biology and Plant Biotechnology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To introduce the term enzyme, its nomenclature and significance.
2. To learn the working of enzyme and its regulation.
3. To learn the role of enzyme inhibitors and hypothetical theories related with enzyme inhibition.
4. To study the relation of mitochondria with cellular respiration.
5. To learn about the Kreb's cycle and electron transport system and their role in energy production.
6. To study various catabolic reactions occur during cellular respiration.
7. To study high energy molecules and quantify energy in the form of ATP.
8. To learn about lipid synthesis and its oxidation, and nitrogen metabolism in plants.
9. To know the basics of biotechnology and its significance.

UNIT I: Basics of Enzymology: Discovery and nomenclature; characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and co-factors; regulation of enzyme activity; mechanism of action.

UNIT II: Respiration: ATP – the biological energy currency; aerobic and anaerobic respiration; Krebs cycle; electron transport mechanism (chemiosmotic theory); redox -potential; oxidative phosphorylation; pentose phosphate pathway.

UNIT III: Lipid metabolism: Structure and functions of lipids; fatty acid biosynthesis; β-oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids. Nitrogen metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation.

UNIT IV: Genetic engineering and Biotechnology: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of Agrobacterium;

vectors for gene delivery and marker genes.

Suggested Readings:

1. Plant Tissue Culture Applications and Limitations. Bhojwani, S.S. 1990:. Elsevier Science Publishers, New York, USA.
2. Plant Biochemistry and Molecular Biology. Lea, P.J. and Leegood, R.C. 1999. John Wiley & Sons, Chichester, England.
3. Principles of Gene Manipulation. Old, R.W. and Primrose, S.B. 1989. Blackwell Scientific Publications, Oxford, UK.
4. Raghavan, V. 1986: Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press, New York, USA.
5. Molecular Biology. H. D. Kumar. II Edition. Vikas Publishing Houses, New Delhi, India.

Course Outcomes: After completing the course, the students will be able to:

1. Identify enzyme's role by its name or vice- versa.
2. Determine significance of enzyme regulation.
3. Analyze the proper utility of enzyme inhibitory effect for human
4. Know the significance of respiration and its mechanism.
5. Know the various high energy compounds (ATP, NADH, $FADH_2$)
6. Know the structure and types of lipids and its uses.
7. Know the importance of nitrogen fixation in plants.
8. Operation of the tools and techniques in biotechnology studies.

BSR 301: Physical Chemistry-II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To know about laws of thermodynamics and carnot cycle.
2. To understand the concept of entropy and Gibbs free energy
3. To learn the phase rules and draw the phase diagrams ofone component systemstwo component systems.
4. To learn the electrochemical cells and understand the concept of standard electrode potential
5. To know the different types of adsorption isotherm likeLangmuir and Freundlich isotherms.
6. To understand the kinetics of complex reactions

Detailed Syllabus

Unit-1

Thermo-dynamics: Spontaneous processes and Second Law of Thermodynamics, Carnot cycle, entropy, entropy changes in reversible and irreversible processes and of universe, physical concept of entropy, entropy changes of an ideal gas in different processes, entropy changes in mixture of gases. Variation of entropy with temperature, determination of absolute entropies of liquid and gases. Third Law of thermodynamics. Applications of Third Law. Free energy and its concept, Gibbs and Helmholtz free energies and their relationship, variation of free energy with temperature and pressure.

Unit-2

Phase Equilibria: Phase, component, degree of freedom, Phase rule, thermodynamic derivation of phase rule, phase diagrams of one component systems (water), two component systems (phenol-water, lead-silver, tin-magnesium). The distribution law, applications to cases of dissociation and association of solutes in one of the phases.

Unit-3

Electrochemical Cells: Reversible and irreversible cells, Reactions in reversible cells, free energy and *emf* of reversible cell. Galvanic cells, *emf* and its measurement. Single electrode potential (Nernst equation), its measurement and sign convention.

Unit-4

Surface and Colloids Chemistry: Adsorption- Langmuir and Freundlich isotherms. Multilayer adsorption-BET equation (no derivation) and its application to surface area measurement. Sols (reversible and irreversible), emulsions and emulsifiers, association colloids (micelles), gels. Applications of colloids.

Unit-5

Kinetics of Complex Reactions: Reversible (first order in both directions), concurrent, consecutive reactions. Unimolecular gas reactions (Lindmann theory), steady-state approximations, theory of absolute reaction rate

Suggested Readings:

1. Physical Chemistry, P. C. Rakshit, 5th Edition (1985), 4th Reprint (1997), Sarat Book House, Calcutta.
2. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton MifflinComp.(1999), New York, International Edition.

Course Outcomes: After the completing the course, the students will be able to:

1. Define reversible, concurrent and consecutive reactions, Phase rule, degree of freedom.
2. Summarize the different types of adsorption isotherms and application of colloids.
3. Determine second and third law of thermodynamics and their applications.

ZYT 351: LAB BASED ON ZOOLOGY (BASED ON PAPER I & PAPER II)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To study the external features of animals specimens of proto-chordates and vertebrate groups.
2. To observe internal structure of animals through microscopic slides.
3. To study about exo and endo skeletal elements like scales, cartilage and bones of fishes and other vertebrates.
4. To dissect out the given fish species to expose its circulatory and nervous system.
5. To learn about principles and methods of temporary mount preparation of given material or animal tissues.

Practical works:
Urochordata
(a) Herdmania
(i) External characters (ii) Dissection (iii) Permanent preparation of branchial wall (iv) Larva and metamorphosis- prepared slides.
Cephalochordata
Branchistoma (Amphioxus)
(i) General features
(ii) Transverse section through the body – prepared slides.

Cyclostomata Petromyzon (Lamprey) – External characters
Chondrichthyes (a) Fish (i) External characters (ii) Exo-skeleton Glycerine and permanent preparation of placoid scales (iii) Endoskeleton
(1) Axial skeleton (a) skull (b) Visceral Skeleton (c) Vertebral column **(2) Appendicular skeleton** (a) Pectoral girdle and fins (b) Pelvic girdle, fins and claspers B.Sc.(ZBC) w.e.f 2016-17 Page 8
(c) Median fins (v) Dissection (a) Digestive system Examination of the folds of stomach and " scroll valve" (b) Vascular system 14 Heart, ventral aorta, dorsal aorta, arterial arches (afferent and efferent) (c) Gills (d) Urinogenital system (e) Nervous system : Cranial nerves (f) Internal ear (g) Eye muscles
Osteichthyles (a) Labeo rohita (Rohu)- General morphology and dissected specimen.
(b) Acipenser (sturgeon), Lepiodosteous (gar-pike), Hippocampus (sea hourse) Antennarius (Indian angler), Angulla (eel), Pleuronectes (sole), Exocoetus (flying fish), Clarius (cat fish), Anabas (climbing perch) and Neoceratodus (lungfish). (c) Different kinds of scales- prepared

slides.

Course Outcomes: After completing the course, the student will be able to:

. 1. Identify the external features of animal specimens of proto-chordates and vertebrate groups.
. 2. Describe internal structure of organ or tissue shown in microscopic slides of different vertebrate groups.
. 3. Discuss the features of skeletal elements of fishes and other vertebrate groups.
. 4. Perform dissection of given fish species for exposing internal details of it.
. 5. Prepare a temporary mount of given material and observe it under microscope.

BOT 351: Lab based on Botany (Paper I & II)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

6. Solve practical problems in a range of areas of plant physiology, biochemistry and molecular biology.
7. Demonstrate the effects of different water qualities on the process of germination.
8. Demonstrate the effects of different plant hormones like auxins (IAA, IBA), cytokinins (Kinetin), gibberellic acid (GA_3), etc. on the process of germination.
9. Use computer packages where appropriate to develop a deeper understanding of physiological and biochemical problems.
10. Communicate plant physiology, biochemistry and molecular biology effectively to a wide range of audiences.

Practical Work:

1. Respirometre
2. Osmosis by using goat bladder/parchment paper
3. Endo-osmosis/Exoosmosis by using the potato Osmometer
4. Imbibition by using gram seeds
5. Transpiration by using Ganong's photometer
6. Photosynthesis by inverted funnel method
7. Ascent of sap water moves through xylem rising the solution
8. Four leaf method
9. Bell Jar experiment

Practical Work:

1. Embryology of the anatropous ovule
2. Embryology of the Orthotropous ovule
3. Embryology of the Campylotropous ovule
4. T.S. of ovule
5. Embryology of the micro-spores
6. Stages of the cell division-meiosis and mitosis in onion

Course Outcomes: After completing the course, the student will be able to:

1. Understand the process of sowing seeds in various kinds of water from different sources and their effectively for germination.
2. List the various resources required for the development of nursery in lab.
3. Distinguish among the different forms of sowing and growing plants as well as seed.
4. Analyze the process of vegetative propagation and cultivation of different vegetables and growth of plants in nursery
5. Appreciate the diversity of plants and selection of gardening.

BSR 351: Chemistry Lab-III	
Teaching Scheme Practicals: 2hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To study the equilibrium of a reaction using distribution method
2. To carry out potentiometric titrations between acids and bases
3. Potentiometric titration of Mohr's salt with potassium dichromate
4. Determination of critical solution temperature

Detailed List of Experiments

(I) Study the equilibrium of at least one of the following reactions by the distribution method:
(i) $I_2(aq) + I^- \rightarrow I_3^-(aq)$
(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$

(II) Perform the following potentiometric titrations (at least two):
(i) Strong acid with strong base
(ii) weak acid with strong base and
(iii) dibasic acid with strong base

(III) Potentiometric titration of Mohr's salt with potassium dichromate.

(IV) Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

Suggested Readings:

1. "Vogel's Quantitative Analysis" by **J. Mendham**, Pearson Education; 6 edition (2009)

Course Outcomes:

After the completing the course, the students will be able to:

1. Perform common laboratory techniques
2. Handle laboratory glassware, equipment, and chemical reagents
3.Measure equilibrium concentrations and equilibrium constants
4. Use the potentiometer
5. Collect, record and analyze data

Semester-IV

ZYT- 401: FUNDAMENTALS OF BIOCHEMISTRY	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To introduce and classify different types of biomolecules.
2. To explore about structure and function of proteins in living system.
3. To learn about structural and physiological role of carbohydrates in living beings.
4. To study metabolism of lipids and their physiological role in organisms.
5. To learn about the enzymes, their mode of action and mechanisms of regulation.
6. To study the details of basic metabolic processes of energy production.

UNIT-I

Classification, Structure and properties (physical and electrochemical) of amino acids. Classification: compositional classification (simple protein & conjugate protein). Biological classification. Protein configuration: Primary structure, secondary structure (α-helix & β-pleated structure). Properties: physical properties, chemical properties (reaction involving-COOH group, -NH2 group, -R group, -SH group).

UNIT-II

Classification of carbohydrate, structure of some representative-examples of monosaccharides, disaccharides and polysaccharides, isomers in carbohydrate, some important properties of monosaccharides. Classification & properties of fatty acids. Biosynthesis of fatty acids (saturated & unsaturated). Biosynthesis of triglycerols, membrane phospholipid, cholesterols, steroid hormones. Oxidation of saturated fatty acids, β-oxidation, oxidation of unsaturated fatty acids, α-oxidation.

UNIT- III

Concept of enzyme and mechanism of enzyme action immobilized enzymes and their industrial applications.

UNIT- IV

Respiration: Types - Aerobic respiration, Anaerobic respiration, respiratory substrates, respiratory quotient, mechanism of respiration: Glycolysis, TCA cycle, terminal oxidation(Oxidative phosphorylation, Electron transport chain). Energy calculation (output) in prokaryotes / eukaryotes. Pentose phosphate pathway

Suggested Readings:

1. Principles of biochemistry (2001). Albert L. Lehninger, Godfin Press, London.
2. Fundamentals of Biochemistry. L.Stylyer. IV Edition. Lambert Press New York, USA.

Course Outcomes: After completing the course, the students will be able to:

1. Describe the structure and function of bimolecules.
2. Determine the physiological role of carbohydrates, lipids and proteins in living beings.
3. Discuss the concept of enzyme, its mechanism of action and regulation.
4. Understand different aspects of metabolism related to carbohydrate and lipids.
5. Describe the basic processes involve in glucose breakdown to produce ATP.
6. Understand and apply the basic knowledge of biochemistry in daily life and industry.

ZYT- 402: ENDOCRINOLOGY & ANIMAL BEHAVIOUR	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To learn about the basic principles of endocrinology and animal behavior.
2. To know about hormone, its chemical nature and mechanism of action.
3. To disclose the role of hypothalamus and pituitary in the regulation of hormone release from different endocrine glands.
4. To learn about the location and hormones of different glands of animals and human beings.
5. To explore the role of hormones in regulation of metabolic processes of the human body.
6. To study the basic type behaviors and their significance, found in animals.
7. To learn about the role of hormones in the regulation of patterns of behaviors in animals.

UNIT-I

Classification and characteristic features of Hormones. Mechanism of hormone action-receptors, Second messenger concept. Structure of pituitary Gland – Hormones, Hypothalamic Regulation for Release of pituitary Hormones. Structure of Thyroid Gland – Biological functions of Thyroid Hormones Regulation of Thyroid Secretion.

UNIT-II

Islets of Langerhans – structure, Hormones, function. Structural features of –Adrenal gland Biological Action of Adrenaline and Noradrenaline – Emergency Hormones . Male Reproductive system – Hormonal control of Testes, Functions of Testosterone. Female Reproductive system-Role of Hormones in Female Sexual cycle ,Placental Hormones – parturition-Lactation.

UNIT-III

Animal Behavior Stereotyped and acquired behavior-learning, fixed action pattern, Foraging, food acquiring and anti predatory behavior, Communication in honeybees (dance Language and pheromones) and their social organization. Migratory behavior of birds and fish, Hormones, Drugs and Behavior, Neural and Hormonal control of Behaviour.

Suggested Readings:

1. Mac E Hadley, 1992 Endocrinology, Third edition, prentice Hall, New Jersey
2. Wilson J.D and Foster D.W 1992, William's textbook of endocrinology, 8th edition, WB Saunders company, Philadelphia
6. Nicholas B. Davies, John R. Krebs, Stuart A. West 2012. An Introduction to behavioral Ecology John Wiley & Sons

Course Outcomes: After completing course, the students will be able to:

1. Describe the all introductory terms concerned with endocrinology and animal behaviour like hormones, endocrine glands and pheromones etc.
2. Understand the basic mechanism of action and physiological effect of hormones.
3. Describe the role of hormones in regulation of metabolic processes of animals and human beings.
4. Analyse basic trends of the animals' behaviour and their significance in biological responses.
5. Evaluate the significance of hormones in regulation of animal behaviour and fixation of pattern of responses.

BOT-401: Economic Botany	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

7. To learn the concept of origin of crops.
8. To learn the major food crops in India and their economic importance.
9. To learn the methods of cultivation of crops and their harvesting.
10. To study the economic uses of crops that produce food, fibers, timber and spices.
11. To learn about the medicinal plants in India.
12. To learn about energy plantation and bio-fuels.

UNIT I: Vavilov's centres of origin of crop plants, Origin, distribution, botanical description, brief idea of cultivation and economic uses of the following:
Food plants - cereals (rice, wheat and maize), pulses (gram, arhar and pea), vegetables, potato, tomato and onion).

UNIT II: Origin, distribution, botanical description, brief idea of cultivation and economic uses of the following: Fibers-cotton, jute and flax; Oils-groundnut, mustard, sunflower and coconut.

UNIT III: Morphological description, brief idea of cultivation and economic uses of the following:
Spices-coriander, ferula, ginger, turmeric, cloves. Medicinal plants-*Cinchona*, *Rauwolfia*, *Atropa*, *Opium*, *Cannabis*, *Azadirachta*, *Withania*.

UNIT IV: Botanical description, processing and uses of: Beverages-tea and coffee; Rubber-*Hevea*; Sugar-sugarcane; General account and sources of timber; energy plantations and bio-fuels.

Suggested Readings:

3. Kocchar, S.L. 1998: Economic Botany in Tropics, 2nd edition, MacMillan India Ltd., New Delhi.
4. Sambammurthy, A.V.S.S. And Subramanyam, N.S. 1989: A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi.
5. Sharma, O.P. 1996: Hills Economic Botany (Late Dr. A.F. Hill adapted by O.P. Sharma), Tata McGraw Hill Co. Ltd., New Delhi.

6. Simpson, B.B. and Conner-Ogorzaly, M. 1986: Economic Botany- Plants in Our World, McGraw Hill, New York.

Course Outcomes: After completing the course, the students will be able to:

7. Know the criteria of geological distribution.
8. Determine the trend of migration of crops globally.
9. Know different methodologies for crop cultivation.
10. Know the types of major crops in India.
11. Know the economic importance of plants.
12. Know the various fibers and their exploitation.
13. Know the major timber producing trees in India.
14. Determine the significance of energy plantation.

BOT 402: Plant Anatomy	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

8. Observe plant structures of monocot and dicot angiosperm plants.
9. To provide students with skills necessary to section and stain fresh plant materials.
10. To train students in the proper use of the compound light microscope and to give them experience in interpreting images.
11. To provide students with skills in modern microscopic processing and analysis techniques.
12. To learnt the complexity of tissue organization within plant bodies to develop as integrated organisms in diverse environments.

UNIT I: Tissues-meristematic and permanent (simple, complex and secretory) Tissue systems (Epidermal, ground and vascular) The Shoot system - shoot apical meristem and its histological organizations.

UNIT II: Cambium-structure and functions. Secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm; Anomalous secondary growth (*Dracaena*, *Boerhaavia* and *Achyranthes*).

UNIT III:
Leaf: Types of leaves (simple and compound); phyllotaxy. Epidermis-uniseriate and ultiseriate, epidermal appendages and their morphological types. Anatomy of typical monocot and dicot leaf

and cell inclusions in leaves, leaf abscission, stomatal apparatus and their morphological types.

UNIT IV: Root system: Root apical meristem; histological organization Secondary growth in dicot root. Structural modifications in roots: Storage (Beta), Respiratory (*Rhizophora*), Epiphytic (*Vanda*).

Suggested Readings:

1. Plant Anatomy: S.N. Pandey and A. Chadha. Ist Edition. Vikas Publishing House, New Delhi, India.
2. Principles of Angiosperms Taxonomy. New Age International Limited, New Delhi. Davis, P.H. and Heywood, V.H. 1963. , Oliver and Boyd. London.
3. Morphology and Evolution of Vascular Plants, Gifford, E.M. and Foster, A.S. 1988. W.H. Freeman & Company, New York.
4. Current concepts in Plant Taxonomy. Heywood, V.H. and Moore, D.M. (eds) 1984. Academic Press, London.
5. An introduction to Plant Taxonomy. Jeffrey, C. 1982. . Cambridge University Press, Cambridge, London. Jones, S.B. Jr. Luchsinger, A.E. 1986.
6. Plants Systematics. McGraw Hill Book Co. 1999, II Edition, New York.

Course Outcomes: After completing course, the students will be able to:

1. Describe the all introductory terms concerned with angiosperms like endosperms, double fertilization, egg cells, egg apparatus, Synergids, apomixis, polyembryony etc.
2. Understand the basic informations about taxonomy, classification systems, cambium.
3. Describe the various types of life cycles, alternation of generation, conservative organs, presence of vessels and tracheids, companion cells, sieve tubes, xylem fibres, xylem parenchyma.
4. Analyse the behaviour of symbiotic and non-symbiotic dicot and monocot, medicinally important angiosperms (dicot and monocot), autotrophic, heterotrophic and chemosynthetic angiosperms (dicot and monocot), heterosporous and homosporous nature and dominancy of phase.
5. Evaluate the significance of the conservative organs, evolutionary development and relationship with the other lower groups like pteridophytes and gymnosperms.
6. Create the comparative knowledge of, bryophytes, pteridophytes, gymnosperms, in respect with angiosperms (dicotyledonous and monocotyledonous).

BSR 401: Organic Chemistry-II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To introduce structure and bonding and shape of organic molecules
2. To illustrate concept of organic reaction mechanisms
3. To introduce IUPAC name and basic chemistry of alkanes and cycloalkanes.
4. To describe the chemistry of Alkanes and alkynes
5. To introduce aromaticity

Detailed Syllabus

Unit-1:

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

Unit-2:

Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples).

Unit-3:

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

alkanes:. Cycloalkanes – Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations.

Unit-4:

Alkenes, Cycloalkenes, Dienes and Alkynes: Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes, Industrial applications of ethylene and propene. Nomenclature and classification of dienes : isolated, and conjugated dienes, Nomenclature, structure and bonding in alkynes, Methods of formation, Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

Unit-5:

Arenes and Aromaticity: Nomenclature of benzene derivatives, The aryl group, Aromatic nucleus and side chain, Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: The Huckle rule. Aromatic electrophilic substitution – general pattern of the mechanism, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of naphthalene and Anthracene.

Unit-6:

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions; Synthesis and uses of DDT and BHC.

Suggested Readings:

1. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. Organic Chemistry, S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition(1985), New Age International (P) Ltd. Publishers, New Delhi.
3. Organic Chemistry – Structure and Reactivity, Seyhan N. Ege. III. rd Edition

(1998), AITBS Publishers and Distributors, Delhi.
4. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, Interrrnational Edition (1998).

Course Outcomes: After the completing the course, the students will be able to:

1. Have a clear concept of hybridization and its relationship with shape of a molecule
2. Develop a clear idea of writing organic reaction mechanism
3. Have the knowledge of chemistry of alkanes, alkenes and alkynes
4. Should be able explain the aromaticity and distinguish aromatic and anti-aromatic molecule.

BSR 402: Inorganic Chemistry-I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To introduce d block elements.
2. To illustrate basic chemistry of coordination compound.
3. To introduce chemistry of lanthanide and actinide.
4. To provide basic concept of acid base.
5. To describe usefulness of non-aqueous solvent in chemistry.

Detailed Syllabus

Unit-1:

Chemistry of Elements of First Transition Series: General characteristic features of d-block elements. Properties of the elements of the first transition series: Ionic Size, Atomic Size, Metallic properties, Ionization potential, magnetic properties, Oxidation State.

Unit-2:

Co-ordination Compounds: Werner's Co-ordination Theory and its experimental verification, effective atomic Number concept, chelates, nomenclature of co-ordination compounds, isomerism in Co-ordination compounds, valence bond theory of transition metal complexes.

Unit-3:

Chemistry of Lanthanide Elements: Occurrence and Isolation of Lanthanides, Electronic Configuration, Oxidation States, Ionic Radii, Lanthanide Contraction and its Consequences.

Unit-4:

Chemistry of Actinides: Occurrence, Position in the periodic table, Electronic configuration. Oxidation State, chemistry of separation of Np, Pu and Am.

Unit-5:

Acids and Bases: Arrhenius, Bronsted-Lawry, The Lux-Flood, Solvent System and Lewis Concept of Acids and Bases.

Unit-6:

Non-Aqueous Solvents: Physical Properties of a Solvent, Types of Solvents and their general Characteristics, Reaction in Non-Aqueous Solvents with reference to liquid NH3 and liquid SO2.

Suggested Readings:

1. A New Concise Inorganic Chemistry, J. D. Lee, 5th Edition (1996), Chapman &Hall, London.
2. Modern Inorganic Chemistry, R. C. Aggarwal, 1st Edition (1987), Kitab Mahal, Allahabad.
3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.

Course Outcomes:

After the completing the course, the students will be able to:

1. To have a knowledge on the properties of transition elements
2. Basic theory of coordination complexes
3. Knowledge on the chemistry of lanthanide and actinide
4. Have the concept of acid and base and their application in application
5. Demonstrate usefulness of non-aqueous solvents in chemistry

ZYT 451:LAB BASED ON ZOOLOGY (BASED ON PAPER I & PAPER II)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To address and identify practical problems in a range of areas of biochemistry, endocrinology and animal behavior.
2. To learn about methods of checking biochemical activity of different biomolecules.
3. To observe the internal structure of different endocrine glands through microscopic slides.
4. To learn about basic biochemical techniques like chromatography, electorphoresis and centrifuge.

Practical Work:

Biochemistry

(a) Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter.

(b) Basic principle and types of chromatagrahy.

Endocrinology

(a) spots, comments on prepared histological slides

Animal Behavior.

(a) Introduction to Ethology and Psychobiology. Patterns of behavior (taxes, reflexes, instinct and motivation).

(b) Biorhythms; learning and memory imprinting their role. Study of migration of fishes Schooling and shoaling& birds.

Course Outcomes: After completing the course, the students will be able to:

1. Solve practical problems in a range of areas of biochemistry, endocrinology and animal behavior.
2. Determine the appropriateness of different methods to check the biochemical activity of different biomolecules.
3. Discuss and describe the internal structure of different endocrine glands..

BOT 451: Lab Based on Botany (Paper I & II)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. Solve practical problems in a range of areas of plant anatomy and economic botany.
2.Determine the appropriateness of different methods of solving anatomical problems like the demonstration of the xylem and phloem components viz., phloem parenchyma, phloem fibers, tracheids and vessels; bast fibres, sieve tubes, companion cells, knots.
3. Communicate issues related to the economic botany like identification of the different types of cereals, identification of the pseudo-cereals and other variable grain types effectively to a wide range of audiences.
4. Use computer packages where appropriate to develop a deeper understanding about the big spectrum of the anatomical and economic issues of the plant produce and other related problems.
5. Collect a wide variety of grains and pseudo-cereals from the local markets of the area on the basis of the basis of the features they learnt from the laboratory experiences.

Practical Work:

1. a) Timbers; b) Oil seeds; c) Sugars and starch; d) Fibres; e) Cereals; f) Legumes
2. Identification and description of the Cotton
3. Identification and description of the Jute
4. Identification and description of the Termeric and other spices.
5. Identification and description of the Tea
6. Identification and description of the Clay and sandy soil
7. To calculate the Biological yield
8. To determine the Harvest index
9. To calculate the economic yield of a crop
10. Stem of *Boerhaavia, Bignonia, Bougainvellia, Dracena, Leptadenia, Nyctanthes, Salvadora*
11. Herbarium preparation of plants belong to the family Graminae/Poaceae
12. Herbarium preparation of plants belongs to the family Leguminosae/Fabaceae

Course Outcomes: After completing the course, the students will be able to:

1. Solve practical problems in a range of areas of plant anatomy and economic botany.
2. Determine the appropriateness of different methods of solving anatomical problems like the demonstration of the xylem and phloem components viz., phloem parenchyma, phloem fibers, tracheids and vessels; bast fibres, sieve tubes, companion cells, knots.

3. Communicate issues related to the economic botany like identification of the different types of cereals, identification of the pseudo-cereals and other variable grain types effectively to a wide range of audiences.
4. Use computer packages where appropriate to develop a deeper understanding about the big spectrum of the anatomical and economic issues of the plant produce and other related problems.
5. Collect a wide variety of grains and pseudo-cereals from the local markets of the area on the basis of the basis of the features they learnt from the laboratory experiences.

BSR 451: Chemistry Lab-IV	
Teaching Scheme Practical: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To introduce conductometry and pH metry titrations
2. To have a handson using colorimeter
3. To develop the skill of synthesis and crystallization

Detailed List of Experiments

Instrumentation:

i) To determine normality and strength of HCl using (0.1N) NaOH Solution Conductmetrically.

ii) To determine normality and strength of acetic acid using (0.1N) NaOH solution Conductmetrically.

iii) To determine normality and strength of HCl using (0.1N) NaOH solution by pH-metrically.

iv) To Verify Lambert-Beers Law using $KMnO_4$ solution.

v) To estimate the amount of Sugar using Polarimeter.

vi) To determine refractive index of ethanol water system.

vii) To determine indicator constant of indicator colorimetrically.

Organic Derivatives:

and Physical Constant:-

i) Acetyl Derivatives

ii) Benzoyl Derivatives

iii) Hydrolysis Derivatives

iv) Bromo-Derivatives

v) Reduction Derivatives

vi) Osazone Derivatives

Preparation, Crystallization

a) Aniline b) Salicylic Acid

a) Aniline b) β-naphthol

a) Ethyl Benzoate b) Aspirin

a) Phenol b) Cinnamic Acid

a) m-dinitrobenzene

a) Sucrose b) Glucose

Organic Estimations:

i) Estimation of nitro group by reduction.
ii) Estimation of glucose

Suggested Readings:

1. "Vogel's Text book on Practical Organic Chemistry" by **Furniss**, Pearson Education; 5 edition (2003)

Course Outcomes:

After the completing the course, the students will be able to:

1. Design conductivity, pH metry and colorimetry experiments
2. Skill to perform small scale synthesis
3. Have the art of crystallization

Semester-V (Botany-Chemistry)

BOT 501: Cytogenetic, Paleobotany, Evolution and Ecology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To study the genetic material of cells.
2. To learn the importance of genetic material.
3. To learn about the various types and structures of genetic material.
4. To study the genetic organization in prokaryotes, viruses and eukaryotes.
5. To learn about the general principles of genetic material replication and the enzymes involve.
6. To learn about the techniques involved for the recombination of the genetic material.

UNIT I: DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.

UNIT II: DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology-linking number, topoisomerases; Organization of DNA-Prokaryotes, Viruses, Eukaryotes. RNA Structure Organelle DNA -- mitochondria and chloroplast DNA.

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

UNIT IV: Genetic engineering and Biotechnology: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of Agrobacterium; vectors for gene delivery and marker genes.

Suggested Readings:

1. Current concepts in Plant Taxonomy. Heywood, V.H. and Moore, D.M. (Eds.) 1984.

Academic Press, London.
2. Plant Biochemistry and Molecular Biology. Lea, P.J. and Leegood, R.C. 1999. John Wiley & Sons, Chichester, England.
3. Principles of Gene Manipulation. Old, R.W. and Primrose, S.B. 1989. Blackwell Scientific Publications, Oxford, UK.

Course Outcomes: After completing the course, the students will be able to:

1. Know the DNA as genetic material and importance of DNA replication in almost all organisms.
2. Determine the structures and role of DNAs and RNAs.
3. Know the transfer of genetic information through genetic code.
4. Know the methods of DNA replication in primitive as well as in advanced cells.
5. Know about the various enzymes and proteins involve in DNA replication.
6. Analyze the significance of DNA and RNA in applied aspects of biology.
7. Know the trend of evolution with changing climatic conditions.
8. Implement learnt methodologies for gene cloning and genetic recombination for human welfare.

BOT 502: Environmental Botany and Plant Pathology	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
2. Understand the principle, working and applications of instruments viz, pH meters, spectrophotometer, centrifuge, viscometer, and laminar air flow.
3. To learn out the prevention and control measures of plant diseases and its effect on economy of crops.
4. Understand the concept, principle and types of sterilization methods.
5. Know the terminologies in plant pathology and the cultivation methods of bacteria, yeast, fungi and virus.

UNIT I: Principles of phytogeography; endemism; hotspots; phyto-geogarphical divisions of India: vegetation of North India, Mineral resources of Planet Earth, Conservation of Mineral Resources, Soils, types, Properties and various problems soils; Water, the sources, physicochemical and biological properties of water, sustainable management of water; Energy resources in India; Forests; global forest wealth, importance of forests.

UNIT II: Plant Pahtology: Definition; Importance; Terms and Concepts; Classification; Causes; Symptoms; Host-Geographical distribution of diseases; etiology; symptomology; disease cycle and environmental relation; prevention and control of pl ant diseases, and role of quarantine.

UNIT III: History and scope of plant pathology; Modes of infection and physiology of parasitism; Mechanisms of host-pathogen interactions; Transmission and spread of plant diseases; Methods of plant disease control.

UNIT IV: Causal organism, symptoms, disease cycle and control measures of the following plant diseases: Green ear disease of bajra, downy mildew of crucifers, powdery mildew of sheesham, rusts of pea and linseed, smut of bajra, wilt of tomato, bacterial blight of rice, mosaic of sugarcane and little leaf of brinjal.

Suggested Readings:

1. Current concepts in Plant Taxonomy. Heywood, V.H. and Moore, D.M. (eds.) 1984. Academic Press, London.
2. Principles of Angiosperms Taxonomy. New Age International Limited, New Delhi. Davis, P.H. and Heywood, V.H. 1963. , Oliver and Boyd. London.
3. Morphology and Evolution of Vascular Plants, Gifford, E.M. and Foster, A.S. 1988. W.H. Freeman & Company, New York.

Course Outcomes:

After completing the course, student will be able to:

1. Describe the all introductory terms concerned with environmental botany and plant pathology like mildews, rust, smut and necrosis, hyperplasia, quarantine etc.

2. Understand the basic information about principles of pathology and environmental botany, their application in daily life and industry.

3. Describe the various types of phyto-geographic regions, and plant growth with environmental changes and their origin, prevalence of some confined diseases in these particular areas.

4. Analyze the behavior of endemic plant species, their nature and their significance for the other relative flora belongs to various taxonomic families.

5. Evaluate the significance of the pathological processes involved in the manufacturing of the bioactive, enzymes, hormones and vitamins in the body of plants.

BOT 503: Cell-Biology-I	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To study the organization of prokaryotic and eukaryotic cells.
2. To study various types of microbes and their organization.
3. To learn about the principles of microscopy.
4. To study in detail the cellular organelles and their role.
5. To learn about the types of mutation and their significance.
6. To describe the terms ploidy, sex determination, barr-bodies and dosage compensation.

UNIT I: Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, Viriods, *Mycoplasma* and *Escherichia coli*.

UNIT II: Microscopic -Principles of Light microscopy; Phase contrast microscopy; Confocal microscopy; Electron microscopy (EM)-scanning EM and scanning transmission EM (STEM); Fluorescence microscopy; Analytical -Flow cytometry-flurochromes, fluorescent probe and working principle; Spectrophotometry; Mass spectrometry; X-ray diffraction analysis.

UNIT III: Molecules of cell, cell membranes and cell Proteins; Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing. The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes.

UNIT IV: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Induced versus Spontaneous mutations; Attached X method, DNA repair mechanisms. Sex Determination: Chromosomal mechanisms, Environmental factors effecting sex determination, Barr bodies, Dosage compensation.

Suggested Readings:

1. Molecular Biology of the Cell (2008), Bruce Albert, Alexander Johnson, et al. (5th ed.).
2. Molecular Biology, David Freifelder (2009), University of California (2nd ed.).

Course Outcomes: After completing the course, the students will be able to:

1. Know the structure and genetic material of different microbes.
2. Know the cellular organization in prokaryotes and eukaryotes.
3. Know various microscopic techniques to study different cells.
4. Know about the structure and importance of cell membrane and nucleus.
5. Analyze chromosomal aberration in different cells and the significance of mutation.
6. Analyze the significance chromosomes and various mechanisms involve in determining sex in an organism.

BSR 501: Physical Chemistry-III	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To illustrate advance concept of quantum mechanics
2. To introduce chemical bonding
3. To describe basic idea of magnetic resonance spectroscopy
4. To illustrate statistical thermodynamics.
5. To describe the liquid state chemistry in terms of surface tension and viscosity

Detailed Syllabus

Unit-1:

Quantum Mechanics and Atomic Structure: A review of the black body radiation and the old quantum theory. The wave nature of electron. The Uncertainty Principle. Schrödinger's wave mechanics. Eigenfunctions and normalizations. Quantum mechanical operators. Orthogonality of wave functions. Atomic orbitals. Orbital quantum numbers and their physical significance. Electron spin. Helium atom and Pauli Principle. The variational principle.

Unit-2:

The Chemical Bond: The Molecular Orbital (MO) theory. The hydrogen molecule ion. Hydrogen molecule (MO and VB descriptions). Simple molecular orbitals for homonuclear and heteronuclear diatomic molecules. Bond description. Hybridization.

Unit-3:

Magnetic Resonance Spectroscopy: Nuclear Magnetic Resonance spectroscopy. Chemical shifts. Spinspinsplittings. Relaxation times. Electron Spin Resonance. Nuclear hyperfine splittings.

Unit-4:

Molecular Statistics: The Boltzmann distribution. Maxwell distribution law for distribution of molecular speeds. The Maxwell-Boltzmann distribution law for the distribution of molecular energies. The partition functions. Thermodynamic quantities from partition functions. The Sackrur-Tetrode equation for molar entropy of monoatomic gases. Rotational and vibrational partition functions. The characteristic temperature. The calculation of Gibbs free energy changes and equilibrium constant in terms of partition functions.

Unit-5:

Liquid state: Surface tension of liquids-capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.

Suggested Readings:

1. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.
2. Physical Chemistry, I. N. Levine, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.
3. Physical Chemistry - A Molecular Approach, D. A. McQuarrie and J. D. Simon,South Asian Edition (1998), University Science Books, Sausalito CA, by Viva Books, New Delhi.
4. Molecular Spectroscopy, C. N. Banwell and E. N. McCash, McGraw Hill Education.

Course Outcomes:

After the completing the course, the students will be able to:

1. Have a clear concept on quantum mechanics
2. Explain chemical bonding with valance bond and molecular orbital theory
3. Visualize the concept behind the NMR spectroscopy
4. Explain the basic concept of statistical thermodynamics
5. Explain the effect of surface tension and viscosity.

BSR 502: Organic Chemistry-III	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To introduce the chemistry of Heterocyclic compounds
2. To illustrate Carbohydrates
3. To describe the chemistry of amino acids, peptides and proteins
4. To introduce organic dyne molecules
5. To explore the synthetic scope of enolate based reactions.

Detailed Syllabus

Unit-1: Hetrocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, and Skraup synthesis. Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

Unit-2: Carbohydrates: Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, Configuration of monosaccharides, Erythro and threo diastereomers, Conversion of glucose intro mannose, Formation of glcosides, ethers and esters, Determination of ring size of monosaccharides, Cyclic structure of D(+)-glucose, Mechanism of mutarotation. Structures of ribose and deoxyribose, an introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

Unit-3: Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids, Acid-base behavior isoelectric point and electrophoresis, Preparation and reactions of amino acids, Structure and nomenclature of peptides and proteins, Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid-phase peptide synthesis, Structures of peptides and proteins, Levels of protein structure, Protein denaturation/ renaturation; Nucleic acids : Introduction, constituents of nucleic acids, Ribonucleosides and ribonucleotides, The double helical structure of DNA.

Unit-4: Synthetic Dyes: Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

Unit-5: Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.

Suggested Readings:

1. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. Organic Chemistry, S. M. Mukherji , S. P. Singh, and R. P. Kapoor, 1st Edition(1985), 5th Reprint (1999), New Age International (P) Ltd.Publishers, New Delhi.
3. Organic Chemistry – Structure and Reactivity", Seyhan N. Ege, AITBS publishers, Delhi (1998).

Course Outcomes:

After the completing the course, the students will be able to:

1. Explain the reactions based on heterocyclic compounds
2. Have knowledge on the chemistry of carbohydrates, amino acids, peptides and proteins
3. Explain the role of carbohydrate, amino acids, peptides and proteins in human body
4. Knowledge on the chemistry of organic dye

BSR 503: Inorganic Chemistry-II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To provide the variation of different properties across periodic table
2. To illustrate variable valency and electron transfer reactions
3. To demonstrate crystal field theory and its application on coordination complex
4. To illustrate isomerism in coordination complex
5. To describe different properties of transition metals.

Detailed Syllabus

Unit-1

Periodic Properties: Electronic configuration, periodic trends in size of atoms/ions, ionization energy, electro negativity, oxidation state and reactivity. Comparative study of their oxides, hydrides and halides (special emphasis on structure and boning).

Electronic configuration, oxidation state, trends in properties of these elements with respect to size of atom/ion, ionization energy, electronegativity and reactivity. Comparative study of the hydrides and oxides of these elements (structure and bonding), oxyacids of halogens and interhalogens.

Unit-2

Transition Elements: Transition Elements: Electronic structure and position in the periodic table. General properties: variable valency, colour, magnetic properties and catalytic role, important uses of transition metals and their alloys; differences between the first and the other rows, horizontal comparison with Fe, Co, Ni groups; toxicity of Cd and Hg.

Unit-3

Co-ordination Compounds: IUPAC Nomenclature of mononuclear complexes, Types of ligands and chelates Werner's theory of coordination compounds, isomerism (geometrical and optical) in square planar and octahedral complexes. Sidgwick's theory and EAN Principle, Use of coordination compounds in qualitative analysis (Cu2+/NH3) and quantitative analysis (Ni2+/DMG), Hardness of water using EDTA.

Suggested Readings:

1. Basic Inorganic Chemistry. (2009). II Edition F.A. Cotton, G. Wilkinson, Aksia Pub. Ltd. Germany.
2. New Concise Inorganic Chemistry. (2008) .VI Edition. J.D. Lee. Lambert Press, London.

Course Outcomes:

After the completing the course, the students will be able to:

1. Explain the variation of different properties on periodic table
2. Knowledge of application of electron transfer reactions
3. Explain stability of coordination complex
4. Demonstrate color and magnetic properties of coordination complexes
5. General properties of transition metals.

BOT 551: Lab Based on Botany (Paper I, II & III)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To learn methodologies to measure the rate of transpiration in plants.
2. To learn about the physiological processes occur in plants.
3. To learn the role of different plant hormones practically.
4. To analyze the effect of industrial waste/heavy metal on aquatic flora and fauna.
5. To learn the taxonomy, ecology and biochemistry of some economically useful plants.

Practical Work:

- To demonstrate and measure the rate of transpiration.(By Bell jar/farmer's potometer).
- To measure un-equal transpiration from two surfaces of a leaf.
- To compare the rate of water absorbed and the water lost in transpiration.
- To prove that CO2 is evolved in aerobic respiration.
- Demonstration of the an-aerobic respiration.
- To show the role of gibberellic acid in the germination of seeds.
- To separate and examine chlorophyll pigments from five different plant species.
- To study the effects of some pollutants on aquatic micro-organisms.
- To test the hypothesis that is not possible for two similar species to occupy the some ecological niches in a given habitat.
- To detect and study the glucose, sucrose, starch, fats and proteins in a seed (gram/pea-nuts) and other plant materials.

Practical Work:

- Identification and description of the Cotton.
- Identification and description of the Jute.
- Identification and description of the Termeric and other spices.

- Identification and description of the Tea.
- Identification and description of the Clay and sandy soil.
- To calculate the Biological yield
- To determine the Harvest index.
- To calculate the economic yield of a crop.

Course Outcomes: After completion of the course, the student will be able to:

1. Know the significance of transpiration in plants.
   Know about the anatomical structures responsible for transpiration.
2. Determine the rate of transpiration by different methods.
3. Quantify the processes like photosynthesis and respiration in plants at different environmental conditions.
4. Determine the different plant hormones responsible for the growth and development of plants from seeds.
5. Understand the concept of ecological niche.
6. Analyze the biochemical methods for determining the presence of sugar, fat and proteins in different plant parts.
7. Describe biologically the food and spices or stuff used in daily life.
8. Discriminate different soil types, their geographical distribution and importance.
9. Understand the concept of BOD and factors (living/non-living) responsible for it.
10. Analyze land use pattern and quantify its crop yielding capacity using different indices.

BSR 551: Organic Chemistry Lab	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To demonstrates qualitative analysis to detect different functionality in organic chemistry
2. To have synthetic skill to prepare useful compounds

Detailed List of Experiments

1. **Qualitative analysis of following types of unknown organic** compounds: I. Carbohydrates
   II. Primary, secondary and tertiary amines
   III. Nitro compounds
   IV. Amides
   V. Aryl halides
2. **Preparation of following organic** compounds: I. Acetanilide
   II. Picric acid
   III. Aspirin

Suggested Readings:

1. "Vogel's Textbook on Practical Organic Chemistry", by **Furniss**, Pearson Education; 5 edition (2003)

Course Outcomes:

After the completing the course, the students will be able to:

1. Perform qualitative analysis and identify the functionality in the molecule
2. Synthesize above mentioned three compounds.
3. Design new reaction scheme to prepare similar compounds.

BSR 552: Inorganic Chemistry Lab	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To demonstrate qualitative and quantitative analysis of inorganic salt.
2. To perform redox reactions-based titrations with and without indicators
3. To perform experiments with high accuracy and precision

Detailed List of Experiments

1. Inorganic Qualitative Analysis (Semi-Micro Analysis) (At least five mixtures)
2. Separation of calcium and Barium and estimation of Ca- volumetrically or Ba- gravimetrically
3. Separation of Cu and Ni from binary mixtrire solution and estimation of
   Cri—volumetrically and Nr—gravimetrically.
4. Estimation of oxalic acid and H2SO4 in a given mixture Solution using NaOH and KMnO4 solutions.

Suggested Readings:

1. "Vogel's Quantitative Chemical Analysis" by **J. Mendham**, Pearson Education; 6 edition (2009)

Course Outcomes:

After the completing the course, the students will be able to:

1. Perform qualitative analysis to identify inorganic ions
2. Design experiments to quantitatively estimate inorganic salts

Semester -VI

BOT 601: Plant Resource Utilization, Palynology and Biostatistics	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 Marks

Course Objectives:

1. To lean a range of skills in mathematical modeling, probability and statistics and simple computer programming.
2. Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.
3. Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
4. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
5. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of plant in taxonomy.

UNIT I: Concept of centres of origin, their importance with reference to Vavilov's work; examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversty. Cereals; Wheat and Rice, Role of dwarf varieties in green revolution; brief account of millets and pseudocereals; Legumes General account, importance to man and ecosystem; chief pulses grown in India. Fruits Mango, Citrus. Sugars and starches- Ratooning and nobilization of sugarcane, products and by products of sugarcane industry; Spices- saffron, clove, turmeric.

UNIT II: Beverages-Tea, coffee and cocoa, their processing and some common adulterants.

Oils and Fats -General description with details of groundnut, coconut, linseed and Brassica spp and their use related health implications; Essential Oils, General account and comparison with fatty oils; Natural Rubber, Para Rubber, tapping and processing, Various substitutes of Para Rubber; Drug Yielding Plants, Therapeutic and habit forming drugs with special reference to Cinchona, Digitalis, Rauvolfia, Papaver and Cannabis; Masticatories and Fumitories-Tobacco and Health hazards.

UNIT III: An Introductory Knowledge to Palynology, Morphology, Viability and Germination of Pollens.

UNIT IV: Classification of data, Mean, Median and Mode. Standard Deviation, Standard error, Variance, Co-relation, X2 test and experimental designs.

Suggested Readings:

1. Principles of Angiosperms Taxonomy. New Age International Limited, New Delhi. Davis, P.H. and Heywood, V.H. 1963. , Oliver and Boyd. London.
2. Morphology and Evolution of Vascular Plants, Gifford, E.M. and Foster, A.S. 1988. W.H. Freeman & Company, New York.
3. Principles of Gene Manipulation. Old, R.W. and Primrose, S.B. 1989. Blackwell Scientific Publications, Oxford, UK.
4. Raghavan, V. 1986: Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press, New York, USA.
5. Molecular Biology. H. D. Kumar. II Edition.(2008): Vikas Publishing Houses, New Delhi, India.

Course Outcomes: After completing the course, the student will be able to:

1. Define or describe all the kinds of plant based resources such as biogas.
2. Understand the significance of rich diversity of biostatic tests applicable.
3. Apply the different methods for estimation of biological data.
4. Analyse the role of various kinds of palynological resources in research of the old climatic conditions and their relations with the origin of life and their effect.
5. Evaluate the comparative significance of biostatical aids in systematics,
6. Create the basic knowledge of all kinds of plant resources for daily life needs;

BOT 602: Cell-Biology-II	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To study the organization of prokaryotic and eukaryotic cells.
2. To study various types of microbes and their organization.
3. To learn about the principles of centrifugation and chromatography.
4. To study in detail the cytoskeleton and filaments associated with it.
5. To learn about the molecular organization of chromatin.
6. To describe mechanism of vesicular transport and the cell organelles in detail.

UNIT I: Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, *Mycoplasma* and *Escherichia coli*.Separation -Sub-cellular fractionation- differential and density gradient centrifugation; Chromatography- paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC).

UNIT II: Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes'assembly; Cytoskeleton and Cell Movement Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.

UNIT III: Molecules of cell, cell membranes and cell Proteins; Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing.

UNIT IV: The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport, Lysosomes; Mitochondria, Chloroplasts and Peroxisomes: Structural organization, Function, Marker enzymes, Mitochondrial biogenesis, Protein import in mitochondria.

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Suggested Readings:

1. Modern concept of Micro-biology. H.D. Kumar and Swati Kumar. II Edition.(2006) Vikas Publishing House, New Delhi.
2. Morphology and Evolution of Vascular Plants, Gifford, E.M. and Foster, A.S. 1988. W.H. Freeman & Company, New York.

3. Principles of Gene Manipulation. Old, R.W. and Primrose, S.B. 1989. Blackwell Scientific Publications, Oxford, UK.
4. Raghavan, V. 1986: Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press, New York, USA.
5. Molecular Biology. H. D. Kumar. II Edition. Vikas Publishing Houses, New Delhi, India.

Course Outcomes: After completing the course, the students will be able to:

1. Know the structure and genetic material of different microbes, and can exploit them for different purposes and remedies.
2. Know the cellular organization in prokaryotes and eukaryotes, and the trend of advancement.
3. Learn methodologies to separate compounds based on their color and density.
4. Know about the structure and importance of cell organelles and their role.
5. Learn the origin of mitochondria and chloroplast and their genetic material.

BOT-603: Genetics	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 Marks

Course Objectives:

1. To learn out the major ideas and current experimental approaches to cell and developmental biology, and in the process will illustrate how molecular approaches complement classical cell biology in finding out the details of how cells carry out their basic processes.
2. To learn the knowledge the spread of genes through populations and the role of natural selection in predator-prey relationships, polymorphism and mimicry.
3. To study the phenomenon of dominance, laws of segregation, independent assortment of genes.
4. To understand the different types of genetic interaction, incomplete dominance, co-dominance, inter allelic genetic interactions, multiple alleles and quantitative inheritance etc.
5. Understand the biochemical nature of nucleic acids, their role in living systems, experimental evidences to prove DNA as a genetic material.

UNIT I: Population Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift; Evolutionary Genetics: Genetic variation and Speciation.

UNIT II: The Nucleosome Model of DNA, Genetic Code, Satellite and Repetitive DNA. Genetic Inheritance: Mendelism: Laws of Segregation and Independent Assortment; Linkage Analysis; Allelic and non-allelic interactions, Plasmids. Genetic Variations: Mutations - spontaneous and induced; transposable genetic elements; DNA damage and repair.

UNIT III: Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization; Pedigree analysis Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance; Linkage and crossing over.

UNIT IV: Dosage compensation; Extra-chromosomal Inheritance: Chloroplast mutation/Variegation in Four o' clock plant and Chlymodomonas, Mitochondrial mutations in *Neurospora* and yeast, Maternal effects, Infective heredity- Kappa particles in *Paramecium*.

Suggested readings:

1. Modern concept of Micro-biology. H.D.Kumar and Swati Kumar.II Edition.Vikas Publishing House, New Delhi.
2. Morphology and Evolution of Vascular Plants, Gifford, E.M. and Foster, A.S. 1988. W.H. Freeman & Company, New York.
3. Principles of Gene Manipulation. Old, R.W. and Primrose, S.B. 1989. Blackwell Scientific Publications, Oxford, UK.
4. Raghavan, V. 1986: Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press, New York, USA.
5. Molecular Biology. H. D. Kumar. II Edition. Vikas Publishing Houses, New Delhi, India.

Course Outcomes: After completing the course, the students will be able to:

1. Understand the cell division, chromosome segregation and chromosome structure.
2. Understand the structure of nucleic acids, gene expression, mutation, selection and migration
3. Understand the gene expression and gene regulation in Eukaryotes.
4. Explore the applications of gene mutation, repair and breeding methods in plants
5. Understand nuclear genome organization as well as genes and gene numbers.

BSR 601: Physical Chemistry-IV	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To introduce the concept of conductivity and ionic mobility and its application
2. To illustrate chemical kinetics and its application to decipher reaction mechanisms
3. To describe surface chemistry
4. To introduce concept of catalysis and its application in chemistry

Detailed Syllabus

Unit-1

Applications of conductivity measurements: Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic nobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water.

Unit-2

Chemical Kinetics: Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions first & second order reactions, Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates. Qualitative treatment of the theory of absolute reaction rates.

Unit-3

Surface phenomenon: Colloids, the colloidal state, preparation and purification of colloids and their characteristic properties, lyophilic and lyophobic colloids and coagulation, protection of colloids, gels, emulsions, surfactants and micelles.

Unit-4

Catalysis:

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Saturation Kinetics.

Suggested Readings:

1. Physical Chemistry (2006). Atkins, P. W. & Paula, J. de 8th (Ed)., Oxford University Press..
2. Physical Chemistry (2007). Ball, D. W. Thomson Press, India.
3. Physical Chemistry.(2004). Castellan, G. W. 4th Ed. Narosa Publishers.

Course Outcomes:

After the completing the course, the students will be able to:

1. Have a clear concept of conductivity and ionic mobility and solve related problems
2. Apply chemical kinetics in solving reaction mechanisms.
3. Explain phenomenon related surface chemistry
4. Explain different types of catalysis used in chemical lab

BSR 602: Organic Chemistry-IV	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. To introduce structure property relationships in organic chemistry
2. To illustrate and describe organic reaction mechanism of variety of organic reactions.
3. To describe the chemistry of carbonyl molecules
4. To understand how polymerization reaction works
5. To illustrate the importance of stereochemistry and it application in organic chemistry

Detailed Syllabus

Unit-1: Structure and Reactivity: Atomic orbitals, hybridization, orbital representation of methane, ethane, ethene, ethyne and benzene; polarity of bonds – inductive, resonance effects.

Unit-2: Organic reaction mechanisms: Heterolytic and homolytic cleavage, nucleophiles, electrophiles and free-radicals; substitution, addition and elimination reactions. **Alkanes:** Conformations of ethane and n-butane. **Alkyl halides:** Preparation and reactions, SN1 and SN2 mechanisms.Grignard reagents- preparation and synthetic applications. **Alkenes:** E1 and E2 mechanisms, Elimination versus substitution reactions, Addition reactions (electrophilic and free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. **Alkynes:** Reduction, electrophilic addition, acidity and metal acetylides. **Alcohols:** Comparative study of dehydration, oxidation, substitution and esterification of primary, secondary and tertiary alcohols. **Aldehydes and Ketones:** Nucleophilic addition reactions, aldol condensation, Cannizzaro reaction, oxidation and reduction, Haloform reaction. **Aliphatic Caboxylic Acids:** General preparation and reactions of mono- and di-carboxylic acids. **Polymers and Polymerization:** Elementary treatment - Alkene polymerization and condensation polymers – polyethylenes, nylons and terylene. **Active methylene compounds:** Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate.

Unit-3: Stereochemistry: Fischer, saw-horse and Newman projection formulae. Chirality-optical activity, enantiomerism and diastereoisomerism involving one and two chiral centers, configuration, geometrical isomerism, D/L, R/S and E/Z nomenclatures

Suggested Readings:

1. Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. Organic Chemistry", S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition. (1985), New Age International (P) Ltd. Publishers, New Delhi.

Course Outcomes:

After the completing the course, the students will be able to:

1. Correlate structure and reactivity of organic molecules
2. Have a reasonable approach to solve reaction mechanism
3. Demonstrate the how carbonyl compound may react under different environment
4. Illustrate importance stereochemistry in understanding organic reaction mechanism.

BSR 603: Inorganic Chemistry-III	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment – 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Course Objectives:

1. Understanding the coordination chemistry through Crystal Field Theory
2. To explain electronic spectra exhibited by different transition metal
3. To introduce bio-inorganic chemistry and how chemistry play role in human body
4. To illustrate different chromatographic techniques and their application

Detailed Syllabus

Unit-1

Metal-Ligand Bonding in Transition Metal Complexes: Limitations of Valence Bond Theory, Crystal Field Splitting in Octahedral, Tetrahedral and Square Planar Complexes.

Unit-2

Electronic Spectra of Transition Metal Complexes: Organometallic Compounds, Preparation, Properties, Bonding and Applications of alkyls and aryls of — Li, Al, Hg, Sn and Ti. A Brief account of metal ethylenic Complexes, Nature of bonding in metal carbonyls, A Brief account of metal-ethylenic Complexes.

Unit-3

Bio-inorganic Chemistry:

Essential and *Tace* elements in biological processes, Metalloporphyrins with special reference to hemoglobin, and myoglobin, Biological role of alkali (Na^+, K^+) and alkaline earth metal ions (Mg^{2+}, Ca^{2+}). Nitrogen Fixation.

Unit-4

Chromatography:

Definition of Chromatography, Paper and TLC, Method of Development (Ascending and Descending Chromatography)**,** Locating Technique: UV Light, Chemicals and RF Value, Comparison between Paper and TLC, Applications of Chromatography and High level Automation.

Suggested Readings:

1. Concise Inorganic Chemistry, J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
2. Basic Inorganic Chemistry, F. A Cotton, G. Wilkinson, and Paul L. Gaus, III. rd Edition (1995), John Wiley & Sons, New York.
3. Inorganic Chemistry, A. G. Sharpe, 3rd International Student Edition (1999), ELBS /Longman, U.K.
4. Inorganic Chemistry, D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.

Course Outcomes:

After the completing the course, the students will be able to:

1. Explain the different properties of coordination compound through CFT
2. Explain the difference in color observed for different coordination compound.
3. Explain how inorganic chemistry is essential for living system
4. Good knowledge on different chromatographic techniques and their application

BOT 651: Lab Based on Botany (Paper I, II & III)	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To prepare and study the slides of cell division and its organelles.
2. To learn about the physiological processes occur in plants.
3. To learn the biostatics and its application.
4. To evaluate the diversity and distribution of organisms in particular area.
5. To analyze the effect of industrial waste/heavy metal on aquatic flora and fauna.
6. To calculate the PH of H_2O and quantify dissolved CO_2/O_2.
5. To learn aquatic/terrestrial flora and fauna, and factors responsible for their survival using ecological parameters.

Practical Work:

1. Study of cell division in slides.
2. Study of cell organelles in slides.
3. To study the transpiration by four leaves method.
4. To study the root pressure.
5. To study the moisture content in the soil sample.
6. To study the germination of the gram.
7. Chlorophyll estimation by the method of the Dwedi and Randhawa.
8. Protein estimation by the method of the Lowery's method.
9. Instruments-minimum and maximum thermometers.
10. Rain gauge
11. Biostatics problems like mean, mode and median.
12. Quadrat experiments (Frequency, density, abundant)
13. To determine the procedure of calculating the PH of the solutions of different morality.
14. To measure the PH of a given sample of water.
15. To determine the amount of dissolved oxygen (DO) in a sample of water.
16. To determine the amount of free CO2 in a sample of water.
17. To determine the total alkalinity of a sample of water.
18. To measure the total hardness of a given sample of water.
19. To measures the Biochemical oxygen demand (BOD) of a given sample of water.
20. Total count (quantitative estimation) of plankton.
21. Quantitative estimation of benthos (macro-zoo-benthos).
22. To test the hypothesis that is not possible for two similar species to occupy the same ecological niche in a given habitat.

Course Outcomes: After completing the course, the students will be able to:

1. Understand microscopic stages of cell division.

2. Know about the biological machineries of cell, their structure and function.
3. Determine the rate of transpiration by different methods.
4. Develop statistical methods for designing biological models and experiments, data collection and analysis followed by interpretation of the results.
5. Understand the concept of ecological niche.
7. Understand difference among density, frequency and abundance, and their utility to evaluate flora or fauna of an area.
8. Discriminate different soil types, their nature and water retention capacity.
9. Understand the methods for estimating aquatic life and factors (living/non-living) responsible for their survival and successive detrimental.

BSR 651: Physical Chemistry Lab	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To perform advanced physical chemistry related experiments.
2. To perform experiments using colorimeter, pH meter and conductomer
3. To demonstrate kinetics related experiments.

Detailed Syllabus

1. Viscosity-composition curve for a binary liquid mixture.
2. Surface tension-composition curve for a binary liquid mixture.
3. Determination of indicator constant - colorimetry.
4. Determination of pH of a given solution using glass electrode.
5. Beer's Law - Determination of concentration of solution by colorimetry.
6. Order of reaction of I2 / Acetone / H+.
7. Equilibrium constant of methyl acetate hydrolysis reaction.

Suggested Readings:

1. Practical Physical Chemistry" by B. Viswanathan and P.S Raghaban, Viva Books publications Ltd. Jaipur, Rajisthan.

Course Outcomes: After the completing the course, the students will be able to:

1. Use different instrumental tools such as colorimeter, pH meter.
2. Successfully carry out kinetics related experiments and determined rate.
3. Able to design a experiments to estimate reaction order of any given reaction.

BSR 652: Organic Chemistry Lab	
Teaching Scheme Practicals: 2 hrs/Week	**Examination Scheme** Internal-15 Marks External-35 Marks

Course Objectives:

1. To introduce systematic analysis of organic compounds.
2. To demonstrate organic synthesis of selected molecules
3. To introduce IR spectroscopy to demonstrate functional group characterization.

Detailed List of Experiments

1. Systematic identification of organic compounds (mono-functional and simple bifunctional) and preparation of their derivatives.
2. Preparation of the following compounds:

Suphanilic acid, dibenzyl acetone, methyl orange, dinitrobenzene from benzene, isolation of caffeine.

3. Estimation of phenol (bromide-bromate method) and aniline (bromide-bromate and acetylation methods).
4. Equivalent weight of an acid (neutralization).
5. Identification of organic functional groups by I.R. spectroscopy.

Suggested Readings:

1. Vogel's Textbook of Practical Organic Chemistry (2005): Furniss, Pearson Education; V Edition. Yark Magnetic Presss New York.

Course Outcomes: After the completing the course, the students will be able to:

1. Design experimental procedure to identify organic functionality present in a compound
2. Identify organic functionality using IR spectroscopy
3. Design experiments to synthesize new molecules
4. Carry out experiments to estimate phenol and aniline