

**PROGRAMME PROJECT REPORT**  
**BACHELOR OF SCIENCE**

**CENTRE FOR DISTANCE & ONLINE  
EDUCATION {CDOE}**

<b>Programme Name</b>	<b>:-</b>	<b>Bachelor of Science</b>
<b>Eligibility</b>	<b>:-</b>	<b>10+2 or equivalent</b>
<b>Minimum Duration</b>	<b>:-</b>	<b>3 Years {6 Semester}</b>
<b>Maximum Duration</b>	<b>:-</b>	<b>5 Years</b>

**Programme's Mission and Objective:**

A great deal of innovation is driven by science. A Bachelor of Science degree opens up a world of possibilities for students, including diving into the deepest parts of science and unravelling universal mysteries. At Arunachal University of Studies, the range of science courses is well beyond what any traditional pedagogy teaches in high school. It branches into so many fascinating and challenging avenues.

**Relevance of the Programme with HEI Mission and Goals:**

Getting a degree from Arunachal University of Studies, students get an entire world's worth of knowledge and the resources to put that knowledge into practical usage. Using projects, case studies, assignments, lectures all of the knowledge that is to be gained is presented to the students and makes them equipped to go forth in their roles. AUS has designed the curriculum and pedagogy taking in mind this important subject, which involves a lot of testing and evaluation of industrial standards and also goes into important research to develop student's minds to get ready for employability.

**Nature of Prospective Target Group of Learners:**

Arunachal University of Studies wishes the young students of the Northeast to undertake research & development activities in emerging thrust areas and introduce new manpower innovative courses based on the industry & societal demands and serving the community at large. AUS wishes to educate students to be successful, ethical, and effective problem-solvers and life-long learners who will contribute positively to the economic well-being of our region and nation and who are prepared to tackle complex 21st Century challenges facing the world.

**Appropriateness of the Programme:**

Designed with the utmost detail in mind, the course is in line with the best universities around the world. Along with the course content, the pedagogy delivered makes for the content to be even more insightful and will lead to students having an in-depth knowledge of the areas of their choice.

**Outcome**

With a Bachelor of Science, students can have many career options. Whether it's physics, biology, or chemistry that they are passionate about or mathematics, technology, or computers, some careers are right for all interests and can be long-term careers that they can enjoy for life. The list of careers one can get after doing B.Sc. is just endless. As a result, enrolling for a B.Sc. shall give students the best chances for success.

**Instructional Design:**

1. Title of the Programme : Bachelor of Science
2. Minimum Duration of the Programme : 3 Years {6 Semester}
3. Maximum Duration of the Programme : 5 Years
4. Weather Listed in Section (22) of UGC Act : Yes
5. Level of the Programme : UG-I to UG-III
6. Eligibility : 10+2 or eq.
7. Optional Early Exit Certification : Not Applicable
8. Credit Transfer : Applicable
  - 8.1 To the Second Year of Programme: - For the Candidates who has successfully completed First Year of Programme from a recognized University/ Institution or any other Institution recognized by the Arunachal University of Studies. A student admitted under this system requires submitting fees for Second Year of the Programme along with Credit Transfer fees as prescribed by the University from time to time.
  - 8.2 To the Third Year of Programme: - For the Candidates who has successfully completed First & Second Years of Programme from a recognized University/ Institution or any other Institution recognized by the Arunachal University of Studies. A student admitted under this system requires submitting fees for Third Year of the Programme along with Credit Transfer fees as prescribed by the University from time to time.
  - 8.3 The cases where exact title of Programme is different from the aforementioned Programme Title and more than 75% credits earned in previous qualification matches with the Programme Credits then such Credit Transfers are permitted by the Arunachal University of Studies as per 8.1 and 8.2.
9. Skill Based Credit Transfer : Applicable
  - 9.1 A Candidate who has successfully completed minimum two years of work experience in relevant field or have completed minimum of two-year professional certification from an institution after prescribed qualification for the admission into programme are eligible for Skill Based Credit Transfer. The Skill Based Credit Transfer candidates have to appear in all theory examinations in order to earn minimum Two Years credits of the Programme.
  - 9.2 To the Second Year of Programme: - Such Candidates are required to earn mismatched theory, practical and industrial credits of First Year along with Second Year Examinations. A student admitted under this system requires submitting fees for First and Second Year of the Programme along with Skill Based Credit Transfer fees as prescribed by the Arunachal University of Studies from time to time.
  - 9.3 To the Third Year of Programme: - Such Candidates are required to earn mismatched theory, practical and industrial credits of Second Year along with Third Year Examinations. A student admitted under this system requires submitting fees for Second and Third Year of the Programme

along with Skill Based Credit Transfer fees and Lateral Entry Fees/ Credit Transfer Fees (whichever applicable) as prescribed by the Arunachal University of Studies from time to time.

10. Lateral Entry : Not Applicable

11. Division:

The University will award the Divisions to successful candidates in accordance with Section 22 of Rules and Regulations made under the Arunachal University of Studies Act (No. 9 of 2012).

12. Grading Scale:

The Grading Scale of the University will be in accordance with Section 23 of Rules and Regulations made under the Arunachal University of Studies Act (No. 9 of 2012).

13. Programme Credit Distribution:

The Credit System and Programme Credit Distribution of the University will be in accordance with Section 45 and Section 46 of the First Statutes made under the Arunachal University of Studies Act (No. 9 of 2012).

14. Abbreviations and Formulae for Performance Acknowledgement:

Abbreviations and Formulae for Performance Acknowledgement of the University will be in accordance with Section 25 of the Rules and Regulations made under the Arunachal University of Studies Act (No. 9 of 2012).

15. Admission Procedure:

15.1 Admission in Bachelor of Science Annual/ Semester programme of study shall be made on Merit.

15.2 Admission cannot, however, be claimed by any candidate as a matter of right. The admission or re-admission of a candidate shall be entirely at the discretion of the University which may refuse to admit any student without assigning any reason there for.

15.3 On selection for admission to the programme, the candidate shall, within the time fixed by the Dean/ Director deposit the fees prescribed for the programme. If the candidate fails to deposit fees within the stipulated time, the selection shall automatically stand cancelled. Such a candidate shall not be admitted to the concerned programme unless a fresh order of selection and extension of date for payment of fees is issued.

15.4 The candidates other than the domicile of Arunachal Pradesh are required to fulfill the entry criteria as prescribed by the Government of Arunachal Pradesh time to time.

15.5 The Foreign Nationals are eligible for the Programme. Applications of foreign nationals nominated by the Government of India under scholarship schemes and self-financing Foreign Nationals shall be entertained for the aforesaid programme. The Foreign Nationals are required to obtain Restricted Permit from the Government of Arunachal Pradesh in addition to other papers required by Govt. of India before coming to Arunachal Pradesh.

16. Attendance:

- 16.1 Attendance of a newly admitted candidate shall be counted from the date of his/her admission, or date of beginning of classes whichever is later, while in the case of promoted candidates, attendance shall be counted from the date on which respective class begins. However, in case of promotion after declaration of results of supplementary examination (if any), the attendance will be counted from the date of admission in the respective case.
- 16.2 There shall be an Attendance Monitoring Committee in the Faculty under the Chairmanship of the Dean/ Director.
- 16.3 The Condonation upto 25% can be considered for the following specific cogent reasons:
- Participation in NCC/NSC/NSS Camps duly supported by certificate.
  - Participation in University or College Team Games or Interstate or Inter-University tournaments, duly supported by certificate.
  - Participation in Educational Excursions, which form a part of teaching in any subject conducted on working days duly certified by the Dean/ Director.
  - University Deputation for Youth Festival duly certified by the Dean/ Director.
  - Prolonged illness duly certified by the Medical Officer or any other Registered Medical Practitioner, provided such certificate is submitted to the Dean/ Director.
- 16.4 Minimum attendance criteria will be decided by Dean/ Director of Concerned Faculty from time to time.
- 16.5 There shall be no attendance criteria for External Candidates.

17. Programme Fee:

Programme Fee will be displayed on official website of the University from time to time.

18. Examination and Result:

- 18.1 The Distribution of Continuous Internal Assessment and Term End Examination of the programme will be in accordance with Section 24 of the Rules and Regulations made under the Arunachal University of Studies Act (No. 9 of 2012).
- 18.2 Result will be displayed on the official website of the University. The Statement of Grades will be issued by the Controller of Examination.
- 18.3 Students can apply for Re-Totaling/ Re-Evaluation on demand as per the procedure in practice from time to time.

18.4 Students designated in Grade F or the students desirous of improving their grades can apply for the same through Backlog/ Improvement examination as per the procedure in practice from time to time.

19. Programme Contents: -

The Total Marks includes Continuous Internal Assessment and End Term Examination. The bifurcation of Continuous Internal Assessment and End Term Examination marks will be in accordance with Section 24 of the Rules and Regulations made under the Arunachal University of Studies Act, 2012 (9 of 2012).

<b>First Semester</b>			
<ul style="list-style-type: none"> <li>• <b>Group – I is compulsory.</b></li> <li>• <b>Choose 3 Subjects from Group II, Group III and Group IV. One Subject may have multiple papers in a semester.</b></li> <li>• <b>Subjects chosen from Group II, Group III and Group IV will remain same in all semester.</b></li> </ul>			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	English	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons (T)	4	100
2	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons –Lab (P)	3	100
<b>Physics Group</b>			
1	Mechanics (T)	4	100
2	Mechanics Lab (P)	3	100
<b>Computer Science</b>			
1	Programming Fundamentals Using C++ (T+P)	6	100
2	Computer System Architecture (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Differential Calculus (T)	6	100
<b>Information Technology</b>			
1	Discrete Mathematics (T+P)	6	100
2	Basics of Internet (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Biodiversity (Microbes, Algae, Fungi and Archegoniate) (T)	4	100
2	Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab (P)	3	100
<b>Zoology</b>			
1	Animal Diversity (T)	4	100
2	Animal Diversity Lab (P)	3	100
<b>Micro-Biology</b>			
1	Anatomy and Physiology (T+P)	6	100
2	Fundamentals of Medical Laboratory Science (T+P)	6	100
3	Introductory Microbiology (T+P)	6	100

<b>Second Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Information Technology	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I (T)	4	100
2	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I Lab (P)	3	100
<b>Physics Group</b>			
1	Electricity, Magnetism and EMT	4	100
2	Electricity, Magnetism and EMT-Lab	3	100
<b>Computer Science</b>			
1	Programming in Java (T+P)	6	100
2	Discrete Structures (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Differential Equations	6	100
<b>Information Technology</b>			
1	Operating System (T+P)	6	100
2	Object Oriented Programming Using C++ (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Ecology and Taxonomy	4	100
2	Plant Ecology and Taxonomy Lab	3	100
<b>Zoology</b>			
1	Comparative Anatomy and Developmental Biology of Vertebrates	4	100
2	Comparative Anatomy and Developmental Biology of Vertebrates Lab	3	100
<b>Micro-Biology</b>			
1	Principles of Transmission Genetics (T+P)	6	100
2	Principles of Immunology (T+P)	6	100
3	Cell Structure & Dynamics (T+P)	6	100

<b>Third Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Environmental Science	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II (T)	4	100
2	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II Lab (P)	3	100
3	IT Skills for Chemists	3	100
<b>Physics Group</b>			

1	Thermal Physics and Statistical Mechanics (T)	4	100
2	Thermal Physics and Statistical Mechanics-Lab (P)	3	100
3	Physics Workshop Skills	3	100
<b>Computer Science</b>			
1	Android Programming (T+P)	6	100
2	Computer Networks (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Real Analysis	6	100
<b>Information Technology</b>			
1	Data Structure (T+P)	6	100
2	System Analysis & Design (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Anatomy and Embryology (T)	4	100
2	Plant Anatomy and Embryology Lab (P)	3	100
<b>Zoology</b>			
1	Physiology and Biochemistry (T)	4	100
2	Physiology and Biochemistry Lab (P)	3	100
<b>Micro-Biology</b>			
1	Microbial Growth & Reproduction (T+P)	6	100
2	Systemic Bacteriology (T+P)	6	100
3	Pathology and Microbiology (T+P)	6	100

<b>Fourth Semester</b>			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Business Entrepreneurship and Management	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics (T)	4	100
2	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Lab (P)	3	100
3	Basic Analytical Chemistry (T)	3	100
<b>Physics Group</b>			
1	Waves and Optics (T)	4	100
2	Waves and Optics Lab (P)	3	100
<b>Computer Science</b>			
1	Design and Analysis of Algorithms (T+P)	6	100
2	Database Management Systems (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Algebra	6	100
<b>Information Technology</b>			
1	Computer Organization (T+P)	6	100
2	Artificial Intelligence (T+P)	6	100



<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Physiology and Metabolism (T)	4	100
2	Plant Physiology and Metabolism Lab (P)	3	100
3	Biofertilizers	3	100
<b>Zoology</b>			
1	Genetics and Evolutionary Biology (T)	4	100
2	Genetics and Evolutionary Biology Lab (P)	3	100
<b>Micro-Biology</b>			
1	Enzymology (T+P)	6	100
2	Parasitology (T+P)	6	100
3	Microbial Biotechnology (T+P)	6	100

<b>Fifth Semester</b>			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Dissertation & Seminar	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Polymer Chemistry and Green Chemistry (T)	4	100
2	Polymer Chemistry and Green Chemistry Lab (P)	3	100
<b>Physics Group</b>			
1	Element of Modern Physics (T)	4	100
2	Element of Modern Physics Lab (P)	3	100
<b>Computer Science</b>			
1	Internet Technologies (T+P)	6	100
2	Theory of Computation (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Integral Calculus (T)	6	100
2	Matrix (T)	6	100
<b>Information Technology</b>			
1	Unix and Shell Programming (T+P)	6	100
2	Graph Theory (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Economic Botany and Biotechnology (T)	4	100
2	Economic Botany and Biotechnology Lab (P)	3	100
3	Herbal Technology (T)	3	100
<b>Zoology</b>			
1	Applied Zoology (T)	4	100
2	Applied Zoology Lab (P)	3	100
<b>Micro-Biology</b>			
1	Hematology & Blood Banking (T+P)	6	100
2	Lab Instruments and Ethics (T+P)	6	100
3	DNA Typing, Proteomics & Beyond (T+P)	6	100

<b>Sixth Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Project	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Quantum Chemistry, Spectroscopy & Photochemistry (T)	4	100
2	Quantum Chemistry, Spectroscopy & Photochemistry Lab (P)	3	100
<b>Physics Group</b>			
1	Solid State Physics (T)	4	100
2	Solid State Physics Lab (P)	3	100
3	Electrical Circuits and Network Skills (T)		
<b>Computer Science</b>			
1	Visual Basic (T+P)	6	100
2	Computer Graphics (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Linear Programming	6	100
<b>Information Technology</b>			
1	Multimedia Technology (T+P)	6	100
2	Web Technology (T+P)	6	100
3	Digital Image Processing (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Bioinformatics(T)	4	100
2	Bioinformatics Lab (P)	3	100
<b>Zoology</b>			
1	Insect, Vector and Diseases (T)	4	100
2	Insect, Vector and Diseases Lab (P)	3	100
3	Apiculture (T)	3	100
<b>Micro-Biology</b>			
1	Histopathology and Cytopathology Techniques (T+P)	6	100
2	Plant and Animal Tissue Culture Techniques and Applications (T+P)	6	100
3	Recombinant DNA Technology (T+P)	6	100

**20. Detailed syllabus: -**
**First Semester**

<b>First Semester</b>			
<ul style="list-style-type: none"> <li>Group – I is compulsory.</li> <li>Choose 3 Subjects from Group II, Group III and Group IV. One Subject may have multiple papers in a semester.</li> <li>Subjects chosen from Group II, Group III and Group IV will remain same in all semester.</li> </ul>			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	English	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons (T)	4	100
2	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons –Lab (P)	3	100
<b>Physics Group</b>			
1	Mechanics (T)	4	100
2	Mechanics Lab (P)	3	100
<b>Computer Science</b>			
1	Programming Fundamentals Using C++ (T+P)	6	100
2	Computer System Architecture (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Differential Calculus (T)	6	100
<b>Information Technology</b>			
1	Discrete Mathematics (T+P)	6	100
2	Basics of Internet (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Biodiversity (Microbes, Algae, Fungi and Archegoniate) (T)	4	100
2	Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab (P)	3	100
<b>Zoology</b>			
1	Animal Diversity (T)	4	100
2	Animal Diversity Lab (P)	3	100
<b>Micro-Biology</b>			
1	Anatomy and Physiology (T+P)	6	100
2	Fundamentals of Medical Laboratory Science (T+P)	6	100
3	Introductory Microbiology (T+P)	6	100

**Subject Name: ENGLISH**

**Unit 1: English Grammar**

- An Introduction to Part of Speech** : Verb, Tenses, Voice, Direct and Indirect Forms of Speech.
- Prepositions
- List of Appropriate Preposition Used
- Sentence

5. Synthesis of Sentences
6. Transformation of Sentences
7. Syntax
8. Punctuation
9. **Vocabulary** : Antonyms and Synonyms, Similar Words Distinguished, One Word Substitutions, More about words, Idioms & Phrases, Idioms.
10. **Common Error** : Some fundamental Rules for Correction, Sentences with error.
11. Comprehension

**Unit 2 : Composition**

1. Paragraph Writing
2. Letter writing
3. Essay Writing
4. The Essays

**Subject Name:** ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

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**Subject Name:** ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

**Section A: Inorganic Chemistry**

**Atomic Structure:** Review of: Bohr's theory and its limitations, Heisenberg Uncertainty principle.

Dual behaviour of matter and radiation, de-Broglie's relation. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of  $\psi$  and  $\psi^2$ , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers  $m_l$  and  $m_s$ . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number ( $s$ ) and magnetic spin quantum number ( $m_s$ ).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

**Chemical Bonding and Molecular Structure**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic

compounds. Statement of Born-Landé equation for calculation of lattice energy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H<sub>2</sub>O, NH<sub>3</sub>, PCl<sub>5</sub>, SF<sub>6</sub>, ClF<sub>3</sub>, SF<sub>4</sub>) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.

### **Section A: Inorganic Chemistry**

#### **Fundamentals of Organic Chemistry**

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Reaction intermediates: Carbocations, Carbanions and free radicals. Electrophiles and nucleophiles

Aromaticity: Benzenoids and Hückel's rule.

#### **Stereochemistry**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

#### **Aliphatic Hydrocarbons**

Functional group approach for the following reactions (preparations physical property & chemical reactions) to be studied with mechanism in context to their structure.

**Alkanes:** Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Grignard reagent. Reactions: Free radical Substitution: Halogenation.

**Alkenes:** Preparation: Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO<sub>4</sub>) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

**Alkynes:** Preparation: Acetylene from CaC<sub>2</sub> and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides and acidity of alkynes, addition of bromine and alkaline KMnO<sub>4</sub>, ozonolysis and oxidation with hot alk. KMnO<sub>4</sub>. Hydration to form carbonyl

#### **Reference Books:**

- J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.17
- F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
- Douglas, McDaniel and Alexander: Concepts and Models in Inorganic Chemistry, John Wiley.
- James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
- T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
- I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
- Atkins, Overton, Rourke, Weller, Armstrong, Shriver and Atkins Inorganic Chemistry, Oxford

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

**Section A:**

**Inorganic Chemistry - Volumetric Analysis**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
5. Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

**Section B:**

**Organic Chemistry**

1. Purification of OC by crystallisation (from water and alcohol) and distillation.
2. Criteria of purity: Determination of Mpt/Bpt
3. Detection of extra elements (N, S, Cl, Br, I) in organic compounds
4. Separation of mixtures by Chromatography: Measure the  $R_f$  value in each case (combination of two compounds to be given)
  - (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

**Reference Books:**

- Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
- Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
- Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
- Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960

**Subject Name:** MECHANICS

**Vectors:** Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

**Ordinary Differential Equations:** 1<sup>st</sup> order homogeneous differential equations. 2<sup>nd</sup> order homogeneous differential equations with constant coefficients.

**Laws of Motion:** Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

**Momentum and Energy:** Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

**Rotational Motion:** Angular velocity and angular momentum. Torque. Conservation of angular momentum.

**Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

**Elasticity:** Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia -  $q$ ,  $\eta$  and  $\lambda$  by Searles method

**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

**Reference Books:**

1. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. Engineering Mechanics, Basudeb Bhattacharya, 2<sup>nd</sup> edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

**Subject Name : MECHANICS-LAB**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine  $g$  by Bar Pendulum.
8. To determine  $g$  by Kater's Pendulum.
9. To determine  $g$  and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of  $g$

**Reference Books:**

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.

**Subject Name: PROGRAMMING FUNDAMENTALS USING C++**

1. OOP paradigm , Advantages of OOP , Comparison between Functional Programming and OOP approach, characteristics of Object oriented Language objects, Class, Inheritance, Polymorphism, and abstraction, encapsulation, Dynamic Binding, Message passing.
2. Introduction to C++, Identifier and keywords, constants, C++ Operators, Type Conversion, variable declaration, Statement, expressions, User defined data types, Conditional expression (For, While, Do-while) loop statement , breaking control statement (Break, Continue).
3. Defining a function, type of functions, Inline functions, Call by value and Call by reference, Preprocessor, Header files and standard functions, Structures, Pointers and structures, Unions, Enumeration. **Classes**, Member functions, Objects, Array of objects, Nested classes, Constructors, Copy Constructors, Destructors, Inline member functions, Static class member, friend functions, Dynamic memory allocation.
4. Inheritance: Single inheritance, Multi-level inheritance, hierarchical, Virtual base class, Abstracts classes, Constructors in Derived classes, nesting of classes.
5. Function overloading , Operator overloading, polymorphism, Early binding, Polymorphism with pointers, Virtual functions, Late binding , Pure virtual functions, Opening and closing of files, Stream member function , Binary file operations, Structure and file operations, classes and file operations, Random access file processing.

**Subject Name: COMPUTER SYSTEM ARCHITECTURE**

1. **Processor Organization:** General structure of CPU registers, Stack, operation of stack, ALU and control unit. Instruction format, mathematical operations, fixed point addition, multiplication or



- division. Principle of arrays and pipeline processors, principle of instruction decoding and implementation, hardware and micro-instruction based control unit.
2. **Design of Controller:** Identifying micro-instruction, minimizing micro-instruction, size, parallelism in micro instruction, encoding control instruction, timing cycle and clock generation, organization of micro-Programme based control unit.
  3. **Memory Organization:** Static memory, dynamic memory, memory hierarchies, memory refresh, paging concept of memory compaction, interleave memory and principle of address interleaving associative memory, memory segmentation, block address calculation, concept of cache memory.
  4. **Data Transfer Technique:** Various I/O devices, IOP, CPU configuration

**Subject Name:** DIFFERENTIAL CALCULUS

Limit and Continuity ( $\epsilon$  and  $\delta$  definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of  $\sin x$ ,  $\cos x$ ,  $e^x$ ,  $\log(1+x)$ ,  $(1+x)^m$ , Maxima and Minima, Indeterminate forms.

**Books Recommended**

- H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
- G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

**Subject Name:** BASICS OF INTERNET

**Unit-I**

**Internet Technology**

1. **Evolution & Protocols:** Internet Evolution, Protocols, Interface Concept, Internet V.s. Internet growth of internet ISP, Connectivity - dial up, leased line, VSAT etc. URLs. Domain names, Portals, Application E-mail File Transfer Protocol, Telnet, Chatting, Data Transmission Protocol, Client/Server, architecture and its characteristics, FTP and its Usages. Telnet Concepts, remote logging, protocols, terminal emulation, message board, Internet Chatting, Voice chat, Text chat.
2. **Web Concept:** World Wide Web, Web Publishing, HTML, Design tools, HTML edition, Image edition, Issue in website creation & maintenance FTP s/w for uploading Use of frames and forms in web pages.

**Unit-II**

**E-Commerce**

**Introduction to E-Commerce:** Introduction, Concept technology in E-Commerce, Internet business, Advantage of E-Commerce, Application, Feasibility and constrain.

**Subject Name:** BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

**Unit 1: Microbes**

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

**Unit 2: Algae**

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae.

**Unit 3: Fungi**

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

**Unit 4: Introduction to Archegoniate**

Unifying features of archegoniate, Transition to land habit, Alternation of generations.

**Unit 5: Bryophytes**

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of Sphagnum.

**Unit 6: Pteridophytes**

General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris. (Developmental details not to be included). Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

**Unit 7: Gymnosperms**

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus. (Developmental details not to be included). Ecological and economical importance.

**Subject Name:** BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIAE) LAB

**Practical**

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining & Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus\* and Polysiphonia through temporary.

**Subject Name:** ANIMAL DIVERSITY

**&**

**Subject Name:** ANIMAL DIVERSITY LAB

**Unit 1. Protista**

General characters of Protozoa; Life cycle of Plasmodium

**Unit 2. Porifera**

General characters and canal system in Porifera

**Unit 3. Radiata**

General characters of Cnidarians and polymorphism

**Unit 4. Aceolomates**

General characters of Helminthes; Life cycle of Taenia solium

**Unit 5. Pseudocoelomates**

General characters of Nemethelminthes; Parasitic adaptations

**Unit 6. Coelomate Protostomes**

General characters of Annelida ; Metamerism.

**Unit 7. Arthropoda**

General characters. Social life in insects.

**Unit 8. Mollusca**

General characters of mollusca; Pearl Formation

**Unit 9. Coelomate Deuterostomes**

General characters of Echinodermata, Water Vascular system in Starfish.

**Unit 10. Protochordata**

Salient features

**Unit 11. Pisces**

Osmoregulation, Migration of Fishes

**Unit 12. Amphibia**

General characters, Adaptations for terrestrial life, parental care in Amphibia.

**Unit 13.**

Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.

**Unit 14. Aves:**

The origin of birds; Flight adaptations

**Unit 15. Mammalia**

Early evolution of mammals; Primates; Dentition in mammals.

**PRACTICAL**

1. Study of following specimens:

Non Chordates: Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, , Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon. Chordates: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds- (Crow, duck, Owl), Squirrel and Bat.

2. Study of following Permanent Slides:

Cross section of Sycon, Sea anemone and Ascaris (male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.

3. Temporary mounts of

- Septal & pharyngeal nephridia of earthworm.
- Unstained mounts of Placoid, cycloid and ctenoid scales.

4. Dissections of

- Digestive and nervous system of Cockroach.
- Urinogenital system of Rat

**SUGGESTED BOOKS**

- Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
- Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.

- Kardong, K. V. (2002). *Vertebrates Comparative Anatomy. Function and Evolution*. Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H. and Johnson, G. B. (2004). *Biology*, 6th edition, Tata McGraw Hill Publications. New Delhi.

**Subject Name: ANATOMY AND PHYSIOLOGY**

1. The human body as a whole.
2. Blood, Cardio vascular system, Digestive system etc.
3. Definition of Forensic Medicine and Medical Jurisprudence.
4. Courts in India and their powers: Supreme Court, High Court, Sessions Court, Additional Sessions Court, Magistrate's Courts.
5. Court procedures: Summons, conduct money, oath, affirmation, perjury, types of witnesses, recording of evidence, conduct of doctor in witness box.
6. Medical certification and medico-legal reports including dying declaration.
7. Death: Definition, types; somatic, cellular and brain-death, Sudden natural and unnatural deaths, Suspended animation.
8. Changes after death: Immediate changes, cooling of body, lividity, rigor mortis, cadaveric spasm, cold stiffening and heat stiffening, Putrefaction, mummification, adipocere and maceration, Postmortem artifacts.
9. Inquest: Inquest by police, magistrate.
10. Identification of unknown person, dead bodies and remains of a person by age, sex, stature, dental examination, scars, moles, tattoos, dactylography, DNA typing and personal belonging including photographs.
11. Definition, classification of mechanical injuries; description of blunt force, sharp force and firearm injuries.
12. Sexual Offences: Virginity, rape, unnatural sexual offences; sexual perversions.

**Subject Name: FUNDAMENTALS OF MEDICAL LABORATORY SCIENCE**

**1. Introduction to Laboratory Sciences**

Historical development, Role of clinical laboratory science in health care, Role of clinical laboratory scientists, Structure of clinical laboratory services in Nepal, International and national organization in laboratory practice.

**2. Laboratory Safety Rules**

Laboratory hazard and accidents, Safe laboratory design and organization, Preventing laboratory infection, Pipetting and dispensing safety, Safe use and storage of chemical and reagent, WHO guide lines for clinical laboratory biosafety, Biological safety cabinet.

**3. Clinical Laboratory Organization**

Operational standard and management, Staffing, Element of the services, The Laboratory Manual or protocol accommodation, equipment, training, safety precautions, quality assurance, use of computer in clinical laboratory.

#### **4. The General Clinical Laboratories**

Introduction, purposes and practice in a) Microbiology, b) Pathology, c) Biochemistry, d) hematology and e) Blood bank laboratories.

#### **5. Research and Literature in Clinical Laboratory**

Medical Dictionaries, Merck Index, Indian Pharmacopoea (IP), British Pharmacopoea (BP), United States Pharmacopoea (USP), European Pharmacopoea (EP), Japanese Pharmacopoea (JP), Nepalese Formularies, General Medical Books, Journals, Original research articles, Review, Pubmed Database, Role of seminar and conference, Role of literature on research.

#### **Reference Books:**

1. Clinical Diagnosis and Management by Laboratory Methods. 20th Ed. John Bernard Henry M. D. W. B. Saunders Co. Philadelphia.
2. Mackie and McCartney, Practical Medical Microbiology, 14th Ed.
3. Monica Chees Brough: Medical Laboratory Manual for tropical countries, volume I, II.
4. WHO: Laboratory biosafety Manual.
5. Mapping the literature of Clinical Laboratory Science JMLA, 2003; July91 (3)303-3110(1999a).
6. A brief history of medical diagnosis and the birth of the clinical laboratory: Part 1. Ancient times through the 19th century. Medical Laboratory Observer (July), 28-40.
7. Berger, D. (1999b). A brief history of medical diagnosis and the birth of the clinical laboratory: part 2. Laboratory science and professional certification in the 20th century. Medical Laboratory Observer (August), 32-38.
8. Berger, D. (1999c). A brief history of medical diagnosis and the birth of the clinical laboratory Part Medicare, government regulation, and competency certification. Medical Laboratory Observer (October), 40- 44.
9. Berger, D. (1999d). A brief history of medical diagnosis and the birth of the clinical laboratory: Part 4. Fraud and abuse, managed care, and lab consolidation. Medical Laboratory Observer(December), 38-42.
10. Bailey and Scott's Diagnostic Microbiology, 9th edition.

**Subject Name:** INTRODUCTORY MICROBIOLOGY

#### **UNIT I**

Basic concepts – Spontaneous generation, Germ theory of diseases, Cell theory. Contributions of Antonie van leuwenhoek, Joseph Lister, Robert Koch, Louis Pasteur, Edward Jenner,

John Tyndall, Sergei N. Winogradsky, Selman A. Waksman, Alexander Flemming, Paul Erlich, Fannie Hesse, Elie Metchnikoff, Kary Mullis. Development of pure culture methods. Cell ultra-structure: Peptidoglycan structure and synthesis. Cytoplasmic matrix and components: Inclusion bodies.

#### **UNIT II**

Sterilisation and disinfection- Definitions, Principles. Methods of sterilization- Physical methods (Heat, Filtration), Radiation and Chemical methods. Control of sterilization and Testing of sterility. Microscopy – Principles, Light microscope, Phase Contrast, Dark field, Bright field, Fluorescent, Interference microscope (Stereo microscope), Confocal, Inverted microscope, and Electron microscope (TEM and SEM). Measurement of Microorganisms- Micrometry. Staining- Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining, Nuclear staining and Acid fast staining.

#### **UNIT III**

Microbiological media, composition and types: selective and differential media Growth curve and growth kinetics. Influence of environmental factors for microbial growth. Nutritional groups of bacteria: overview Estimation of Microbes- Direct Microscopic count, Turbidometric assay, TVC- Indirect Method- CO<sub>2</sub> liberation- Protein estimation- Maintenance and Preservation of cultures

#### **UNIT IV**

Taxonomy– Principle and its types (Classical approach– Numerical, Chemical, Serological and Genetic). Bacterial taxonomy– Bergey’s manual of Systematic Bacteriology (Eubacteria and Archaeobacterium).

#### **REFERENCES**

- Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
- Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
- Stainer R.Y. Ingraham J.L. Wheelis H.H and Painter P.R. 1986 The Microbial world, 5<sup>th</sup> edition. Eagle Works Cliffs N.J. Prentice Hall.

**Second Semester**

<b>Second Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Information Technology	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I (T)	4	100
2	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I Lab (P)	3	100
<b>Physics Group</b>			
1	Electricity, Magnetism and EMT	4	100
2	Electricity, Magnetism and EMT-Lab	3	100
<b>Computer Science</b>			
1	Programming in Java (T+P)	6	100
2	Discrete Structures (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Differential Equations	6	100
<b>Information Technology</b>			
1	Operating System (T+P)	6	100
2	Object Oriented Programming Using C++ (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Ecology and Taxonomy	4	100
2	Plant Ecology and Taxonomy Lab	3	100
<b>Zoology</b>			
1	Comparative Anatomy and Developmental Biology of Vertebrates	4	100
2	Comparative Anatomy and Developmental Biology of Vertebrates Lab	3	100
<b>Micro-Biology</b>			
1	Principles of Transmission Genetics (T+P)	6	100
2	Principles of Immunology (T+P)	6	100
3	Cell Structure & Dynamics (T+P)	6	100

**Subject Name: FUNDAMENTAL OF INFORMATION TECHNOLOGY**

- Information Concepts & Processing:** Definition of Information, Data VS Information, Introduction to Information System, Information Representation Digital Media, Images, Graphics, Animation, Audio, Video etc. Need a Value & Quality of Information the concept of Information entropy & Numerical.
- Computer Appreciation:** Definition of electronic Computer, History, Generation, Characteristics & Application of Computers, Classification of Computers, RAM, ROM, Computer Hardware, CPU, Various I/O Devices, Peripherals, Storage Media, Software Definition and Concepts.



- 3. Data Communication & Networks:** Computer Networks, Networking of Computers, Introduction to LAN, WAN, MAN, Network Topologies, Basic Concepts in Computer Networks, Introduction to GPRS, CDMA, GSM & FM Technologies.
- 4. Introduction to Internet Technologies:** HTML, DHTML, WWW, FTP, TELNET, Web Browser, Net Surfing, Search Engines, E-Mail, ISP, E-Commerce, Public Key, Private Key, Safety of Business Transaction on Web.
- 5. Concepts in Operating System:** Elementary Concepts in Operating System, GUI, Introduction to DOS, MS Windows.

**Subject Name:** CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I  
&

**Subject Name:** CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL GROUP ORGANIC CHEMISTRY-I  
LAB

### **Section A: Physical Chemistry-1**

#### **Chemical Energetics**

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

**Chemical Equilibrium:** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between  $G$  and  $G_0$ , Le Chatelier's principle. Relationships between  $K_p$ ,  $K_c$  and  $K_x$  for reactions involving ideal gases.

**Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

### **Section B: Organic Chemistry-2**

Functional group approach for the following reactions (preparations physical properties and Chemical reactions) to be studied in context to their structure with mechanism.

#### **Aromatic hydrocarbons**

Preparation (benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (benzene): Electrophilic substitution reactions: nitration, halogenation sulphonation. Friedel-Craft's reaction (alkylation and acylation) Side chain oxidation of alkyl benzenes.

### **Alkyl and Aryl Halides**

#### **Alkyl Halides**

Preparation: from alkenes and alcohols.

Reactions: Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions, hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

**Aryl Halides** Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic electrophilic and nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism:  $\text{KNH}_2/\text{NH}_3$  (or  $\text{NaNH}_2/\text{NH}_3$ ).

Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards Nucleophilic substitution reactions.

#### **Alcohols, Phenols and Ethers**

**Alcohols:** Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk.  $\text{KMnO}_4$ , acidic dichromate, conc.  $\text{HNO}_3$ ), factors affecting acidity, Oppeneauer oxidation

Diols: oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. acidity and factors affecting

#### **Ethers (aliphatic and aromatic).**

**Preparation** : Williamson ether synthesis.

**Reactions:** Cleavage of ethers with HI

#### **Aldehydes and ketones (aliphatic and aromatic):**

Preparation: from acid chlorides and from nitriles.

Reactions – Nucleophilic addition, Nucleophilic addition – elimination reaction including Reaction with HCN, ROH,  $\text{NaHSO}_3$ ,  $\text{NH}_2\text{-G}$  derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

#### **Reference Books:**

- T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.

- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.
- G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007).
- G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
- J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
- B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
- R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

CHEMISTRY LAB: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

**Section A:**

**Physical Chemistry**

**Thermochemistry**

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO<sub>3</sub>, NH<sub>4</sub>Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of H.

**Ionic equilibria pH measurements**

- a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
- b) Preparation of buffer solutions:
  - (i) Sodium acetate-acetic acid
  - (ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

**Section B: Organic Chemistry**

1. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
  - (a) Bromination of Phenol/Aniline
  - (b) Benzoylation of amines/phenols
  - (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone
2. Systematic Qualitative organic analyses of organic compounds possessing monofunctional groups (Alcohols, Phenols, Carbonyl, -COOH) and preparation of one suitable derivative.

**Reference Books:**

- A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
- F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

**Subject Name:** ELECTRICITY, MAGNETISM AND EMT

**Vector Analysis:** Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

**Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

**Magnetism:**

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

**Maxwell's equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

**Reference Books:**

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings

**Subject Name:** ELECTRICITY, MAGNETISM AND EMT-LAB

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
  - (i) Measurement of charge and current sensitivity
  - (ii) Measurement of CDR
  - (iii) Determine a high resistance by Leakage Method
  - (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its
  - (a) Anti-resonant frequency and
  - (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem

**Reference Books**

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers

**Subject Name:** Programming in Java

1. Internet
2. Object Oriented Programming
3. Introduction to Java
4. Java Fundamentals

5. Java Programming
6. Data Types, Variables and Operators
7. Classes and Objects
8. Exploring Methods and Inheritance
9. Packages and Interface
10. String, Array and Vector
11. Java Language Support and Utility Package
12. File Handling
13. Graphics
14. Networking
15. Remote Method Invocation (RMI)
16. Java Beans
17. HTML and Java Script

**Subject Name: DISCRETE STRUCTURE**

- **Logic:** propositional logic, logical equivalence, predicates & quantifiers, and logical reasoning.
- **Sets:** basics, set operations
- **Functions:** one-to-one, onto, inverse, composition, graphs
- **Integers:** greatest common divisor, Euclidean algorithm.
- Sequences and Summations
- **Mathematical reasoning and induction:** Proof strategies, Mathematical Induction, Recursive definitions, Structural Induction
- **Counting:** basic rules, Pigeonhole principle, Permutations and Combinations, Binomial coefficients and Pascal triangle.
- **Probability:** Discrete probability. Expected values and variance
- **Relations:** Properties, Combining relations, Closures, Equivalence, Partial ordering
- **Graphs:** directed, undirected graphs.

**Subject Name: DIFFERENTIAL EQUATIONS**

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

**Books Recommended**

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967

**Subject Name: - OPERATING SYSTEMS**

1. **Operating System Overview:** Introduction, Objectives and functions, Basic Elements, Evolution of Operating System, Instruction Execution, Interrupts, Memory, Memory Hierarchy, System Components, Operating system Services, System Calls, Virtual Machines, System Design and Implementation.
2. **Process Concepts:** Introduction, Process States, Process Control Block (PCB), Process Scheduling, Co-operating Processes, Threads, Inter Process Communications (IPC).
3. **CPU Scheduling:** Scheduling Criteria, Types of Scheduling, Scheduling Algorithms, Multiple-processor Scheduling, Real-time Scheduling, Disk-Scheduling Policies.
4. **Memory Management:** Introduction, Memory –management Requirements, Logical and Physical Address Space, Swapping, Loading Programs into main memory, Paging, Page Replacement Algorithms, Allocation Of Frames, Translation Look Aside Buffer (TLB), Simple Segmentation with Paging, page Size, Thrashing.
5. **File System:** Introduction, File Organization and Access Methods, Directory Structure, Protection, Security Threats, Intruders, Viruses, File-System Structure, File Allocation Methods, Free-Space Management, Directory Management, Efficiency and Performance of Secondary Storage.
6. **Deadlocks:** Introduction, Principles, Principles Of Deadlocks, System Model, Deadlock Characterization, Resource- allocation Graphs, Methods For Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection on, Recovery from Deadlock.
7. **Process Management and Synchronization:** Introduction, Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions, Monitors, Message Passing.

**Subject Name: OBJECT ORIENTED PROGRAMMING USING C++**

1. OOP paradigm , Advantages of OOP , Comparison between Functional Programming and OOP approach, characteristics of Object oriented Language objects, Class, Inheritance, Polymorphism, and abstraction, encapsulation, Dynamic Binding, Message passing.
2. Introduction to C++, Identifier and keywords, constants, C++ Operators, Type Conversion, variable declaration, Statement, expressions, User defined data types, Conditional expression (For, While, Do-while) loop statement , breaking control statement (Break, Continue).
3. Defining a function, type of functions, Inline functions, Call by value and Call by reference, Preprocessor, Header files and standard functions, Structures, Pointers and structures, Unions, Enumeration. **Classes**, Member functions, Objects, Array of objects, Nested classes, Constructors, Copy Constructors, Destructors, Inline member functions, Static class member, friend functions, Dynamic memory allocation.

4. Inheritance: Single inheritance, Multi-level inheritance, hierarchical, Virtual base class, Abstracts classes, Constructors in Derived classes, nesting of classes.
5. Function overloading , Operator overloading, polymorphism, Early binding, Polymorphism with pointers, Virtual functions, Late binding , Pure virtual functions, Opening and closing of files, Stream member function , Binary file operations, Structure and file operations, classes and file operations, Random access file processing.

**Subject Name:** PLANT ECOLOGY AND TAXONOMY

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**Subject Name:** PLANT ECOLOGY AND TAXONOMY LAB

**Unit 1: Introduction**

**Unit 2: Ecological factors**

**Soil:** Origin, formation, composition, soil profile. **Water:** States of water in the environment, precipitation types. **Light and temperature:** Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes

**Unit 3: Plant communities**

Characters; Ecotone and edge effect; Succession; Processes and types

**Unit 4: Ecosystem**

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

**Unit 5: Phytogeography**

Principle biogeographical zones; Endemism

**Unit 6 Introduction to plant taxonomy**

Identification, Classification, Nomenclature.

**Unit 7 Identification**

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

**Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.**

**Unit 9 Taxonomic hierarchy**

Ranks, categories and taxonomic groups

**Unit 10 Botanical nomenclature**

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.



### **Unit 11 Classification**

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

### **Unit 12 Biometrics, numerical taxonomy and cladistics**

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

### **Practical**

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).  
(b) Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law 45
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae - Brassica, Alyssum / Iberis; Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax; Solanaceae - Solanum nigrum, Withania; Lamiaceae - Salvia, Ocimum; Liliaceae - Asphodelus / Lilium / Allium.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

### **Suggested Readings**

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition

**Subject Name:** COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

**&**

**Subject Name:** COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES LAB

**Unit 1: Integumentary System**

Derivatives of integument w.r.t. glands and digital tips

**Unit 2: Skeletal System**

Evolution of visceral arches

**Unit 3: Digestive System**

Brief account of alimentary canal and digestive glands

**Unit 4: Respiratory System**

Brief account of Gills, lungs, air sacs and swim bladder

**Unit 5: Circulatory System**

Evolution of heart and aortic arches

**Unit 6: Urinogenital System**

Succession of kidney, Evolution of urinogenital ducts

**Unit 7: Nervous System**

Comparative account of brain

**Unit 8: Sense Organs**

Types of receptors

**Unit 9: Early Embryonic Development**

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

**Unit 10: Late Embryonic Development**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

**Unit 11: Control of Development**

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

**PRACTICAL**

1. Osteology:

- a) Disarticulated skeleton of fowl and rabbit
- b) Carapace and plastron of turtle /tortoise
- c) Mammalian skulls: One herbivorous and one carnivorous animal.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

#### **SUGGESTED READINGS**

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
- Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
- Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

#### **Subject Name: PRINCIPLES OF TRANSMISSION GENETICS**

1. **Science of Genetics** – an overview of modern history of Genetics before 1860, 1860-1900, 1900-1944, 1944-Present, about 3 general areas of Genetics (Classical, Molecular & Evolutionary).
2. **Mendelism & Chromosome Theory** – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial).
3. **Extension of Mendelism** – Deviation from Mendel's Dihybrid phenotype, Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson & Punnett's Coupling & Repulsion hypothesis.
4. **Linkage & Crossing over** - Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

5. **Allelic Variation & Gene function** – Multiple allele, Genetic interaction, Epistatic interactions, Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.
6. **Non-Mendelian inheritance** – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), non-chromosomal inheritance, maternal inheritance, uniparental inheritance.
7. **Chromosomal variation in Number & Structure** – Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants, Aneuploidy in Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution.
8. **Chromosome Mapping** - Haploid mapping (2 point & 3 point cross), Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.
9. **Human Cyto-Genetics** – Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in Medical science, Chromosomal abnormalities in spontaneous abortions, viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, Genomic position effects on Gene expression.
10. **Pedigree analysis** – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.
11. **Formulating & Testing Genetic Hypothesis** – problems of Sex-linkage, problems of genes with Multiple alleles, problems of gene interactions, Chi-square, t-test.

**Subject Name:** PRINCIPLES OF IMMUNOLOGY

1. **Immune Response** - an overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.
2. **Regulation of immunoglobulin gene expression** – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity, alternate pathways of transcript splicing, variable joining sites & somatic mutation, role of antibody (alone, in complement activation & with effector cells), monoclonal antibodies.
3. **Major Histocompatibility complexes** – class I & class II MHC antigens, antigen processing.
4. **Immunity to infection** – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms.
5. **Immuno-techniques** - Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA.
6. **Vaccines & Vaccination** – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of

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

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

**Subject Name:** CELL STRUCTURE & DYNAMICS

1. **Origin of life on Earth** - The theory of Extraterrestrial contact - import of life through meteorites. Theory of Chemical Evolution, Primitive Earth Conditions - anoxic reductive atmosphere, relatively high temperature, Volcanic eruption, radioactivity, high frequency UV radiation. Abiotic formation of sugars, amino acids, organic acids, purines, pyrimidines, glycerol and formation of nucleotides and their polymerization to RNA on reactive Surfaces, polymerization of amino acids to Polypeptides and Proteins. Ribozymes and RNA World. Formation of DNA, Formation of nucleoproteins, Prions, Natural Selection of Self replicating Polymers.
2. **Basics of Cell Biology (structure & function)** – Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and microbodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells.
3. **Biogenesis of Cellular organelles** – Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.
4. **Structure and function of Prokaryotic cell & its components** - The Slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of Gram-negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores, exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocysts and akinets of Cyanobacteria, Gliding and motility.
5. **Membrane structure & transport** – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport
6. **Cell cycle** - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant.

### Third Semester

Third Semester			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Environmental Science	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II (T)	4	100
2	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II Lab (P)	3	100
3	IT Skills for Chemists	3	100
<b>Physics Group</b>			
1	Thermal Physics and Statistical Mechanics (T)	4	100
2	Thermal Physics and Statistical Mechanics-Lab (P)	3	100
3	Physics Workshop Skills	3	100
<b>Computer Science</b>			
1	Android Programming (T+P)	6	100
2	Computer Networks (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Real Analysis	6	100
<b>Information Technology</b>			
1	Data Structure (T+P)	6	100
2	System Analysis & Design (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Anatomy and Embryology (T)	4	100
2	Plant Anatomy and Embryology Lab (P)	3	100
<b>Zoology</b>			
1	Physiology and Biochemistry (T)	4	100
2	Physiology and Biochemistry Lab (P)	3	100
<b>Micro-Biology</b>			
1	Microbial Growth & Reproduction (T+P)	6	100
2	Systemic Bacteriology (T+P)	6	100
3	Pathology and Microbiology (T+P)	6	100

**Subject Name:** FUNDAMENTAL OF ENVIRONMENTAL SCIENCE

**Unit 1:** The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

**Natural Resources:** Renewable and non-renewable resources:

Natural resources and associated problems

- a) Forest resources: Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

- b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
- c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.
- f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

### **Unit 2: Ecosystems:**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession. - Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem:
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

### **Biodiversity and its Conservation**

- a. Introduction-Definition: genetic, species and ecosystem diversity.
- b. Biogeographical classification of India.
- c. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- d. Biodiversity at global, National and local levels.
- e. India as a mega-diversity nation.
- f. Hot-spots of biodiversity.
- g. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- h. Endangered and endemic species of India.
- i. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **Unit 3: Environmental Pollution:**

- Causes, effects and control measures of: -

- a. Air pollution
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

#### **Social Issues and the Environment**

- From Unsustainable to Sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act. - Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

#### **Unit 4: Human Population and the Environment**

- Population growth, variation among nations.
- Population explosion-Family welfare Programme.
- Environment and human health.
- Human Rights.



- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of information Technology in Environment and human health.
- Case Studies.

**Unit 5: Field Work (Practical)**

- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

**Subject Name:** SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II

**&**

**Subject Name:** SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II LAB

**Section A: Physical Chemistry-2**

**Solutions**

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

**Phase Equilibrium**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-componentsystems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (leadsilver, FeCl<sub>3</sub>-H<sub>2</sub>O and Na-K only).

**Conductance**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of

ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

### **Electrochemistry**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

### **Section B: Organic Chemistry-3**

Functional group approach for the following reactions (preparations Physical Property & Chemicals reactions) to be studied in context to their structure with mechanism.

#### **Carboxylic acids and their derivatives**

Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters.

Reactions: Hell – Vohlard - Zelinsky Reaction, Acidity of carboxylic acid, effect of substitution on acid strength.

#### **Carboxylic acid derivatives (aliphatic):**

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion claisen condensation.

Reactions: Relative reactivities of acid derivatives towards nucleophiles, Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic):

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, reaction with HNO<sub>2</sub>, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation basic character of amines.

#### **Diazonium salts:**

Preparation: from aromatic amines.

Reactions: conversion to benzene, phenol, dyes.

#### **Amino Acids, Peptides and Proteins:**

Zwitterion, Isoelectric point and Electrophoresis

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis.

Reactions of Amino acids: ester of  $-\text{COOH}$  group, acetylation of  $-\text{NH}_2$  group, complexation with  $\text{Cu}^{2+}$  ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Determination of Primary structure of Peptides by degradation Edmann degradation (N- terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C- activating groups and Merrifield solid-phase synthesis.

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

**Reference Books:**

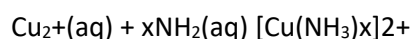
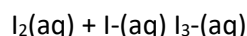
- G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007).
- G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).
- J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009). •B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998).
- R. H. Petrucci, General Chemistry, 5th Edn., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
- Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman

CHEMISTRY LAB: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & BIOMOLECULES

**Section A: Physical Chemistry**

**Distribution**

Study of the equilibrium of one of the following reactions by the distribution method:



**Phase equilibria**

- a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
- b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
- c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

**Conductance**

- I. Determination of cell constant
- II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base

**Potentiometry** Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Potassium dichromate vs. Mohr's salt

**Section B: Organic Chemistry**

**I** Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (amide, nitro, amines, Hydrocarbons, Halo Hydrocarbons) and preparation of one derivative.

**II**

1. Determination of the concentration of glycine solution by formylation method
2. Action of salivary amylase on starch
3. Differentiation between a reducing and nonreducing sugar

**Reference Books:**

- A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
- F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
- B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

**Subject Name:** IT SKILLS FOR CHEMISTS

**Computer programming**

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

BASIC programs for curve fitting, numerical differentiation and integration (Trapezoidal rule, Simpson's rule), finding roots (quadratic formula, iterative, Newton-Raphson method).

### **HANDS ON**

**Introductory writing activities:** Introduction to word processor and structure drawing (ChemSketch) software. Incorporating chemical structures, chemical equations, expressions from chemistry (e.g. Maxwell-Boltzmann distribution law, Bragg's law, van der Waals equation, etc.) into word processing documents.

**Handling numeric data:** Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck's distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell-Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations.

**Numeric modelling:** Simulation of pH metric titration curves. Excel functions LINEST and Least Squares. Numerical curve fitting, linear regression (rate constants from concentration- time data, molar extinction coefficients from absorbance data), numerical differentiation (e.g. handling data from potentiometric and pH metric titrations, pKa of weak acid), integration (e.g. entropy/enthalpy change from heat capacity data).

**Statistical analysis:** Gaussian distribution and Errors in measurements and their effect on data sets. Descriptive statistics using Excel. Statistical significance testing: The t test. The Ftest.

**Presentation:** Presentation graphics

### **Reference Books:**

- McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
- Mortimer, R. Mathematics for Physical Chemistry. 3 Ed. Elsevier (2005).
- Steiner, E. The Chemical Maths Book Oxford University Press (1996).
- Yates, P. Chemical calculations. 2 Ed. CRC Press (2007).
- Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).

- Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

**Subject Name:** THERMAL PHYSICS AND STATISTICAL MECHANICS

**Laws of Thermodynamics:**

**Thermodynamic Description of system:** Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero

**Thermodynamic Potentials:** Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for  $(CP - CV)$ ,  $CP/CV$ ,  $TdS$  equations.

**Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

**Statistical Mechanics:** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

**Reference Books:**

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications

**Subject Name:** THERMAL PHYSICS AND STATISTICAL MECHANICS- LAB

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.

2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

**Reference Books:**

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

**Subject Name:** PHYSICS WORKSHOP SKILLS

**Introduction:** Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

**Mechanical Skill:** Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothing of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

**Electrical and Electronic Skill:** Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

**Introduction to prime movers:** Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

**Reference Books:**

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.

- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

**Subject Name:** ANDROID PROGRAMMING

**Basic of Android Programming:** Introduction to Android OS, Setting up the Android Application Development Environment, Creating, Testing and Debugging Applications, Android Stack, Android applications structure, Activity life cycle, Understanding implicit and explicit intents

**User Interface in Android:** Adaptive and responsive user interfaces, User Input Controls, Menus, Screen Navigation, RecyclerView, Drawables, Themes and Styles, Fragments Fragment Life Cycle, Introduction to Material Design, Testing the user interface

**Background tasks:** AsyncTask, AsyncTaskLoader, Connecting App to Internet, Broadcast receivers, Services, Notifications, Alarm managers.

**Sensor, Location and Maps:** Sensor Basic, Motion and Position Sensors, Location services, Google maps API, Google Places API

**Working with data in Android:** Shared Preferences, App Setting, SQLite primer, Store data using SQLite database, Content Providers, Content Resolver, Loader

**Performance Improvement of App:** Performance Parameters, Profiling Tools, Rendering and Layout, Garbage Collection and Memory Leaks, Best Practices

**Publishing Your App:** Preparing for publishing, Signing and preparing the graphics, Publishing to the Android Market

**References:**

1. Android: A Programming Guide by J.F. DiMarzio
2. Hello, Android: Introducing Google's Mobile Development Platform by Ed Burnett
3. Programming android by Zigurd Mednieks
4. Android User Interface Design: Turning Ideas and Sketches into Beautifully Designed Apps by Ian G. Clifton
5. Android Developer Fundamental Course by Google.
6. Advance Android Developer Course by Google.

**Subject Name:** Computer Network

1. **Introduction to Computer Networks:** Introduction, User of Networks: Goals and applications, OSI Reference Model, Novell Netware, ARPANET, NSFNET, The Internet.



2. **The Physical Layer:** Transmission media, Twisted Pair, Baseband and Broadband Coaxial Cable, Fiber Optics, Wireless Transmission, Radio Transmission, Microwave Transmission, Infrared Transmission, Light Wave Transmission, ISDN Services, Virtual Circuits versus Circuit Switching, Transmission in ATM Network, Paging System, Cordless Telephone, Cellular Telephone, and Communication Satellite.
3. **The Data Link Layer:** The data link Layer, Framing , Error Control, Flow- Control, Error Detection and Correction Protocols, Simplex Stop and Wait Protocols, One Bit sliding Window, Using Go-Back n, the Data link layer in the internet.
4. **The Medium Access Sub – Layer:** The Medium Access Sub Layer , Framing Static and Dynamic Channel Allocation in LAN and MANs ,IEEE standard 802.3 and Ethernet, IEEE standard 802.4 and Token Bus, IEEE 802.4 and Token Ring; Bridges, Bridges form 802x to 802y, Transparent Bridges, Source Routing Bridges.
5. **The Network Layer:** The network layer , network layer Design Issues, shortest Path routing, Flooding, Flow Based Routing , Broadcast Routing, Congestion Control and Prevention Policies, Internet Working, Connectionless Internet Working , Tunneling Internet Work Routing, Fragmentation, Firewalls, IP Address Internet Control Protocols.
6. **The Transportation Layer:** The transportation Layer, The Transport Service, Transport Protocols, Addressing,, Establishing a Connection, Releasing a Connection, The Internet Transport Protocols, TCP.
7. **The Application Layer:** The Application layer, Network Security, Electronic mail, working of e-mail.

**Subject Name:** REAL ANALYSIS

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of  $\mathbb{R}$ , Archimedean property of  $\mathbb{R}$ , intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

**Books Recommended**

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.

**Subject Name: DATA STRUCTURE**

**Unit-I Basic Concepts**

1. Fundamental: Data Structures, Algorithms and various types of applications.
2. Basic Data Types: Stack, Lists and recursion.

**Unit-II Trees & Sets**

1. Trees: Definition and implementation of binary tree, tree traversal, postfix, prefix notations, heap.
2. Sets: Definition and Implementation of hash table, priority queues.

**Unit-III Algorithms & File Structure**

1. Sorting Algorithms : Quick sort, insertion sort, Bubble sort, merge sort
2. Searching Algorithms: Linear search, Binary search, depth first search and Breadth first search techniques.
3. File Structure: Sequential, Index Sequential file Structure.

**Subject Name: SYSTEM ANALYSIS & DESIGN**

1. **System Definition and Concepts:** General Theory systems, Manual and automated systems, Real-life business Sub - Systems. System environment and boundaries. Real - time and distributed systems. Basic principles of successful systems. Approach to system development: Structure system analysis and design, Prototype, Joint application development.
2. **System Analyst:** Role and need of system analyst. Qualifications and responsibilities. System analysis as a profession.
3. **System Development Cycle:** Introduction to Systems Development Life cycle (SDLS). Various phases of SDLS: Study, Analysis, Design, Development, Implementation, Maintenance.
4. **Systems documentation consideration:** Principles of systems documentation, types of documentation and their importance, enforcing documentation discipline in an organization.
5. **System Planning:** Data and fact gathering techniques: Interviews, group Communication - questionnaires, Presentations and visits. Assessing project feasibility: Technical, Operational, Economic, Cost benefits analysis, Schedule, Legal and contractual, Political. Modern methods for determining system requirement: joint application, Development program, prototyping, Business Process re-engineering. System selection plan and proposal.
6. **Modular and Structured Design:** module specifications. Top-down and bottom-up design. Module coupling and cohesion. Structure charts.
7. **System Design and Modeling :** Process modeling , Logical and Physical design Conceptual Data modeling Entity- relationship analysis, Entity -relationship modeling, ERDs and DFDs, Concepts of normalization. Process description: Structured English, Decision tree, Decision tables. Documentation: Data dictionary, Recording data
8. **Input and Output:** Classification of forms, Input/output forms design. User-interface design, Graphical interfaces. Standards and guideline for GUI design. Designing physical files and

databases: Designing field, Designing physical record, Designing Physical files, Designing database. Introduction to CASE tools, Feature, Advantages and Limitations of CASE tools, Awareness about some commercial CASE tools.

9. **System Implementation and Maintenance:** Planning consideration Conversion methods, Procedures and Controls. System acceptance criteria. System evaluation and performance. Testing and Validation. Preparing user manual .Maintenance activities and issues.
10. **Computer System Audit and Security:** Audit of Computer system usage. Types of threats to computer system control measures: Threat and risk analysis, Disaster recovery and contingency planning, viruses.
11. **OO Analysis/ Design:** Introduction to UML OO development life cycle and modeling .Static and dynamic modeling. Comparison of OO and module-oriented approach. Modeling using UML.
12. **Introduction to Management Information System (MIS):** Meaning and role of MIS. System approach to MIS. Types of information systems: Transaction processing system, Management information system Decision support system, Expert system case studies (Illustrative): MIS for accounting and function, MIS for marketing system.

**Subject Name:** PLANT ANATOMY AND EMBRYOLOGY

**&**

**Subject Name:** PLANT ANATOMY AND EMBRYOLOGY PRACTICAL

**Unit 1: Meristematic and permanent tissues**

Root and shoot apical meristems; Simple and complex tissues

**Unit 2: Organs**

Structure of dicot and monocot root stem and leaf.

**Unit 3: Secondary Growth**

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)

**Unit 4: Adaptive and protective systems**

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

**Unit 5: Structural organization of flower**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

**Unit 6: Pollination and fertilization**

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

**Unit 7: Embryo and endosperm**

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship

**Unit 8: Apomixis and polyembryony**

Definition, types and Practical applications

**Practical**

1. Study of meristems through permanent slides and photographs. 2
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent lides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent lides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent lides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

**Suggested Readings**

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA

**Subject Name:** PHYSIOLOGY AND BIOCHEMISTRY

**&**

**Subject Name:** PHYSIOLOGY AND BIOCHEMISTRY LAB

**Unit 1: Nerve and muscle**

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

**Unit 2: Digestion**

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

**Unit 3: Respiration**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

**Unit 4: Excretion**

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

**Unit 5: Cardiovascular system**

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

**Unit 6: Reproduction and Endocrine Glands**

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

**Unit 7: Carbohydrate Metabolism**

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

**Unit 8: Lipid Metabolism**

Biosynthesis and  $\beta$  oxidation of palmitic acid

**Unit 9: Protein metabolism**

Transamination, Deamination and Urea Cycle

**Unit 10: Enzymes**

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

**PRACTICAL**

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions

**SUGGESTED READINGS**

- Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill

- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

**Subject Name:** MICROBIAL GROWTH & REPRODUCTION

1. **Basic concepts of Microbes** : General characteristics and functions of Microbes, Physical and Chemical Structures of different Microbes, Importance of Cell shape cell size in rods and cocci, septum formation, cell elongation, brief outline of Microbial cell wall synthesis and cell separation, Bacterial Sporulation - Endospore formation in Bacillus, Occurrence of Ca-dipicolinate (DPA) and soluble Proteins (SASP), Spore germination
2. Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetics, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure and nutrient concentration per cell.
3. Microbial Reproduction : Different modes of Microbial DNA replication, Mechanism of DNA replication – rolling circle model & Theta structure-Bidirectional replication, Fats proteins, Divisomes, MreB Proteins, Impairment of proof reading in mutants, Mutant genes in bacteria, mutation frequency, Rate of mutation, Repair of UV-damage, Photoreactivation, Excision repair, SOS response.
4. Sexuality and bacterial recombination - Rarity in Bacteria, Male and femaleness in bacteria (F+, F' and Hfr), Plasmids and pilus mediated transfer of genes in the conjugation process in E.coli, Homologous Recombination, Site specific Recombination (Holliday model).

**Subject Name:** SYSTEMIC BACTERIOLOGY

**THEORY**

Staphylococcus, Streptococcus, Pneumococcus, Neisseria gonorrhoea, Neisseria meningitis, Corynebacterium diphtheriae, Mycobacterium, Clostridium, E.coli, H. pylori, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio & Spirochaetes with reference to their :

- Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis.

**PRACTICAL**

1. Culture techniques
2. Culture media
3. Preparation of media

4. Identification of media & their uses
5. Culture methods & identification of common bacteria on media.
6. Antibiotic sensitivity testing.

**Subject Name:** PATHOLOGY & MICROBIOLOGY

1. General characters and classification of Bacteria.
2. Characteristics of Bacteria.
3. Growth and Maintenance of Microbes.
4. Sterilization and Disinfection.
5. Culture Media.
6. Staining Methods.
7. Collection and Transportation of Specimen.
8. Care and Handling of Laboratory Animals.
9. Disposal of Laboratory/Hospital Waste.
10. Cell Injury and Cellular Adaptations.
11. Inflammation.
12. Haemodynamic Disorders.
13. Neoplasia.
14. Healing.

### Fourth Semester

<b>Fourth Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Foundation Course in Business Entrepreneurship and Management	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics (T)	4	100
2	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Lab (P)	3	100
3	Basic Analytical Chemistry (T)	3	100
<b>Physics Group</b>			
1	Waves and Optics (T)	4	100
2	Waves and Optics Lab (P)	3	100
<b>Computer Science</b>			
1	Design and Analysis of Algorithms (T+P)	6	100
2	Database Management Systems (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Algebra	6	100
<b>Information Technology</b>			
1	Computer Organization (T+P)	6	100
2	Artificial Intelligence (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Plant Physiology and Metabolism (T)	4	100
2	Plant Physiology and Metabolism Lab (P)	3	100
3	Biofertilizers	3	100
<b>Zoology</b>			
1	Genetics and Evolutionary Biology (T)	4	100
2	Genetics and Evolutionary Biology Lab (P)	3	100
<b>Micro-Biology</b>			
1	Enzymology (T+P)	6	100
2	Parasitology (T+P)	6	100
3	Microbial Biotechnology (T+P)	6	100

**Subject Name:** FOUNDATION COURSE IN BUSINESS ENTREPRENEURSHIP AND MANAGEMENT

1. Entrepreneurship:
  - a. Definition, basic concept, need, scope and characteristics of entrepreneurship.
  - b. Women entrepreneurship.
  - c. Assistance to small scale enterprises from national level organization like SIDO, NSIC, NRDC, m KVIC
  - d. Assistance to small scale enterprises from State level organization like DOI, DIG; RFC, SISIK RHDC, Pollution Control Board, Rajasthan Khadi &



- e. Facilities to women entrepreneurs.
  2. Emerging Areas in Entrepreneurship:
    - a. Innovation & Creativity
    - b. Introduction to Intellectual Property Rights (IPRs) & Patents
    - c. National Knowledge Commission:: basic concept, need & scope
    - d. Service sector: scope & future trends
    - e. Energy & Auditing
  3. Project formulation Process:
    - a. Steps in planning a small scale enterprise,
    - b. Structure of project report,
    - c. Analysis of sample, project reports
    - d. Preparation of project reports,
    - e. Techno-economic & Feasibility of the project.
  4. Financial Sources for SSI Loan:
    - a. State Govt. RFC, Credit facilities by banks.
  5. Roles & Regulation:
    - a. Licensing & registration procedure .
    - b. Important provision of Factory, Act.
    - c. Shop & Commercial Establishment Act.
    - d. Sales of Goods Act.
    - e. Partnerships Act.
    - f. Value Added Tax (VAT)
    - g. Service Tax
    - h. Professional Tax
    - i. Income Tax,
    - j. Sales tax & Excise rules
    - k. Municipal bye laws & insurance coverage.
  6. Meaning and Scope of Business:
    - a. Definition of profession, trade and Industry.
    - b. Objective of business and profession.
    - c. Types of Business Organization:
    - d. Brief description, advantage and disadvantages of individual-partnership cooperative private and public limited organizations,
    - e. Characteristics of small business ethics, organization charts.
- Entrepreneurial Awareness Camp:  
Topics to be covered in the camp:
1. Who is an entrepreneur?
  2. Need for entrepreneurship, entrepreneurial career and wage employment.
  3. Scenario of development of small scale enterprises in India.
  4. Entrepreneurial history in India, Indian values and entrepreneurship.
  5. Assistance from District Industries Center. Commercial banks. State Financial Corporation. Small Industries Service Institutes. Research and Development laboratories & other financial and development corporations.

6. Considerations for product selection.
7. Opportunities for business, service & entrepreneurship ventures.
8. Learning from Indian experiences in entrepreneurship (Interaction with successful entrepreneurs should be arranged).

**Reference Books:**

1. Hand Book of Small Scale Industry - P.M. Bhandari
2. Hand Book on Entrepreneurship Development - O/O. Harkut
3. Entrepreneurial Development - S.S. Khanka
4. Statistical Quality Control - Manohar Mahajan
5. Management of Small Scale Industries - 3rd, Himalaya, Bombay, 1986
6. The Story of an Entrepreneur - M. Nath, IMT Monograph
7. Small Industry Entrepreneurs Hand Book Service International - Mohan K.R., Bombay Productivity

Hand Book of Entrepreneurship – Rao & Pareek, New Delhi, Learning System 1978

**Subject Name:** TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

***Section A: Inorganic Chemistry***

**Transition Elements (3d series)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

**Coordination Chemistry**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

**Crystal Field Theory**

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry.

Jahn-Teller distortion, Square planar coordination.

***Section B: Physical Chemistry***

**Kinetic Theory of Gases**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO<sub>2</sub>.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

### **Liquids**

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

### **Solids**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

### **Chemical Kinetics**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

### **Reference Books:**

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
- Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
- Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
- Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.

**Subject Name:** TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS LAB

**Section A: Inorganic Chemistry**

Semi-micro qualitative analysis (using H<sub>2</sub>S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup>

Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>2</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup>

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg<sup>2+</sup> or (ii) Zn<sup>2+</sup> by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

**Section B: Physical Chemistry**

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
  - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
  - b. Saponification of ethyl acetate.
  - c. Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate

**Reference Books:**

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

**Subject Name:** BASIC ANALYTICAL CHEMISTRY

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

**Analysis of soil:** Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

- a. Determination of pH of soil samples.
- b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

- a. Determination of pH, acidity and alkalinity of a water sample.
- b. Determination of dissolved oxygen (DO) of a water sample.

**Analysis of food products:** Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
- b. Analysis of preservatives and colouring matter.

**Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

- a. Paper chromatographic separation of mixture of metal ion ( $\text{Fe}^{3+}$  and  $\text{Al}^{3+}$ ).
- b. To compare paint samples by TLC method. Ion-exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

**Analysis of cosmetics:** Major and minor constituents and their function

- a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
- b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

**Reference Books:**

- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
- Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
- Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.

- Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
- Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
- Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
- Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

**Subject Name:** WAVES AND OPTICS

**Superposition of Two Collinear Harmonic oscillations:** Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

**Superposition of Two Perpendicular Harmonic Oscillations:** Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

**Waves Motion- General:** Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

**Fluids:** Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaeger's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge - Detection of leakage.

**Sound:** Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

**Wave Optics:** Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

**Interference:** Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

**Michelson's Interferometer:** Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

**Diffraction:** Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. (14 Lectures)

**Polarization:** Transverse nature of light waves. Plane polarized light - production and analysis. Circular and elliptical polarization. (5 Lectures)

**Reference Books:**

- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley

**Subject Name:** WAVES AND OPTICS -LAB

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify  $\lambda^2 - T$  Law.
3. To study Lissajous Figures
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

**Reference Books:**

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

**Subject Name:** DESIGN AND ANALYSIS OF ALGORITHM

1. Algorithm
2. Growth of Function
3. Analyzing Algorithm Control Structures
4. Recurrences
5. Quick Sort
6. Curriculum of Social Studies
7. Amortized Analysis
8. Heap
9. Sorting in Linear Time
10. Median and Order Statistics
11. Backtracking

**Subject Name:** DATABASE MANAGEMENT SYSTEM

1. **Basic - Concepts of Database Systems:** Database Schema, Instance and Database state, The Three-Schema Architecture, Data Independence, DBMS Languages, People Deal with Databases.
2. **Entry - Relationship Model:** The E- R Model, Entity Relationship Diagram, Composite versus Atomic Attributes, Role Names Recursive Relationships, Constraints on Relationship Types.
3. **Data Models and Its Implementation:** The Hierarchical Data Model, the Network Data Model, Network Modeling Concepts, the Relational Model.
4. **Introduction to Relational Model:** CODD'S 12 Rules for a fully relational DBMS, Basic Concepts of Relational Model, Referential Integrity Constraints, Enforcing Integrity Constraints.
5. **Oracle: A Relational Database Management System** Oracle System Structure,. Oracle Server, Oracle Database Structure, Oracle Schema Objects, Oracle Data Dictionary.
6. **Structured Query Language: SQL:** Three Parts of SQL, Sub-Queries, Referential Integrity, Some Other SQL Command.
7. **Procedural Language/ Structured Query Language:** PL/SQL Runtime Architecture (PL/SQL Engine), Procedure, Parameters, Packages, Cursors, Triggers.
8. **Relational Algebra and Relational Calculus:** Relational- Oriented Operation, Set-Oriented Operations and Union Compatibility, Aggregate Function and Grouping, Tuple Relation Calculus.
9. **Normalizing Database:** Benefits of Normalization, Function Dependency, The Domain Key Normal Form.
10. **Database Design and Tuning:** The Database Design Process, Requirements and Analysis, Choice of DBMS, Logical Database Design, Database Implementation and Tuning.
11. **Transaction Processing:** Concurrency Control, Recoverability.
12. **Query Processing and Query Optimization:** Query Processing, Query Optimization, Heuristics Rules in Query Optimization, Information used in Cost Function.
13. **Database Recovery Techniques:** Classification of Transaction Failures, Recovery Techniques Base on Deferred Update, Recovery Techniques Base on Immediate Update, Buffer Management.
14. **Concurrency Control Techniques:** The Acid Test for Transaction Management, Binary Locks, Serializability by Two-Phase Locking, Deadlock Problem.



- 15. Data Warehousing:** Data Warehouse Definition, Data Form Legacy Systems, Decision- Support and Executive Information Systems.
- 16. Data Mining and Web Mining:** Data Mining Techniques, Future Direction of Data Mining, Data Mining Techniques for Web Searching.
- 17. Object- Oriented Database:** History Of OODBMS, Need for Abstract Data Types, O-O Features in SQL3, Hypertext Databases.
- 18. Distributed Database:** Structure of Distributed Database, Design of Distributed Database, Advantage of Distributed Database, DDBMS Prototypes.

**Subject Name:** ALGEBRA

Definition and examples of groups, examples of abelian and non-abelian groups, the group  $Z_n$  of integers under addition modulo  $n$  and the group  $U(n)$  of units under multiplication modulo  $n$ . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group  $GL_n(n, R)$ , groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group  $Sym(n)$ , Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non- commutative rings: rings from number systems,  $Z_n$  the ring of integers modulo  $n$ , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields:  $Z_p$ ,  $Q$ ,  $R$ , and  $C$ . Field of rational functions.

**Books Recommended**

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.

**Subject Name:** Computer Organization

**Unit-I**

**The Von Neumann Architecture & ALU Organization**

1. Details of Von Neumann Architecture
2. Simple ALU Organization, Arithmetic Processor.

**Unit-II**

**Control Unit & Memory Organization**

1. **Control Unit** : Hardwired and Micro programmed Control

- 2. Memory Organization:** Primary Memory, Secondary Memory, High Speed memory, Virtual Memory.

### **Unit-III**

#### **I/O Transfer, Peripherals & Assembly language Programming**

- 1. I/O Transfer :** Program Controlled, interrupt Controlled and DMA
- 2. Peripherals & Assembly Language:** Introduction to Computer buses, Peripherals, performance bench marking and current trends in architecture / Assembly language programming.

**Subject Name:** ARTIFICIAL INTELIGENCE

#### **Unit 1: Introduction to Data Science and AI & ML**

- Data Science, AI & ML
- Use Cases in Business and Scope
- Scientific Method
- Modeling Concepts
- CRISP-DM Method

#### **Unit 2: R Essentials (Tutorial) Programming**

- Commands and Syntax
- Packages and Libraries
- Introduction to Data Types
- Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames
- Importing and Exporting Data.
- Control structures and Functions Descriptive Statistics
- Data exploration (histograms, bar chart, box plot, line graph, scatter plot)
- Qualitative and Quantitative Data
- Measure of Central Tendency (Mean, Median and Mode),
- Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles),
- Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Anscombe's quartet
- Other Measures: Quartile and Percentile, Interquartile Range

#### **Unit 3: Statistical Analysis Initial Data Analysis**

- Relationship between attributes: Covariance, Correlation Coefficient, Chi Square
- Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs

#### **Probability**

- Probability (Joint, marginal and conditional probabilities)
- Probability distributions (Continuous and Discrete)

- Density Functions and Cumulative functions

**Subject Name:** PLANT PHYSIOLOGY AND METABOLISM

**&**

**Subject Name:** PLANT PHYSIOLOGY AND METABOLISM LAB

**Unit 1: Plant-water relations**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

**Unit 2: Mineral nutrition**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

**Unit 3: Translocation in phloem**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

**Unit 4: Photosynthesis**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C<sub>3</sub>, C<sub>4</sub> and CAM pathways of carbon fixation; Photorespiration.

**Unit 5: Respiration**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

**Unit 6: Enzymes**

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

**Unit 7: Nitrogen metabolism**

Biological nitrogen fixation; Nitrate and ammonia assimilation.

**Unit 8: Plant growth regulators**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

**Unit 9: Plant response to light and temperature**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

**Practical**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

#### **Suggested Readings**

1. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

#### **Subject Name: BIOFERTILIZERS**

**Unit 1:** General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

**Unit 2: Azospirillum:** isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

**Unit 3:** Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

**Unit 4:** Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

**Unit 5:** Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

#### **Suggested Readings**

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.

4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New \_Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic \_Farming Akta Prakashan, Nadiad

**Subject Name:** GENETICS AND EVOLUTIONARY BIOLOGY

**&**

**Subject Name:** GENETICS AND EVOLUTIONARY BIOLOGY LAB

**Unit 1: Introduction to Genetics**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

**Unit 2: Mendelian Genetics and its Extension**

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

**Unit 3: Linkage, Crossing Over and Chromosomal Mapping**

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

**Unit 4: Mutations**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations,

**Unit 5: Sex Determination**

Chromosomal mechanisms, dosage compensation

**Unit 6: History of Life**

Major Events in History of Life

**Unit 7: Introduction to Evolutionary Theories**

Lamarckism, Darwinism, Neo-Darwinism

**Unit 8: Direct Evidences of Evolution**

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

**Unit 9: Processes of Evolutionary Change**

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

**Unit 10: Species Concept**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)  
CBCS Undergraduate Program in Zoology 2015

**Unit 11: Macro-evolution**

Macro-evolutionary Principles (example: Darwin's Finches)

**Unit 12: Extinction**

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

**PRACTICAL**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts: a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

**SUGGESTED READINGS**

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.

**Subject Name:** ENZYMOLOGY

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**Subject Name:** ENZYMOLOGY-(P)

1. Introduction to bio-catalysis, differences between chemical and biological catalysis.
2. Nomenclature and classification of enzymes. Enzyme specificity. Active site.
3. Principles of energy of activation, transition state. Interaction between enzyme and substrate- lock and key, induced fit models. Definition of holo-enzyme, apo-enzyme , coenzyme, cofactor. Fundamentals of enzyme assay, enzyme units.
4. Factors affecting the catalysis- substrate concentration, pH, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of  $K_M$  and  $V_{max}$ . Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive.
5. Outline of mechanism of enzyme action- acid-base catalysis, covalent catalysis, electrostatic catalysis, and metal ion catalysis. Regulation of enzyme activity- allosterism and co-operativity, ATCase as an allosteric enzyme, covalent modulation- covalent phosphorylation of phosphorylase, zymogen activation- activation of trypsinogen and chymotrypsinogen. Isoenzymes (LDH). Multienzyme complexes (PDH). Ribozyme.

**Subject Name:** PARASITOLOGY

**THEORY**

- a. Definition - parasitism, HOST, Vectors etc.
- b. Classification of Parasites
- c. Phylum Protozoa- general Pathogenic and nonpathogenic protozoa.
- d. Phylum Nematelminths/Round worms (Nematoda)
- e. Phylum Platyhelminths - class-Cestoda, class-Trematoda
- f. Lab diagnosis of parasitic infections.

**Protozoa :**

1. Intestinal Amoebae
  - a. E. Histolytica : Life cycle, Morphology, Disease & Lab Diagnosis
  - b. E. coli : Life cycle, Morphology, Disease & Lab Diagnosis
2. Flagellates of intestine/genitalia
  - a. Giardia lamblia : Life cycle, Morphology, Disease & Lab Diagnosis
  - b. Trichomonas vaginalis : Life cycle, Morphology, Disease & Lab Diagnosis
3. Malarial Parasite
  - a. Plasmodium vivax : Life cycle, Morphology, disease & lab diagnosis
  - b. Differences between P. vivax, P. malaria, P. falciparum & P.ovale.

**Nematodes :**

Intestinal Nematodes :

- a. Ascaris : Life cycle, Morphology, disease & lab diagnosis
- b. Brief discussion about Enterobius vermicularis (Thread worm ) and Ancylostoma duodenale (Hook worm)

Tissue Nematodes : W. Bancrofti - Life cycle, Morphology, Disease & Lab Diagnosis

Phylum Platyhelminths

- a. Cestodes - T. solium, T. saginata & E. granulosus.
- b. Trematodes - S. haematobium & F. hepatica.

### **PRACTICAL**

- Stool examination.
- Identification of different ova & cysts in stool samples.

**Subject Name:** MICROBIAL BIOTECHNOLOGY

- a. **Commercial Production of Microorganisms** – Industrial Fermenters, Single-cell Protein.
- b. **Bioconversions** – Biomining and bioleaching of ores (Use of thermophilic microorganisms in industrial microbiology Bio-gas, Bio-leaching, Bio-diesel.
- c. **Microorganisms & Agriculture** – Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides.
- d. **Products from Microorganisms** – Metabolites, Enzymes, Antibiotics.
- e. **Bioremediation** – Petroleum prospecting and formation of oil spills,, Wastewater treatment, chemical degradation, heavy Metals.
- f. **Principles of Microbial growth** – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics).



### Fifth Semester

Fifth Semester			
S. No.	Name of Subject	Credits	Total Marks
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Dissertation & Seminar	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Polymer Chemistry and Green Chemistry (T)	4	100
2	Polymer Chemistry and Green Chemistry Lab (P)	3	100
<b>Physics Group</b>			
1	Element of Modern Physics (T)	4	100
2	Element of Modern Physics Lab (P)	3	100
<b>Computer Science</b>			
1	Internet Technologies (T+P)	6	100
2	Theory of Computation (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Integral Calculus (T)	6	100
2	Matrix (T)	6	100
<b>Information Technology</b>			
1	Unix and Shell Programming (T+P)	6	100
2	Graph Theory (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Economic Botany and Biotechnology (T)	4	100
2	Economic Botany and Biotechnology Lab (P)	3	100
3	Herbal Technology (T)	3	100
<b>Zoology</b>			
1	Applied Zoology (T)	4	100
2	Applied Zoology Lab (P)	3	100
<b>Micro-Biology</b>			
1	Hematology & Blood Banking (T+P)	6	100
2	Lab Instruments and Ethics (T+P)	6	100
3	DNA Typing, Proteomics & Beyond (T+P)	6	100

**Subject Name:** DISSERTATION & SEMINAR

**Subject Name:** POLYMER CHEMISTRY AND GREEN CHEMISTRY

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**Subject Name:** POLYMER CHEMISTRY AND GREEN CHEMISTRY LAB

**Introduction and history of polymeric materials:**

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

**Functionality and its importance:**

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

**Kinetics of Polymerization:**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

**Crystallization and crystallinity:**

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

**Nature and structure of polymers**-Structure Property relationships.

**Determination of molecular weight of polymers** ( $M_n$ ,  $M_w$ , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

**Glass transition temperature ( $T_g$ ) and determination of  $T_g$** , Free volume theory, WLF equation, Factors affecting glass transition temperature ( $T_g$ ).

**Polymer Solution** – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

**Properties of Polymers** (Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

**Reference Books:**

- Seymour's Polymer Chemistry, Marcel Dekker, Inc.
- G. Odian: Principles of Polymerization, John Wiley.
- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

CHEMISTRY PRACTICAL - DSE LAB: POLYMER CHEMISTRY

**Polymer synthesis**

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
  - a. Purification of monomer
  - b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)
2. Preparation of nylon 66/6
  1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
    - a. Preparation of IPC
    - b. Purification of IPC
    - c. Interfacial polymerization
  3. Redox polymerization of acrylamide
  4. Precipitation polymerization of acrylonitrile
  5. Preparation of urea-formaldehyde resin
  6. Preparations of novalac resin/resold resin.
  7. Microscale Emulsion Polymerization of Poly(methylacrylate).

**Polymer characterization**

1. Determination of molecular weight by viscometry:
  - (a) Polyacrylamide-aq. NaNO<sub>2</sub> solution
  - (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of —head-to-head|| monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

**Polymer analysis**

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques

3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis

\*at least 7 experiments to be carried out.

**Reference Books:**

- Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
- Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
- Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
- Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
- Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
- Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013)

**Introduction to Green Chemistry**

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

**Principles of Green Chemistry and Designing a Chemical synthesis**

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.
- Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.
- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluoruous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.

- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD “What you don’t have cannot harm you”, greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

#### **Future Trends in Green Chemistry**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C2S3); Green chemistry in sustainable development.

#### **Reference Books:**

- Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998).
- Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnensand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
- Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.

#### **LAB: GREEN CHEMISTRY**

##### **1. Safer starting materials**

- Preparation and characterization of nanoparticles of gold using tea leaves.

##### **2. Using renewable resources**

- Preparation of biodiesel from vegetable/ waste cooking oil.

##### **3. Avoiding waste**

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

- Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH<sup>-</sup> → propene + trimethylpropene + water H<sub>2</sub>SO<sub>4</sub>/Δ

(II) 1-propanol → propene + water

- Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

##### **4. Use of enzymes as catalysts**

- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

#### 5. **Alternative Green solvents**

Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared from dry ice.

Mechanochemical solvent free synthesis of azomethines

#### 6. **Alternative sources of energy**

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

#### **Reference Books:**

- Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).
- Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).
- Ryan, M.A. Introduction to Green Chemistry, Tinnensand; (Ed), American Chemical Society, Washington DC (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore ISBN 978-93-81141-55-7 (2013).
- Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008).
- Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).
- Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.
- Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach, W.B.Saunders, 1995.

#### **Subject Name:** ELEMENTS OF MODERN PHYSICS

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment.

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

Position measurement- gamma ray microscope thought duality, Heisenberg uncertainty principle- impossibility trajectory; Estimating minimum energy of a confined principle; Energy-time uncertainty principle.

experiment; Wave-particle of a particle following a particle using uncertainty

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life;  $\alpha$  decay;  $\beta$  decay - energy released, spectrum and Pauli's prediction of neutrino;  $\gamma$ -ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

**Reference Books:**

- Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2009, PHI Learning
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
- Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
- Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning
- Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

**Subject Name:** ELEMENTS OF MODERN PHYSICS-LAB

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

**Reference Books:**

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

**Subject Name:** INTERNET TECHNOLOGIES

- 1 **Introduction to WWW** : Protocols and programs, secure connections, application and development tools, the web browser, Web Design: Web site design principles, planning the site and navigation,
- 2 **Introduction to HTML** : The development process, HTML tags and simple HTML forms, web site structure Introduction to XHTML : XML, Move to XHTML, Meta tags, Character entities, frames and frame sets, inside browser.
- 3 **Style sheets** : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2
- 4 **Javascript** : Client side scripting, What is Javascript, How to develop Javascript, simple Javascript, variables, functions, conditions, loops and repetition DHTML : Combining HTML, CSS and Javascript, events and buttons, controlling your browser.
- 5 **XML** : Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application. XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT
- 6 **Web Hosting** : registering domains, parking websites, publishing with FTP
- 7 **PHP** : Starting to script on server side, Arrays, function and forms, advance PHP Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

**Review of Mathematical Theory:** Sets, Functions, Logical statements, Proofs, relations, languages, Mathematical induction, strong principle, Recursive definitions

**Regular Languages and Finite Automata:** Regular expressions, regular languages, applications, Automata with output-Moore machine, Mealy machine, Finite automata, memory requirement in a recognizer, definition, union, intersection and complement of regular languages. Non Determinism Finite Automata, Conversion from NFA to FA,  $\wedge$ - Non Determinism Finite Automata Conversion of NFA-  $\wedge$  to NFA and equivalence of three Kleene's Theorem, Minimization of Finite automata Regular And Non Regular Languages – pumping lemma.

**Context free grammar (CFG):** Definition, Unions Concatenations And Kleen's of Context free language Regular grammar, Derivations and Languages, Relationship between derivation and derivation trees, Ambiguity Unambiguous CFG and Algebraic Expressions BacosNaur Form (BNF), Normal Form – CNF

**Pushdown Automata, CFL And NCFL:** Definition, deterministic PDA, Equivalence of CFG and PDA, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL

**Turing Machine (TM):** TM Definition, Model Of Computation And Church Turning Thesis, computing functions with TM, Combining TM, Variations Of TM, Non Deterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy



**Computable Functions:** Partial, total, constant functions, Primitive Recursive Functions, Bounded Minimization, Regular function, Recursive Functions

**Subject Name:** INTEGRAL CALCULUS

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution. Double and Triple integrals.

**Books Recommended**

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

**Subject Name:** MATRIX

$R$ ,  $R^2$ ,  $R^3$  as vector spaces over  $R$ . Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of  $R^2$ ,  $R^3$ .

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

**Books Recommended**

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, *Theory and Problems of Matrix Operations*, Tata McGraw Hill, 1989.

**Subject Name:** UNIX AND SHELL PROGRAMMING

1. **Introduction:** Features, System Structure, Shell & its Features, Kernel: Architecture of the UNIX OS, Kernel Data Structure.
2. **Overview:** Logging in & out, I node and File Structure, File System Structure and Features, Booting Sequence & init process, File Access Permissions.
3. **Shell Programming:** Environmental & user defined variables, Argument Processing, Shell's interpretation at prompt, Arithmetic expression evaluation, Control Structure, Redirection, Background process & priorities of process, Conditional Execution, Parameter & quote substitution.
4. **Advanced Shell Programming:** Filtering utilities, Awk, Batch Process, Splitting, comparing, sorting, Merging & Ordering Files, Communications with other users.
5. **Editors and utility:** Link Editor (ed), Screen Editor tutorial (Vi), Fck Utility.

**Subject Name:** GRAPH THEORY

**Unit I: Fundamental concepts**

Basic definitions, operations, properties, proof styles; Trees (properties, distances and centroids, spanning trees, enumeration).

**Unit II: Matchings**

Bipartite graphs, general graphs, weighted matching; Connectivity (vertex and edge connectivity, cuts, blocks, k-connected graphs, network flows).

**Unit III: Traversibility**

Eulerian tours, Hamiltonian cycles; Coloring (vertex and edge coloring, chromatic number, chordal graphs).

**Unit IV: Planarity**

Duality, Euler's formula, characterization, 4-color theorem; Advanced topics (perfect graphs, matroids, Ramsay theory, extremal graphs, random graphs); Applications.

**References**

1. Douglas B. West, Introduction to Graph Theory, Prentice Hall of India, 1996.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science. Prentice-Hall, 1974.
3. Frank Harary, Graph Theory, Narosa, 1994.
4. R. Ahuja, T. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications, Prentice-Hall, 1988.

**Subject Name:** ECONOMIC BOTANY AND BIOTECHNOLOGY

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**Subject Name:** ECONOMIC BOTANY AND BIOTECHNOLOGY LAB

**Unit 1: Origin of Cultivated Plants**

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 diversity.

**Unit 2: Cereals**

Wheat and Rice (origin, morphology, processing & uses), brief account of millets.

**Unit 3: Legumes**

General account, importance to man and ecosystem.

**Unit 4: Sugars & Starches**

Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

**Unit 5: Spices**

Listing of important spices, their family and part used, economic importance with Special reference to fennel, saffron, clove and black pepper

**Unit 6: Beverages**

Tea, Coffee (morphology, processing & uses)

**Unit 7: Oils & Fats**

General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and Brassica and Coconut (Botanical name, family & uses)

**Unit 8: Essential Oils**

General account, extraction methods, comparison with fatty oils & their uses.

**Unit 9: Natural Rubber**

Para-rubber: tapping, processing and uses.

**Unit 10: Drug-yielding plants**

Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.

**Unit 11: Tobacco**

Tobacco (Morphology, processing, uses and health hazards)

**Unit 12: Timber plants**

General account with special reference to teak and pine.

**Unit 13: Fibres**

Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses).

**Practical**

1. **Cereals:** Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. **Legumes:** Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. **Sugars & Starches:** Sugarcane ( habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
4. **Spices:** Black pepper, Fennel and Clove (habit and sections).
5. **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. **Oils & Fats:** Coconut- T.S. Nut, Mustard—plant specimen, seeds; tests for fats in crushed seeds.
7. **Essential oil-yielding plants:** Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs).
8. **Rubber:** specimen, photograph/model of tapping, samples of rubber products.
9. **Drug-yielding plants:** Specimens of Digitalis, Papaver and Cannabis.
10. **Tobacco:** specimen and products of Tobacco.
11. **Woods:** Tectona, Pinus: Specimen, Section of young stem.
12. **Fibre-yielding plants:** Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).

**Suggested Readings**

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.

**Subject Name:** HERBAL TECHNOLOGY

**Unit 1:** Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

**Unit 2:** Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

**Unit 3:** Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system), Clerodendron phlomoides (anti-rheumatic) and Centella asiatica (memory booster).

**Unit 4:** Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

**Unit 5:** Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi- Herbal foods-future of pharmacognosy)

### **Suggested Readings**

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book - Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

**Subject Name:** APPLIED ZOOLOGY

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**Subject Name:** APPLIED ZOOLOGY LAB

### **Unit 1: Introduction to Host-parasite Relationship**

Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

### **Unit 2: Epidemiology of Diseases**

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

### **Unit 3: Rickettsiae and Spirochaetes**

Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum

### **Unit 4: Parasitic Protozoa**

Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*

**Unit 5: Parasitic Helminthes**

Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*

**Unit 6: Insects of Economic Importance**

Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*

**Unit 7: Insects of Medical Importance**

Medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*

**Unit 8: Animal Husbandry**

Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle

**Unit 9: Poultry Farming**

Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

**Unit 10: Fish Technology**

Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

**PRACTICAL**

1. Study of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliiothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

**SUGGESTED READINGS**

- Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B Publishers.
- Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.

- Kumar and Corton. Pathological Basis of Diseases.
- Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
- Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
- Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
- Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
- Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.

**Subject Name: HEMATOLOGY & BLOOD BANKING**

1. Specimen Collection and Laboratory Preparations in Hematology.
2. Routine Hematological Test: HB Estimation, Total Leukocyte Estimation, Total Erythrocyte Estimation, Differential Leukocyte Count.
3. Routine Hematological Test: ESR, Packed Cell Volume, Reticulocyte Count, Platelet Count.
4. Routine Hematological Test: Absolute Eosinophil Count, Arnett Count, Sedimentation Count, Red Cell Indices, Peripheral Cell – Morphology.
5. Special Hematological Test: Foetal Hemoglobin Estimation, Foetal Red Cell Estimations.
6. Special Hematological Test: Lupus Erythrocyte Cell Preparation, Osmotic Fragility Test.
7. Heinz Bodies Preparation: Bone Marrow Smear Preparations, Study of Blood Parasites.
8. Interpretation of Lab Findings In Hematology Anemia, Leukemia, Abnormal RBC And WBC Morphology.
9. Introduction to Homeostasis, Coagulation And Bleeding Disorders.
10. Clotting and Bleeding Time Determinations, Coagulation Mechanisms Coagulation Studies.
11. Principles of immunohematology, clinical significance of blood transfusions. Collection and processing of blood for transfusion.
12. Routine Lab Procedures In Blood Bank: ABO System, Rh System, Sub Grouping, Compatibility Testing, Coombs Testing, Antibody Titration And Direct Testing.

**Subject Name: LAB INSTRUMENTS AND ETHICS**

1. Safety Measures.
2. pH and buffer solution.
3. Photometric techniques.
4. Centrifugation techniques.
5. Chromatography.
6. Electrophoresis.
7. Molecular biology techniques.
8. Automation in clinical chemistry.
9. Automated cell counter 18 parameters and 21 parameters, coagulometer, microhematocrit.

10. Flow cytometry, qbc analysis, elisa reader.
11. Component separator, cell washer, blood bag shaker.
12. Refrigerated centrifuge, apheresis machine, automation in blood group.
13. Serology - photometric reading system and continuous flow system.
14. Automatic tissue processor. automated microtome, automated knife sharpening machine automated hones.
15. Automated stainer, cryostat, trinocular microscope with microphoto.
16. Accessories and monitor, computer printer and scanner.
17. Electron microscope, cytocentrifuge, tissue microarray, auto pap stainer.
18. Hot air oven, autoclave, incubator, biosafety cabinet.
19. Microscope: light microscope, fluorescent microscope, dark field microscope, electron microscope.
20. Centrifuge, elisa reader, pcr, bactec, api system.

**Subject Name: DNA TYPING, PROTEOMICS & BEYOND**

1. **DNA Typing:** DNA polymorphisms: the basis of DNA typing, Minisatellite analysis, Polymerase chain reaction based analysis, Short tandem repeat analysis, Mitochondrial DNA analysis, Y chromosome analysis, Randomly amplified polymorphic DNA (RAPD) analysis.
2. **Proteomics and beyond:** Analysis of the transcriptome, Proteomics-Expression analysis & Characterization of proteins, Metabolomics & global biochemical networks.
3. **High-throughput analysis of gene function** - DNA microarrays, Protein arrays, Mass spectrometry.
4. **Single Nucleotide Polymorphisms** - The nucleolar proteome, Mapping disease-associated SNPs: Alzheimer's disease.



**Sixth Semester**

<b>Sixth Semester</b>			
<b>S. No.</b>	<b>Name of Subject</b>	<b>Credits</b>	<b>Total Marks</b>
<b>Group – I {Liberal Group}</b>			<b>Compulsory</b>
1	Project	4	100
<b>Group – II {General Science Group} :- Candidates with Physics and Chemistry at Science 10+2 Level</b>			
<b>Chemistry Group</b>			
1	Quantum Chemistry, Spectroscopy & Photochemistry (T)	4	100
2	Quantum Chemistry, Spectroscopy & Photochemistry Lab (P)	3	100
<b>Physics Group</b>			
1	Solid State Physics (T)	4	100
2	Solid State Physics Lab (P)	3	100
3	Electrical Circuits and Network Skills (T)		
<b>Computer Science</b>			
1	Visual Basic (T+P)	6	100
2	Computer Graphics (T+P)	6	100
<b>Group - III {Reckon Science Group} :- Candidates with Physics and Chemistry at 10+2 Science Level</b>			
<b>Mathematics</b>			
1	Linear Programming	6	100
<b>Information Technology</b>			
1	Multimedia Technology (T+P)	6	100
2	Web Technology (T+P)	6	100
3	Digital Image Processing (T+P)	6	100
<b>Group – IV {Life Science Group} :- Candidates with Biology at Science 10+2 Level</b>			
<b>Botany</b>			
1	Bioinformatics(T)	4	100
2	Bioinformatics Lab (P)	3	100
<b>Zoology</b>			
1	Insect, Vector and Diseases (T)	4	100
2	Insect, Vector and Diseases Lab (P)	3	100
3	Apiculture (T)	3	100
<b>Micro-Biology</b>			
1	Histopathology and Cytopathology Techniques (T+P)	6	100
2	Plant and Animal Tissue Culture Techniques and Applications (T+P)	6	100
3	Recombinant DNA Technology (T+P)	6	100

**Subject Name:** PROJECT

**Subject Name:** QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY

**Subject Name:** QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY-LAB

**Module 1**

**Quantum Chemistry** Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and “particle-in-a-box” (rigorous treatment), quantization of energy levels, Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

### **Module 2**

**Chemical bonding:** Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of  $H_2^+$ . Bonding and antibonding orbitals. Qualitative extension to  $H_2$ . Comparison of LCAO-MO and VB treatments of  $H_2$  (only wavefunctions, detailed solution not required) and their limitations.

Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic ( $BeH_2$ ,  $H_2O$ ) molecules. Qualitative MO theory and its application to  $AH_2$  type molecules.

### **Module 3**

#### **Molecular Spectroscopy:**

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

**Rotation spectroscopy:** Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

### **Module 4**

**Vibrational spectroscopy:** Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, the concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

### **Module 5**

### **Raman and Electronic Spectroscopy**

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

### **Module 6**

**Nuclear Magnetic Resonance (NMR) spectroscopy:** Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

### **Module 7**

#### **Photochemistry**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients.

Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

#### **Reference Books:**

1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
5. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

**Subject Name:** SOLID STATE PHYSICS

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**Subject Name:** SOLID STATE PHYSICS LAB

**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T<sub>3</sub> law

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

**Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeier relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons.

**Elementary band theory:** Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

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

**Reference Books:**

- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid-state Physics, H. Ibach and H Luth, 2009, Springer
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

**LAB: SOLID STATE PHYSICS**

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency

5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (from room temperature to 150 oC) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

#### **Reference Books**

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

#### **Subject Name:** ELECTRICAL CIRCUITS AND NETWORK SKILLS

**Basic Electricity Principles:** Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity.

Familiarization with multimeter, voltmeter and ammeter.

**Understanding Electrical Circuits:** Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

**Electrical Drawing and Symbols:** Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

**Generators and Transformers:** DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

**Electric Motors:** Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

**Solid-State Devices:** Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

**Electrical Protection:** Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

**Electrical Wiring:** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage,

power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

**Reference Books:**

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

**Subject Name:** VISUAL BASIC

1. **Introduction to Visual Basics:** Object-Oriented Programming (OOP), What Is the Visual Basic ?, Visual Basic Application, Introduction to Visual Basic , Event-Driven Programming, Integrated Development Environment(IDE), Toolbox, Form Layout Window, Properties Window, Menu Bar, Immediate Window, Creating the interface, Resizing, Moving , and Locking Controls, To Lock all Control Positions, To Adjust the Position of Locked Controls, Setting Properties, Designing a form, Saving the Project, Working with Multiple Projects, Merging Text, Using Wizard and Add-Ins, Using Wizards, Making and Running an Executable File Adding Controls, OLE, Command Button.
2. **Data Types in Visual Basics:** Data Type, Operator, Precedence of Operators, Arrays.
3. **Controls Statements in Visual Basic:** Introduction to Control Statements, Decision Structures or Selection Statements, More Worked Out Programming Examples.
4. **Standards Library Functions in Visual Basics:** Introduction, Characters and Strings, String Data Types, Concatenation of Strings, Concatenation Operator (& Operator), Arithmetic Operators, String Functions, Numeric Functions, Date, Time and Now Functions, Date Arithmetic Functions (Date Add,, Data Diff), Data Type Functions, Arithmetic Functions, Remainder.
5. **Visual Basic Forms, Procedures and Functions:** Introduction, to Forms, Single Documents Interface (SDI), Multiple Document Interface (MDI), Managing Projects, Using Procedures and Functions, Procedures, Calling Sub Procedures, Calling Function Procedures, Passing Arguments to Procedures, Using Optional Arguments.

**Subject Name:** COMPUTER GRAPHICS

1. Keyboard, Touch Panel, Light pens, Graphic tablets, Joysticks, Touch balls, Image scanner, Mouse, Handy copy device:-Zero impact and Non-Impact printers, Dot matrix, Laser printer, Inkjet printer, Dectrostare, Flatted and drum plotters. Video display devise:-Cathode Rey tube, Resistance, Resolution ,Aspect ratio vertical and horizontal ,Color CRT monitors, Direct view storage tube, Flat panel displays, LCD Virtual reality, Faster scan system, Random scan system. Memory device:- Memory (RAM, ROM), CD, Floppy disk, Magnetic tapes, Magnetic disks.
2. Scan conversion algorithm for line (DDA & Bresenham's algorithm) ,Midpoint circle ,Circle & ellipse, Midpoint ellipse, Midpoint ellipse ,Bresenham's algorithm ,Area filling techniques, Scan line polygene fill, Boundary fill character generation.2-dimensional Graphics: Cartesian & Homogeneous coordinate system, Geometric transformations, Affine transformation (Translation, Scaling ,Rotation, Reflection, Shearing),Composite transformation ,Affine Viewing pipeline, Two dimensional viewing transformation and clipping(Line, Polygon and Text).

3. Three Dimensional Graphics:-Geometric transformation (Translation, Scaling, rotation, reflection, shearing), Composite transformations, Mathematics of projections (parallel & perspective), View pipeline, 3D viewing transformations and clipping (normalized view volumes, view port, clipping).
4. Hidden line and surface elimination algorithms, Z-buffer, Scan-line, Sub-division, and Painter's algorithm. Illumination Models: Diffuse reflection, specular reflection, refracted light, Texture surface patterns, half toning, dithering. Surface rendering methods: Constant intensity method, Gourmand shading, Hong shading. Color Model: Introduction to RGB, CMY & HSV color models.

**Subject Name: LINEAR PROGRAMMING**

Linear Programming Problems, Graphical Approach for Solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

**Recommended Books**

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 8th Ed., Tata McGraw Hill, Singapore, 2004.
3. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006

**Subject Name: MULTIMEDIA TECHNOLOGY**

**Unit-I**

**Introduction and Hardware:**

Definition Of Multimedia, CD-ROMs and Multimedia applications, Multimedia requirements – Hardware, Software, Creativity and Organization, Multimedia skills and training Macintosh Verses PC, the Macintosh platform, PC platform, Connections, Memory and storage devices, input devices, Output hardware ,Communication devices.

**Unit-II**

**Multimedia Software:**

Basic tools, painting and drawing tools, OCR software, Sound editing programs, Animation devices and digital movies and other accessories, Linking multimedia objects , Office suites, word processor, spreadsheets presentation tools, Types of Authoring tools card and page based, icon based and time based authoring tools, Object oriented tools.

**Unit-III**

**Production Building Blocks:**

Test-Using test in Multimedia, Computers and Text, Font editing and design tools, Hypertext, Sounds-multimedia system sounds MIDI Verses Digital Audio, Audio file Formats, Working with sound in Windows, Notation interchange file format (NIFF),Adding sound.

#### **Unit-IV**

##### **Production Tips:**

Image-Creation, making still images, images colors, Images, File format, Animation-principles of animations, making workable animations Video, using video, Broadcast Video, Standard, Integrating Computer and TVs, Shooting and editing Video, Using Recording formats, Video tips, Video Compression.

#### **Unit-V**

##### **Multimedia Project Development and case Studies:**

Project planning, Estimating, RPFs and Bid proposals, Designing, Producing acquiring and using contents, Using Telnet, Testing, Preparing for delivery , CD-ROM Technology and Standards. Designing for the Word Wide, Working on the Web, Text for the Web, Images for the Web, and Animation for the Web.

##### **Subject Name: WEB TECHNOLOGY**

1. **Current Trends on Internet:** Languages, Internet Phone, Internet Video, Collaborative Computing, e-commerce.
2. **Web Publishing and Browsing:** Overview SGML ,web hosting, HTML,CGL Documents interchange Standards, Components of web Publishing, Documents management, Web page Design, Consideration and Principles, Search and Meta Search Engines, WWW, Browser, HTTP, Publishing Tools.
3. **Interactivity Tools:** ASP, VB Script, Java Script, JAVA, Front Page and Flash.
4. **Internet Security Management Concepts, Information Privacy and Copyright Issues:** Overview of Internet Security, Firewall, Internet Security, Management Concepts and information Privacy and Copyright issues, Basics of Asymmetric Cryptosystems.

##### **Subject Name: DIGITAL IMAGE PROCESSING**

**Introduction:** Fundamentals of Image formation, components of image processing system, image sampling and quantization.

**Image enhancement in the spatial domain:** Basic gray-level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters.

**Image restoration:** A model of the image degradation/restoration process, noise models, restoration in the presence of noise—only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain.

**Image Compression:** Need of image compression, image compression models, error-free compression, lossy predictive coding, image compression standards.

**Morphological Image Processing:** Preliminaries, dilation, erosion, open and closing, basic morphologic algorithms, The Hit-or-Miss Transformation

**Image Segmentation:** Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region-based segmentation.

**Object Recognition:** Patterns and patterns classes, matching, classifiers.

##### **Text Books:**



1. Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.
2. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.
3. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology
4. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications
5. Digital Image Processing using Matlab, RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.

**Subject Name:** BIOINFORMATICS

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**Subject Name:** BIOINFORMATICS LAB

**Unit 1. Introduction to Bioinformatics**

Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

**Unit 2. Databases in Bioinformatics**

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

**Unit 3. Biological Sequence Databases**

National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

**Unit 4. Sequence Alignments**

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

**Unit 5. Molecular Phylogeny**

Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

**Unit 6. Applications of Bioinformatics**

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement

**Practical**

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.

4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

**Suggested Readings**

1. Ghosh Z. and Bibekanand M. (2008) *Bioinformatics: Principles and Applications*. Oxford University Press.
2. Pevsner J. (2009) *Bioinformatics and Functional Genomics*. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) *Discovering Genomics, Proteomics and Bioinformatics*. \_II Edition. Benjamin Cummings.

**Subject Name:** INSECT, VECTOR AND DISEASES

**Unit I: Introduction to Insects**

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

**Unit II: Concept of Vectors**

Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

**Unit III: Insects as Vectors**

Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

**Unit IV: Dipteran as Disease Vectors**

Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes

Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly

**Unit IV: Siphonaptera as Disease Vectors**

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases –Plague, Typhus fever; Control of fleas

**Unit V: Siphunculata as Disease Vectors**

Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse

**Unit VI: Hemiptera as Disease Vectors**

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

**Subject Name:** INSECT, VECTOR AND DISEASES LAB

1. Study of different kinds of mouth parts of insects

2. Study of following insect vectors through permanent slides/ photographs: Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phthirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors

**SUGGESTED READINGS**

- Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK
- Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK
- Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication
- Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

**Subject Name:** APICULTURE

**Unit 1: Biology of Bees**

History, Classification and Biology of Honey Bees. Social Organization of Bee Colony

**Unit 2: Rearing of Bees**

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)

**Unit 3: Diseases and Enemies**

Bee Diseases and Enemies Control and Preventive measures

**Unit 4: Bee Economy**

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

**Unit 5: Entrepreneurship in Apiculture**

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

**SUGGESTED READINGS**

- Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
- Bisht D.S., Apiculture, ICAR Publication.
- Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.

**Subject Name:** HISTOPATHOLOGY AND CYTOPATHOLOGY TECHNIQUES

1. Theory of histopathology, reception of specimens, histopathology of tumor cell.
2. Histopathology of liver, kidney, adrenal, ovary, testies.
3. Method of preparing stains & fixatives.
4. Theory of tissue processing and embedding.

5. Theory of h & e staining.
6. Use of microtome.
7. Tissues section cutting.
8. Embedding and preparation of blocks.
9. Fixation of tissue with DPX mount.
10. Theory of frozen section preparation.
11. Preparation of smear for fine needle aspiration cytology.
12. Pap's smear theory and identification of cells in a normal vaginal smear

**Subject Name:** PLANT AND ANIMAL TISSUE CULTURE TECHNIQUES AND APPLICATIONS

1. **Introduction to Techniques** - Introductory history, Laboratory organization, Media, Aseptic manipulation.
2. **Basic concepts in cell culture** - cell culture, Cellular Totipotency, Somatic Embryogenesis.
3. In vitro culture : approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture.
4. Tissue nutrition : Growth Hormones - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media); Animal cells (substrate on which cells grow, Feeder layer on substrate, gas phase for tissue culture, media and supplements).
5. Tissue culture methodologies - Plant cells (Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis); Animal cells (Source of tissue, primary culture, differentiation of cells, growth kinetics, animal cell lines and their origin and characterization).
6. Cloning & Selection of specific cell types – cloning, somatic cell fusion and HAT selection, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies.
7. Organ Culture - Culture of embryonic organs, whole embryo culture, culture of adult organs.

**Subject Name:** RECOMBINANT DNA TECHNOLOGY

1. **Gene Recombination and Gene transfer:** Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser.
2. **Changing genes:** site-directed mutagenesis and Protein engineering: Primer extension is a simple method for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.
3. **Genetic engineering in animals:** Production of transgenic mice, ES cells can be used for gene targeting in mice, Applications of gene targeting, Using Yeast to study Eukaryotic gene function, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines, Transgenic animals, Production of proteins of Pharmaceutical value.

4. Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *Arhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

**Procedure for Admission:**

Student may collect the information regarding admission through University website or helpdesk number according to their convenience. Student can download the admission form from the University website and send directly through online or offline mode to the University. After scrutinizing the documents and clearance of fees the admission will be confirmed and Registration/ Enrolment number will be issued.

**Fees Structure:**

Sr.no.	Particular	Fees
1	Course Fees	16,000/-
2	Credit Transfer/ Lateral Entry	1000/-
3	Continuation Fees	1000/-
4	Examination Fees	200/- (Per Paper)
5	Reappear/ Revaluation Fees	300/- (Per Paper)

In case of any scholarship applicable as per the UGC norms or any other statutory body, the admission committee will discuss the same and issue the appropriate decision accordingly.

The Examination will be conducted in Online/ Offline mode. The Evaluation will be done by the Internal Evaluators as well as External Evaluators.

The Result will be declared on the website of Centre for Distance & Online Education. After declaration of result student will be asked to submit re-evaluation form (if any) within 15 days of declaration of result.

**Requirement of the Laboratory:**

The University is going to use the ICT (Information Communication Technology) for conducting the programme. In case of any programme required practical to be conducted either the same will be performed by applying virtual reality methods or in offline mode at the University campus/ associated colleges. Also, the student will be provided a practical hand book for their help and better understanding.

Every Student would be provided SLM material in printed form. Also, the same will be available online on the University website.

**Cost Estimate of the Programme:**

The estimated cost would be Rs.4,00,000/- for programme development, delivery and maintenance.



## CENTRE FOR DISTANCE & ONLINE EDUCATION

*State Education & Skill Self-Sponsored University*

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### **Quality Assurance:**

Every year the curriculum of the course will be reviewed and forwarded to the Academic Council with suggestions. The Academic Council will discuss the suggestions and recommended to Board of Management for its approval. The changes in the course curriculum as per the needs and requirements from time to time. The University will help the passed-out students in their placement in different industries through their training and placement cell.