STAREX UNIVERSITY

SCHOOL OF LIFE SCIENCES

B.Sc. (Medical)

Course Structure & Syllabus Outline

(Undergraduate Program Effective From Year 2017-18)

STAREX UNIVERSITY

GURUGRAM, HARYANA (122413)

VISION OF COURSE

The current course structure of botany section under B.Sc. Medical was introduced by the faculty with the view of introducing students to recent developments in major disciplines of life sciences. They will be acquired with the knowledge of inter-disciplinary connections in science and how to utilize them for research purposes. Theory portion of each subject is updated in a way to build strong foundation of basics in students, followed by more technical yet syllabus relatable practicals. They will be exposed to the vast range of biological diversity by papers like Phycology, Mycology, Microbiology, Plant diversity. Study of angiosperms will be dealt in much greater details, covering all their aspects like reproduction, physiology, biochemistry, ecology, pathology, anatomy and systematics. Recently trending subjects like plant tissue culture, plant molecular biotechnology, environmental sciences are introduced to keep pace with the fast growing industrial demand and research work being done in them. With the hope that students will learn and think about the present global concerns and will work towards their solutions to build a better society.

PREAMBLE

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course**: Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course**: The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They (i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 **AE Compulsory Course (AECC)**: Environmental Science, English Communication/MIL Communication.

3.2 **AE Elective Course (AEEC)**: These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction. **Project work/Dissertation** is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of Courses Under B.Sc. (Medical) Undergraduate Programme

COURSE	CREDITS	
	Theory + Practical	Theory + Tutorials
1. Core Course (12 Papers in 3 years) 04 Courses from each of the 03 disciplines of choice **Core Course Practical / Tutorial*** (12 Practical/ Tutorials* in 3 years) 04 Courses from each of the 03 Disciplines of choice	12X4= 48 12X2=24	12X5=60 12X1=12
2. Elective Course (6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature. **Elective Course Practical / Tutorials*** (6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature	6x4=24 6 X 2=12	6X5=30 6X1=6
▪ Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester.		
3. Ability Enhancement Courses **a. Ability Enhancement Compulsory** (2 Papers of 2 credits each) Environmental Science English/MIL Communication **b. Ability Enhancement Elective** (Skill Based) (4 Papers of 2 credits each)	2 X 2=4 4 X 2=8	2X2=4 4 X 2=8
	Total credit= 120	Total credit= 120

***wherever there is practical there will be no tutorials and vice –versa.**

Structure of B.Sc. Medical under CBCS

SEM	CORE COURSE(12)	Ability Enhancement Compulsory Courses (2)	Skill Enhancement Courses (SEC) (2)	Discipline Specific Elective DSE (4)
1	CC-Botany I CC-Zoology II CC-Chemistry III	English communication/ Environmental Science	SEC-I	
2	CC-Botany IV CC-Zoology V CC-Chemistry VI	English communication/ Environmental Science	SEC-II	
3	CC-Botany VII CC-Zoology VIII CC-Chemistry IX		SEC-III	
4	CC-Botany X CC-Zoology XI CC-Chemistry XII		SEC-IV	
5			SEC-V	DSE-Botany I DSE- Zoology II DSE-Chemistry III
6			SEC-VI	DSE-Botany IV DSE- Zoology V DSE-Chemistry VI

Scheme of Papers for B.Sc. Medical under CBCS

SEMESTER	COURSE OPTED	COURSE NAME	Credits
1	Ability Enhancement Compulsory Course-I	English Communications/ Environmental Sciences	2
	Skill enhancement course-I	Basic IT	2
	Core Course Botany I	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4
	Core Course Botany I Practical	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	2
	Core Course Zoology II	Animal Diversity	4
	Core Course Zoology II Practical	Animal Diversity	2
	Core course Chemistry III	Chemistry-1	4
	Core Course Chemistry III Practical	Chemistry-1	2
2	Ability Enhancement Compulsory Course-II	English Communications/ Environmental Science	2
	Sill Enhancement course-II	Basic mathematics	2
	Core course Botany IV	Plant Ecology and Taxonomy	4
	Core Course Botany -IV Practical	Plant Ecology and Taxonomy	2
	Core Course Zoology V	Developmental Biology & Comparative Anatomy	4
	Core Course Zoology V Practical	Developmental Biology & Comparative Anatomy	2
	Core Course Chemistry VI	Chemistry-2	4
	Core Course Chemistry VI Practical	Chemistry-2	2

SEMESTER	COURSE OPTED	COURSE NAME	Credits
3	Skill Enhancement Course-III	Ethnobotany/ Aquarium keeping/ Basic analytical chemistry	2
	Core Course Botany VII	Plant Anatomy and Embryology	4
	Core Course Botany VII Practical	Plant Anatomy and Embryology	2
	Core Course Zoology VIII	Physiology and Biochemistry	4
	Core Course Zoology VIII Practical	Physiology and Biochemistry	2
	Core course Chemistry IX	Chemistry-3	4
	Core Course Chemistry IX Practical	Chemistry-3	2
4	Skill Enhancement Course-IV	Medicinal Botany/ Biostatics/ Fuel chemistry and chemistry of cosmetics and perfumes	2
	Core course Botany X	Plant physiology and metabolism	4
	Core Course Botany -X Practical	Plant physiology and metabolism	2
	Core Course Zoology XI	Genetics and evolutionary biology	4
	Core Course Zoology XI Practical	Genetics and evolutionary biology	2
	Core Course Chemistry XII	Chemistry-4	4
	Core Course Chemistry XII Practical	Chemistry-4	2

SEMESTER	COURSE OPTED	COURSE NAME	Credits
5	Skill Enhancement Course-V	Biofertilizers/FOOD, NUTRITION & HEALTH/ CHEMICAL TECHNOLOGY & SOCIETY and BUSINESS SKILLS FOR CHEMISTRY	2
	Discipline specific elective Course Botany I	*To be chosen by the students	4
	Discipline specific elective Course Botany practical I	*To be chosen by the students	2
	Discipline specific elective Course Zoology II	*To be chosen by the students	4
	Discipline specific elective Course Zoology practical II	*To be chosen by the students	2
	Discipline specific elective Course Chemistry III	*To be chosen by the students	4
	Discipline specific elective Course Chemistry practical III	*To be chosen by the students	2
6	Skill Enhancement Course-VI	*To be chosen by the students	2
	Discipline specific elective Course Botany IV	*To be chosen by the students	4
	Discipline specific elective Course Botany practical IV	*To be chosen by the students	2
	Discipline specific elective Course Zoology V	*To be chosen by the students	4
	Discipline specific elective Course Zoology practical V	*To be chosen by the students	2
	Discipline specific elective Course Chemistry VI	*To be chosen by the students	4
	Discipline specific elective Course Chemistry practical VI	*To be chosen by the students	2

SEMESTER I

Core Course: I
BOTANY
Biodiversity (Microbes, Algae, Fungi and Archegoniate)
THEORY

Paper Code: 0601101 **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

(10 Lectures)

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.

Section-B

(12 Lectures)

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.

Section-C

(12 Lectures)

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.

Section-D

(**26 Lectures)**

Unifying features of archegoniates, Transition to land habit, Alternation of generations. 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*.

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.

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.

Practical

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 50 **Credits: 2**

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. To perform gram staining. Study of types of Bacteria from temporary/permanent slides/photographs; EM bacterium.
3. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Oedogonium, Vaucheria*, *Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
4. Study of sexual and asexual stages through temporary mounts/permanent slides/specimens/photographs/ Herbarium specimens of *Rhizopus, Penicillium, Alternaria*, *Puccinia*, *Agaricus*.
5. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
6. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
7. Study of thallus morphology and reproductive structures through sectioning/temporary mounts/permanent slides/specimens of *Marchantia, Funaria*, *Selaginella, Equisetum, Pteris, Cycas*, *Pinus.*

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Core Course: II
ZOOLOGY
ANIMAL DIVERSITY
THEORY

Paper Code: 0601102 **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of marks and consists of short answer type questions of mark each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section A

Lower Non Chordates

Kingdom Protista: General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Phylum Porifera: General characters and classification up to classes; Canal System in *Sycon*

Phylum Cnidaria: General characters and classification up to classes; Polymorphism in Hydrozoa

Phylum Platyhelminthes: General characters and classification up to classes; Life history of *Taenia solium*

Phylum Nemathelminthes: General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations 17 Hrs

Section B

Higher Non Chordates

Phylum Annelida: General characters and classification up to classes; Metamerism in Annelida

Phylum Arthropoda: General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Phylum Mollusca: General characters and classification up to classes; Torsion in gastropods

Phylum Echinodermata: General characters and classification up to classes; Water-vascular system in Asteroidea 16 Hrs

Section C

Lower Chordates

Protochordates: General features and Phylogeny of Protochordata

Agnatha: General features of Agnatha and classification of cyclostomes up to classes

Pisces: General features and Classification up to orders; Osmoregulation in Fishess

Amphibia: General features and Classification up to orders; Parental care 15 Hrs

Section D

Higher Chordates

Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Aves: General features and Classification up to orders; Flight adaptations in birds

Mammals: Classification up to orders; Origin of mammals 12 Hrs

PRACTICAL

Paper Code: 0601102 **Time Allowed: 3 Hours**
Max. Marks: 50 **Credits: 2**

Study of the following specimens:

1. *Amoeba*, *Euglena, Plasmodium, Paramecium, Sycon*, *Hyalonema,* and *Euplectella*, *Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus, Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis,*

Any sixcommon birds from different orders, *Sorex*, Bat, *Funambulus, Loris*

2. Study of the following permanent slides:

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

3. Key for Identification of poisonous and non-poisonous snakes.

Suggested readings:

1. Parker, T.J. and Haswell, W.A. Text book of Zoology, Invertebrates. 7th ed., Vol. I. Delhi: CBS Publishers & Distributors, 1992.

2. Barnes, R.D. Invertebrate Zoology (1982) VI Edition. Holt Saunders International Edition.

3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.

4. Barrington, E.J.W. (1979) Invertebrate Structure and Functions.II Edition. E.L.B.S. and Nelson.

5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.

6. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

7. Kotpal, R.L. Text Book of Zoology Vertebrates, Meerut Rastogi Publications, 2012.

8. Parker, T.J., and Haswell, W.A. A Text Book of Zoology Vertebrates 7th ed. Vol. II London, Mac Millan, 1972.

9. Dodson, E.O. A Text Book of Zoology, Delhi CBS Publishers & Distributors, 1976.

10.Young, J. Z. The Life of Vertebrates III Edition. Oxford university press., 2004

11.Hall B.K. and Hallgrimsson B. Strickberger's Evolution IV Edition. Jones and Bartlett Publishers Inc 2008.

Core Course: III
CHEMISTRY
ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBON
THEORY

Paper Code: 0601103 **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of mark each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION -A

Atomic Structure

Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Schrodinger wave equation and meaning of various terms in it. Significance of ψ and $\psi 2$. 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, Shapes of s, p and d atomic orbitals, nodal planes. 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. Slater rules and applications. 14 Hrs

SECTION - B

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, 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 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 up to Ne (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches. 16 Hrs

SECTION - C

Fundamentals of Organic Chemistry

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

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. 8 Hrs

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer projections. 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). 10 Hrs

SECTION – D

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and antiMarkownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: Formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$. 12 Hrs

Suggested readings:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).

6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
9. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

LAB

Paper Code: **Time Allowed: 3 HOURS**
Max Marks: 50 **Credits – 2**

I. 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 KMnO4.

3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

II. Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing up to two extra elements)

2. Separation of mixtures by Chromatography: Measure of Rf value of a mixture of o-nitroaniline and p-nitroaniline.

Suggested readings:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Ability Enhancement Compulsory Course- I
Environmental Sciences

Paper Code: 0601191 **Time Allowed: 3 Hours**
Max. Marks:50 **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 10 marks each and may contain more than one part. Question 1 will be of 10 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section- A

Introduction to environmental studies

- Multidisciplinary nature of environmentalstudies;
- Scope and importance; Need for publicawareness.

Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a) Forestecosystem
b) Grasslandecosystem
c) Desertecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans,estuaries) 15HRS

Section- B

Natural Resources: Renewable and Non-renewable Resources

- Land resources and landuse change; Land degradation, soil erosion anddesertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribalpopulations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international &inter-state).
- Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs.

Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hotspots
- India as a mega-biodiversity nation; Endangered and endemic species ofIndia
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation ofbiodiversity.

15 HRS

Section – C

Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human healthrisks
- Solid waste management: Control measures of urban and industrialwaste.
- Environmental legalization and implementation in India.

Environmental Policies & Practices

- Sustainability and sustainable development.
- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act.
- Nature reserves and human wildlife conflicts in Indian context. 15HRS

Section – D

Human Communities and the Environment

- Human population growth: Impacts on environment, human health andwelfare.
- Disaster management: floods, earthquake, cyclones andlandslides.
- Environmental movements: Chipko, Silent valley, Bishnois ofRajasthan.
- Environmental ethics: Role of Indian and other religions and cultures inenvironmental conservation.

Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna,etc.
- Visit to a local pollutedsite-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles ofidentification.
- Study of simple ecosystems-pond, river, Delhi Ridge,etc.

15HRS

Suggested readings:

1. Bharucha, E. 2003, Textbook for Environmental Studies, University Grants Commission,
2. New Delhi and Bharati Vidyapeeth Institute of Environmental Education and Research, Pune. 361.
3. Carson, Rachel. 1962. Silent Spring (Boston: Houghton Mifflin, 1962), Mariner Books, 2002
4. Economy, Elizabeth. 2010. The River Runs Black: The Environmental Challenge to China's Future.
5. Gadgil, M. & Ramachandra, G. 1993. *This fissured land: an ecological history of India*. Univ of California Press.
6. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
7. Grumbine, R. Edward, and Pandit, M.K. Threats from India's Himalaya dams. *Science* 339.6115 (2013): 36-37.

Skill Enhancement Compulsory Course- I
INFORMATION TECHNOLOGY

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 50 **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 10 marks each and may contain more than one part. Question 1 will be of 10 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Introduction to Computers, characteristics and limitations of computer,uses of computers, Blockdiagram of Computer,
servers and super computers;Classification of computers, Types of computers, , computer generations.

Section-B

Input and output devices,
Memory: Concept of primary & secondary memory, RAM, ROM, types of ROM, Cache Memory

Section-C

Computer Networks: LAN, MAN, WAN, router, switch, hub, repeater, bridge,
gateway, modem,
Computer Virus: Definition,types of viruses, Characteristics of viruses, anti-virus software.

Section-D: Computer Lab work

MS Word: Getting Started Working with Microsoft Office
2010, Understanding Word Basics. Editing and Formatting Text, Documents; Microsoft Excel:
Understanding Excel Basics, Formatting and Editing the Worksheet,
Microsoft PowerPoint: Understanding PowerPoint Basics;Formatting and Modifying Presentations, Enhancing the Presentation.

Suggested Readings:
1. Fundamentals of Computers –P. K. Sinha; BPB Publication
2. Fundamentals of computers –V Rajaraman; Prentice Hall of India
3. Introduction to Information Technology: Leon and Leon; Leon Tech World
4. Information Technology in Business Management: MukeshDhunna& and J. B. Dixit; Laxmi Publications, New Delhi.
5. Computer Applications in Business Management: Versha Mehta, N. Kumar; Anmol Publications

SEMESTER-II

Core Course-IV
BOTANY
PLANT ECOLOGY AND TAXONOMY

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of mark each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

(17 Lectures)

Introduction and scope
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.
Plant communities: Characters; Ecotone and edge effect; Succession; Processes and types.

Section-B

(13 Lectures)

Ecosystem: Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous Principle biogeographical zones; Endemism

Section-C

(18 Lectures)

Introduction to plant taxonomy, Identification, Classification, Nomenclature.
Functions of Herbarium, important herbaria and botanical gardens of the world and India;
Documentation: Flora, Keys: single access and multi-access.
Taxonomic evidences from palyonology, cytology, phytochemistry and molecular data.
Taxonomic hierarchy: Ranks, categories and taxonomic groups 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.

Section-D

(12 Lectures)

Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).
Biometrics, numerical taxonomy and cladistics
Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

Practical

Paper Code: **Time Allowed: 3 HOURS**
Max Marks: 50 **Credits – 2**

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 dissolved oxygen of water samples from polluted and unpolluted sources.

6. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)

7. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law

8. 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.*

9. 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.

Core Course: V
ZOOLOGY
Developmental biology and Comparative Anatomy
THEORY

Paper Code: 0601202 **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2-3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section- A

Integumentary System: Derivatives of integument and glands

Skeletal System : Evolution of visceral arches

Digestive System : Brief account of alimentary canal and digestive glands 17 Hrs

Section B

Respiratory System : Brief account of Gills, lungs, air sacs and swim bladder

Circulatory System : Evolution of heart and aortic arches

Urinogenital System : Succession of kidney, Evolution of urinogenital ducts 18 Hrs

Section C

Nervous System: Comparative account of brain

Sense Organs: Types of receptors 14 Hrs

Section D

Early Embryonic Development : Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), 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.

Late Embryonic Development : Implantation of embryo and types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Control of Development : Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death 17 Hrs

PRACTICAL

Paper Code: **Time Allowed: 3 HOURS**
Max Marks: 50 **Credits – 2**

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:

1. Parker, T.J. and Haswell, W.A. Text book of Zoology, Invertebrates. 7th ed., Vol. I. Delhi: CBS Publishers & Distributors, 1992.
2. Barnes, R.D. Invertebrate Zoology (1982) VI Edition. Holt Saunders International Edition.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
4. Barrington, E.J.W. (1979) Invertebrate Structure and Functions.II Edition. E.L.B.S. and Nelson.
5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
7. Kotpal, R.L. Text Book of Zoology Vertebrates, Meerut Rastogi Publications, 2012.
8. Parker, T.J., and Haswell, W.A. A Text Book of Zoology Vertebrates 7th ed. Vol. II London, Mac Millan, 1972.
9. Dodson, E.O. A Text Book of Zoology, Delhi CBS Publishers & Distributors, 1976.
10. Young, J. Z. The Life of Vertebrates III Edition. Oxford university press., 2004
11. Hall B.K. and Hallgrimsson B. Strickberger's Evolution IV Edition. Jones and Bartlett Publishers Inc 2008.
12. Dhami, P.S., Dhami, J.K.Chordate Zoology 5th ed.New Delhi R. Chand & Co.,2006

Core Course: VI
CHEMISTRY -II
CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY
THEORY

Paper Code: 0601203 **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2-3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section -A

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.

12 Hrs

SECTION - B

Chemical Equilibrium:
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases. 6 Hrs

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. 10 Hrs

SECTION – C

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

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

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation, Williamson's ether synthesis. Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

17 Hrs

SECTION - D

Alcohols, Phenols and Ethers (Upto 5 Carbons)

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. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation Diols: (Upto 6 Carbons) 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.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: From acid chlorides and from nitriles.

Reactions: Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. 15 Hrs

Suggested readings:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

7. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
8. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
9. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

LAB COURSE

Paper Code: **Time Allowed: 3 HOURS**
Max Marks: 50 **Credits – 2**

I. 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 (KNO3, NH4Cl).

5. Determination of enthalpy of hydration of copper sulphate.

II. 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.

III. Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.

2. Criteria of Purity: Determination of melting and boiling points.

3. Preparations of organic compounds – Iodoform and Glucosazone

Suggested readings :

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

Ability Enhancement Compulsory Course-II
ENGLISH COMMUNICATION SKILLS

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 50 **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 10 marks each and may contain more than one part. Question 1 will be of 10 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Introduction: Theory of communication, types and modes of communication; Language and communication: Verbal and Non-verbal (Spoken and Written); Personal, Social and Business; Barriers and Strategies; Intra-personal and group communication.

Section-B

Speaking skills: Monologue Dialogue; Group discussion; Effective communication/Mis-communication; Interview; Public speech

Section-C

Reading and Understanding: Close reading; Comprehension; Summary Paraphrasing; Analysis and Interpretation; Translation (from Indian language to English and vice-versa); Literary/Knowledge Texts

Section-D

Writing skills: Documentation; Report writing; making notes; Letter writing

Suggested Readings:

1. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. Ranjana Kaul, Dr. Brati Biswas
2. Fluency in English, Part II Oxford University Press 2006
3. Business English, Pearson, 2008
4. Business Communication- K.K. Sinha- Galgotia publishing Company, New Delhi

Skill Enhancement Course-II
BASIC MATHEMATICS

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 50 **Credits: 2**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 10 marks each and may contain more than one part. Question 1 will be of 10 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

Matrices & Determinants: Definition, Types of Matrix, Algebra of Matrix, Transpose of Matrix, Adjoint of Matrix, Inverse of Matrix; Determinants; Solution of system of equations using Cramer's Rule;

Section-B

Limits &Continuity; Differentiation: Differentiation of sums, products & Quotients, Chain rule, Composite Differentiation; Simple Application of Differentiation

Section-C

Integration:Indefinite Integral, Method of Integration by substitution, by parts, by partial fraction; Simple application of integration;

Section-D

Sets, Venn diagram and its applications, Operations on sets, Cartesian product of sets; Measure of Central Tendency; Simple AP/GP problems;

Suggested Readings:

1. Business Mathematics For B.B.A: Janardian Dinodia & Dalip Kumar; Jeevansons Publications
2. Business Mathematics: Zameeruddin, Q; Vikash Publishing House Pvt. Ltd.
3. Mathematics-Volume II: R. D. Sharma; Dhanpat Rai Publications
4. Business Mathematics: Trivedi, K; Pearson Education India
5. NCERT Mathematics(XI,XII)

SEMESTER-III

Core Course-VII
BOTANY
PLANT ANATOMY AND EMBRYOLOGY
THEORY

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of mark each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

(12 Lectures)

Meristematic and permanent tissues
Root and shoot apical meristems; Simple and complex tissues.
Organs
Structure of dicot and monocot root, stem and leaf.

Section-B

(16 Lectures)

Secondary Growth
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).
Adaptive and protective systems
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Section-C

(16 Lectures)

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

Section-D

(16 Lectures)

Embryo and endosperm
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.
Apomixis and polyembryony
Definition, types and practical applications.

Practical

Paper Code: **Time Allowed: 3 HOURS**
Max Marks: 50 **Credits – 2**

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent Slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent Slides).
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 Slides).
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.

3. Esau, Katherine. (2016) Anatomy of Seed Plants. John Wiley and Sons, USA.

Core Course: VIII
ZOOLOGY
BIOCHEMISTRY AND PHYSIOLOGY
THEORY

Paper Code: **Time Allowed: 03 hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Course Objective: To acquaint students with the bimolecular processes and their working and the different internal processes. General physiology with special reference to mammals.

Section A

Introduction to Biochemistry- Carbohydrates: Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, algenic acids, pectins, proteoglycans, salicylic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Proteins: Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Separation of amino acids. Essential amino acids. Structure of peptide bond. Solid - phase synthesis of peptides. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides.

Levels of structure in protein architecture. denaturation and renaturation of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins. (**14 Hours)**

Section B

Nucleic Acid. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA double helix. Structure and roles of different types

of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome. Bile pigments - chemical nature and physiological significance.

Lipid: Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Synthesis of fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert - Meissel Number and reaction of glycerol. Biological significance of fats. Properties and functions of phospholipids, isoprenoids and sterols. (**13 hours)**

Section C

Digestion: Digestion of dietary constituents, viz. lipids, proteins, carbohydrates & nucleic acids; symbiotic digestion. Absorption of nutrients & assimilation; control of enzyme secretion. Transport through biomembranes (Active and Passive), buffers.

Respiration: Exchange of respiratory gases, transport of gases, lung air volumes, oxygen dissociation curve of hemoglobin, Bohr's effect, Haburger's phenomenon (Chloride shift), control / regulation of respiration. Excretion ; Patterns of excretory products viz. Amonotelic, ureotlic uricotelic, ornithine cycle (Kreb's–Henseleit cycle) for urea formation in liver.

Circulation: Origin, conduction and regulation of heart beat, cardiac cycle, electrocardiogram, cardiac output, fluid pressure and flow pressure in closed and open circulatory system; Composition and functions of blood & lymph; Mechanism of coagulation of blood, coagulation factors; anticoagulants, haempoiesis. (**19 Hours)**

Section D

Physiology of excretion and osmoregulation, neural transmission, muscles Excretion: Urine formation, counter-current mechanism of urine concentration, osmoregulation.

Neural Integration: Nature, origin and propagation of nerve impulse along with medullated & non-medullated nerve fibre, conduction of nerve impulse across synapse.

Muscles: Types of muscles, ultra-structure of skeletal muscle. Bio-chemical and physical events during muscle contraction; single muscle twitch, tetanus, muscle fatigue muscle, tone, oxygen debt., Cori's cycle, single unit smooth muscles, their physical and functional properties.

Physiology of endocrine system, thermoregulation Chemical integration of Endocrinology: Structure and mechanism of hormone action; physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads. (**14 Hours)**

PRACTICAL

Paper Code: **Time allowed: 03 hours**
Max. Marks: 50 **Credits: 2**

List of Practicals:

1. Qualitative tests for Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids
2. Preparation of casein from milk and determination of its isoelectric point.
3. Titrimetric analysis of Vitamin C.
4. Identification of food stuffs-starch, sucrose, glucose, proteins and fats.
5. Demonstration of osmosis and diffusion.
6. Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
7. Determination of coagulation and bleeding time of blood.
8. Determination of blood groups of human blood samples.
9. Recording of blood pressure of man.
10. Enumeration of red blood corpuscles and white blood corpuscles of man.
11. Estimation of haemoglobin content in blood.

Suggested readings

- Nelson, David L., and Cox, Michael M., Lehninger Principles of Biochemistry 5 th Edition, W.H. Freeman & Company, New York, 2008. Print.
- Voet, Donald and Voet, Judith G., Biochemistry, 3 Rd Edition, John Wiley & Sons Inc., Singapore, 2004. Print.
- Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's Illustrated Biochemistry, 27 th Edition, McGraw Hill Company Inc. Singapore, 2006. Print.
- Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company, 2006.
- Tortora, G.J. & Grabowski, S. Principles of Anatomy& Physiology. XI Edition John Wiley & sons, 2006.
- Vander A, Sherman J. and Luciano D. Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills, 2014.

Core Course: IX
CHEMISTRY
Solutions, Phase Equillibrium, Conductance, Electrochemistry & Organic Chemistry

Paper Code: **Time Allowed: 03 hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Section- A

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-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, NaCl-H_2O andMg-Znonly). **(15Hours)**

Section-B

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 acidbase).

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: ΔG, ΔH and ΔS 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 andoxidation-reductiononly). **(15Hours)**

Section– C

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids (aliphatic and aromatic) - Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) - Preparation: Acid chlorides,Anhydrides, Esters and Amides from acids and their inter conversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts: Amines (Aliphatic and Aromatic): (Upto 5 carbons - Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, reaction with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol,dyes. **(15Hours)**

Section- D

Amino Acids, Peptides and Proteins

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitter ion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

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 monosaccharide. Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding theirstructureelucidation. **(15Hours)**

Suggested readings:

- 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).
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar,I.L.OrganicChemistry(Volume1),DorlingKindersley(India)Pvt.Ltd.(PearsonEducation).
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).
- 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, W.H. Freeman,2002

PRACTICAL

Paper Code: **Time Allowed: 03 hours**

Max Marks: 50 **Credits: 2**

I. DistributionLaw

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

$I_2(aq) + I(aq) \rightleftharpoons I_3(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)x]^{2+}$

II. Conductance

1. Determination of cellconstant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weakacid.
3. Perform the following conductometric titrations:
   i) Strong acid vs. strong base
   ii) Weak acid vs. strongbase

Or

III. Potentiometry

Perform the following potentiometric titrations:

1. Strong acid vs. strongbase
2. Weak acid vs. strongbase
3. Potassium dichromate vs. Mohr'ssalt

IV. OrganicChemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctionalgroups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of onederivative.

2. Any Two of thefollowing:
   i) Separation of amino acids by paperchromatography
   ii) Determination of the concentration of glycine solution by formylationmethod.
   iii) Titration curve ofglycine
   iv) Action of salivary amylase onstarch
   v) Effect of temperature on the action of salivary amylase onstarch.
   vi) Differentiation between a reducing and a non-reducingsugar.

Suggested readings:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Skill Enhancement Course-III (OPTIONAL)
BOTANY
ETHNOBOTANY

Paper Code: **Time Allowed: 02 hours**
Max. Marks: 50 (40+10) **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section- A

Ethnobotany

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

(7 hours)

Section- B

Methodology of Ethnobotanical studies

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

(7 hours)

Section- C

Role of ethnobotany in modern Medicine

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria. Role of ethnobotany in modern medicine with special example Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania. Role of ethnic groups in conservation of plant genetic resources.Endangered taxa and forest management (participatory forest management). **(10 hours)**

Section- D

Ethnobotany and legal aspects

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with fewexamples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

(8 hours)

Suggested readings:

- S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- Lone et al,. Palaeoethnobotany
- S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.
- Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons-Chichester
- Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.
- Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA SHREE Publishers, Jaipur-1996
- Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd.

ZOOLOGY

AQUARIUM KEEPING

Paper Code: **Time allowed: 02 hours**

Maximum Marks: 50 (40+10) **Credit: 2**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section A

Introduction to Aquarium Fish Keeping: The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes.

(**8 Hours)**

Section B

Biology of Aquarium Fishes: Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.

(**8 Hours)**

Section C

Food and feeding of Aquarium fishes: Use of live fish feed organisms. Preparation and composition of formulated fish feeds

Fish Transportation: Live fish transport - Fish handling, packing and forwarding techniques.

(8 Hours)

Section D

Maintenance of Aquarium: General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry. **Establishing an aquarium for the use of students.**

(**8 Hours)**

Suggested readings:

- Textbook of pisciculture and aquarium keeping by HS Jagtap, SN Mukharjee, VK Garad, 200

CHEMISTRY
BASIC ANALYTICAL CHEMISTRY

Paper Code: **Time Allowed: 02 hours**
Max. Marks: 50 **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section– A

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 ofindicators.
a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometrictitration.

(8Hours)

Section– B

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 andcolouring matter.

(9Hours)

Section– C

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.
a. Paper chromatograrsrsphic separation of mixture of metal ion (Fe^{3+} and 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 isnot feasible). **(6Hours)**

Section– D

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. **(8 Hours)**

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelerants.

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flamephotometry.

b. Spectrophotometric determination of Iron in Vitamin / DietaryTablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid inSoftDrink.

Suggested readings:

- 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 IndiaEd.
- 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, McGrawHill.
- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall ofIndia.
- 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., PrenticeHall.
- Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., PrenticeHall.
- Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York(1995)

SEMESTER-IV

Core Course- X
BOTANY
PLANT PHYSIOLOGY AND METABOLISM
(THEORY)

Paper Code: **Time Allowed: 3 Hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Section-A

(20 Lectures)

Plant-water relations

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

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.

Translocation in phloem

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

Section-B

(14 Lectures)

Enzymes

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

Respiration

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

Section-C

(14 Lectures)

Photosynthesis

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C_3, C_4 and CAM pathways of carbon fixation; Photorespiration.

Nitrogen metabolism

Biological nitrogen fixation; Nitrate and ammonia assimilation.

Section-D

(12 Lectures)

Plant growth regulators

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

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

Paper Code: **Time Allowed: 03 hours**

Max Marks: 50 **Credits: 2**

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. Demonstrate the activity of catalase and study the effect of temperature.
5. To study the effect of temperature, light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.
7. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration/ Stomatal transpiration.
4. Phototropism.
5. Respiration in roots.

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th 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.

Core Course: XI
ZOOLOGY
EVOLUTION AND GENETICS
THEORY

Paper Code: **Time Allowed: 03 hours**

Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Course Objective: This course is aimed at understanding the basic concepts evolution and theories emerging of species and to develop an understanding of genetics at molecular level to develop analytical and quantitative skills.

Section A

Evolution: Age of earth, Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism.

Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution, molecular clock, example of globin gene family, rRNA/cyt c Sources of variations: Heritable variations and their role in evolution.

Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon).

(**21 Hours)**

Section B

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation/ macroevolution (exemplified by Galapagos finches) Extinctions: Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

Origin and evolution of man: Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin.

Phylogenetic trees: Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees. (**15 Hours)**

Section C

Chromosome: Theory of Inheritance, The chromosome theory of heredity, Sex chromosomes, Sex linkage, the parallel behaviour of autosomal genes and chromosomes.

Mendelian laws of inheritance, Monohybrid cross and the law of segregation, Dihybrid cross and law of independent assortment, Chromosome theory of inheritance, Multiple allele, lethal allele, Blood group, Rh factor, Gene interactions, Modified dihybrid ratio. Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Three point testcross, Interference, Calculating recombinant frequencies from selfed dihybrids, examples of linkage maps, The X2 test mitotic segregation in humans. (**12 Hours)**

Section D

Fine Structure of Genes and Chromosomes.

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. Structural organisation of chromatids, Centromeres, Telomeres, Chromatin, Nucleosome organisation; Euchromatin and heterochromatin; Special chromosomes (e.g., polytene and lampbrush chormosomes), Banding patterns in human chromosomes. Structural and numerical aberrations involving chromosomes; Hereditary defects - Kleinefelter, Turner, Cri-du-Chat and Down syndromes. Mutations - spontaneous and induced, Chemical and physical mutagens.

Extrachromosomal inheritance and Molecular Genetics, Coiling of shell in snails, Mitochondrial and chloroplast genetic systems, population genetics: Hardy-Weinberg equilibrium, Gene and genotypic frequencies. (**12 Hours)**

Evolution and Genetics Lab

Paper Code: **Time Allowed: 03 hours**
Max. Marks: 50 **Credits: 2**

Experiments

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Study of Mendelian crosses, incomplete dominance and gene interaction (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4) and test cross
5. Blood Typing: ABO groups & Rh factor.
6. Study of inheritance of Rh factor and blood groups
7. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
9. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
10. Study of human genetic traits: Sickle cell anaemia, Xeroderma pigmentosum, Albinism, red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.

Suggested readings:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
- Strickberger, M.W. Genetics. 3rd Edition. Prentice-Hall, India. 2008. Print.
- Jones, S. The Language of the Genes. HarperCollins Publishers. 2012. Print.
- Ridley, M. Nature via Nurture: Genes, Experience, & What Makes Us Human. HarperCollins Publishers. 2004. Print.
- Aggarwal, V.K. and Verma, V.S. Genetics. 9th Edition. S. Chand, India. 2010. Print.

Core Course: XII
CHEMISTRY
Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics
THEORY

Paper Code: **Time Allowed: 03 hours**
Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Section- A

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.
Lanthanides and actinides: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides and actinides (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 nomenclature ofcoordinationcompounds. **(16Hours)**

Section- B

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 CF splitting. Spectrochemical series. Comparison of CF Splitting for Octahedral and tetrahedral complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Squareplanarcoordination.
(14 Hours)

Section- C

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_2.
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 (qualitativetreatmentonly).**(16Hours)**

Section- D

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 (qualitativetreatmentonly). **(14Hours)**

Suggested readings:

- 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 UniversityPress.
- Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt.Ltd.
- Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd.,2008.

Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Lab

Paper Code: **Time Allowed: 03 hours**

Max Marks:50 **Credits: 2**

Inorganic Mixture Analysis - Semi-micro qualitative analysis of inorganic mixture using H_2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH^{4+}, Pb^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, $Ça^{2+}$, K^{+}
Anions : CO_3^{2-}, S^{2-}, $S_2O_3^{2-}$, NO_3^{-} , CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, F^{-}, SO_4^{2-}, PO_4^{2-}, BO_3^{3-}, $C_2O_4^{2-}$

(Spot tests should be carried out wherever feasible)

1. **Gravimetry**

Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.

2. **Colorimetry**

Draw calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound ($KMnO_4$/ $CuSO_4$) and estimate the concentration of the same in a given solution.

3. **Complexometrictitrations**

a) Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations usingEDTA.

b) Estimation of total hardness of a given sample of water by complexometrictitration.

4. **Surface tension measurement** (use of organic solventsexcluded).

a) Determination of the surface tension of a liquid or a dilute solution using astalagmometer.

b) Study of the variation of surface tension of a detergent solution withconcentration.

5. **Viscosity measurement** (use of organic solventsexcluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using anOstwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration ofsolute.

6. **Chemical Kinetics**

Study the kinetics of the following reactions.

a) Initial rate method: Iodide-persulphate reaction

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_2SO_4 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)

Skill Enhancement Course-IV (Optional)
BOTANY
Medicinal Botany

Paper Code: **Time Allowed: 02 hours**
Max. Marks: 50 (40+10) **Credits: 2**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section- A

Market scenario of medicinal plants, WHO standards and quality control, challenges for herbal market, future strategy for medicinal plants
Classification, identification and naming of medicinal plants **(7 Hours)**

Section- B

Production and management of medicinal plants on farms: time of planting, preparation of soil, nursery techniques and planting techniques
Cultivation of medicinal plants: evolution of sustainable agriculture, organic farming, ecological farming system and MTAS.
Propagation of medicinal plants **(8 Hours)**

Section- C

Diseases of medicinal plants: plant pathogen relation, disease development, classification, diseases in *Digitalis*, *Withania*, *Datura*, Opium poppy, periwinkle.
Pest management: Ecological, physical and mechanical control, biological control and host resistance **(8 Hours)**

Section- D

Harvest technology: harvesting, processing, preservation and standardization
Conservation strategies, legislation for protection of traditional knowledge, National Medicinal Plants Board **(8 Hours)**

Suggested readings:

- Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
- Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

ZOOLOGY
BIOSTATICS

Paper Code: **Time Allowed: 02 hours**
Max. Marks: 50 (40+10) **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section A

Biological variables, Data displays & Descriptive statistics, Sampling Distributions, Probability rules & Probability distributions (Normal & Binomial).

(**8 Hours)**

Section B

Introduction to inference; Sampling Distributions & Confidence intervals, Hypothesis Testing Type I & II errors. (**8 Hours)**

Section C

Comparing Two Means**,** Comparing paired samples; Statistical power**,** Non-parametric alternatives: Analysis of Variance (ANOVA) ANOVA I. (**8 Hours)**

Section D

Introduction to bivariate analysis - Correlation & regression; Linear regression, Correlation & Regression. **Experiments:**Exercise related to Data representation**,**Data Comparison**,** Application of Correlation and regression**,** ANOVA and Chi Square tests (**8 Hours)**

Suggested readings:

- Design and Analysis of Experiments,by Douglas C. Montgomery 8 edition
- Basics of Biostatistics: A Manual for Medical Practitioners 2017 by Jatinder Bali (Author), Anil Kant (Author)

CHEMISTRY
FUEL CHEMISTRY AND CHEMISTRY OF COSMETICS AND PERFUMES

Paper Code: **Time Allowed: 02 hours**
Max. Marks: 50 (40+10) **Credits: 2**

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 02 hours.

Section-A

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.
Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.
Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products andtheir applications.
(9Hours)

Section-B

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.
Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination. **(9 Hours)**

Section-C

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams

(cold, vanishing and shaving creams), antiperspirants and artificialflavours.
(6 Hours)

Section-D

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone,Civetone,Muscone.
(6 Hours)

Suggested readings:

- E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd.UK.
- P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons,Delhi.
- Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut(1996).
- Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).2.
- Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons,Delhi.
- Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meeruts(1996).

SEMESTER V

Discipline Specific Elective Botany- I (OPTIONAL)
Cell and Molecular Biology

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section- A

Techniques in Biology

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

Cell as a unit of Life

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. **12 Hrs**

Section-B

Cell Organelles

Mitochondria:- Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; mitochondrial DNA. Chloroplast-Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes:-Structures and roles.

Peroxisomes and Glyoxisomes:_Structures, composition, functions in animals and plants and biogenesis.

Nucleus:- Nuclear Envelope- structure of nuclear pore complex; chromatin; DNA packaging in eukaryotes, euchromatin and hcterochromatin, nucleolus and ribosome structure (brief).

Cell Membrane and Cell Wall

The functions of membranes; Models of membrane structure; Membrane proteins and their functions; Carbohydrates in the membrane; Selective permeability of the membranes; Cell wall. **20 Hrs**

Section- C

Cell Cycle

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

Genetic material

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi—conservative, semi discontinuous RNA priming, theta mode of replication, replication of linear ds- DNA, replicating the 5 end of linear chromosome including replication enzymes.

18 Hrs

Section- D

Transcription (Prokaryotes and Eukaryotes)

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

Regulation of gene expression

Prokaryotes: Lac operon and Tryptophan operon ; and in Eukaryotes. **10 Hrs**

Practical

Paper Code: **Time Allowed: 03 hours**

Max Marks:50 **Credits: 2**

I. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs or cell organllies
3. To study the structure of plant cell through temporary mounts.
4. To prepare temporary stained preparation of mitochondria from striated muscle cells/cheek epithelial cells using vital stain Janus green.
5. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
6. Study of mitosis and meiosis (temporary mounts and permanent slides).
7. Demonstration of dialysis of starch and simple sugar.
8. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
9. Measure the cell size (either length or breadth/diameter) by micrometry.
10. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
11. Study DNA packaging by micrographs.
12. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinaucr Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Discipline Specific Elective Botany-I

Analytical Techniques in Plant Sciences

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION A

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. **15Hrs**

SECTION B

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.
Use in biological research, auto-radiography, pulse chase experiment. **15Hrs**

SECTION C

Spectrophotometry: Principle and its application in biological research.
Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange
chromatography; Molecular sieve chromatography; Affinity chromatography. **15Hrs**

SECTION D

Characterization of proteins and nucleic acids
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE
Biostatistics
Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.
15Hrs

Practicals

Paper Code: **Time Allowed: 03 hours**
Max Marks:50 **Credits: 2**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd Edition
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

Discipline Specific Elective Zoology-II (OPTIONAL)
IMMUNOLOGY

Paper Code: **Time Allowed: 03 hours**

Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Course Objective: This course is aimed at understanding the basic concepts of Immunology, their system and significance in disease protection.

Section A

Overview of Immune System, Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system. Innate and Adaptive ImmSection y. Anatomical barriers, Inflammation, Cell and molecules involved in innate immSection y, Adaptive immSection y (Cell mediated and humoral), Passive & Artificial and natural ImmSection y, Active: Artificial and natural ImmSection y, Immune dysfunctions (brief account of autoimmSection y with reference to Rheumatoid Arthritis and tolerance, AIDS).

18 Hrs

Section B

Antigens: Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes. Immunoglobulins 10 Structure and functions of different classes of immunoglobulins, Antigenantibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis **18Hrs**

Section C

Major Histocompatibility Complex 6 Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation, Cytokines: Properties and functions of cytokines, Therapeutics Cytokines **12Hrs**

Section D

Complement System: Components and pathways of complement activation. Hypersensitivity, Gell and Coombs' classification and brief description of various types of hypersensitivities. Vaccines: Various types of vaccines. **12 Hrs**

IMMUNOLOGY PRACTICAL

Paper Code: **Time Allowed: 03 hours**
Max Marks:50 **Credits: 2**

1*. Demonstration of lymphoid organs.

2. Histological study of spleen, thymus and lymph nodes through slides/ photographs

3. Preparation of stained blood film to study various types of blood cells.

4. Ouchterlony's double immuno-diffusion method.

5. ABO blood group determination.

6*. Cell counting and viability test from splenocytes of farm bred animals/cell lines.

7. Demonstration of : a. ELISA b. Immunoelectrophoresis

*The experiments can be performed depending upon usage of animals in UG courses.

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology,* VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology.* V Edition. Saunders Publication.

Discipline Specific Elective Zoology-II
REPRODUCTIVE BIOLOGY

Paper Code: **Time Allowed: 03 hours**

Max. Marks: 75 **Credits: 4**

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

SECTION-A

Reproductive Endocrinology

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, andprostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophinsecretion in male and female; Reproductive System: Development and differentiation ofgonads, genital ducts, external genitalia, mechanism of sex differentiation. **15Hrs**

SECTION-B

Functional anatomy of male reproduction

Outline and histological of male reproductive system in rat and human; Testis: Cellularfunctions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonalregulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation;Accessory glands functions; Sperm transportation in male tract. **15Hrs**

SECTION-C

Functional anatomy of female reproduction

Outline and histological of female reproductive system in rat and human; Ovary:folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis andsecretion of ovarian hormones; Reproductive cycles (rat and human) and their

regulation,changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in thefemale tract, fertilization; Hormonal control of implantation; Hormonal regulation ofgestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition andits hormonal regulation; Lactation and its regulation. **15Hrs**

SECTION-D

Reproductive Health

Infertility in male and female: causes, diagnosis and management; Assisted ReproductiveTechnology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT,IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographicterminology used in family planning. **15Hrs**

REPRODUCTIVE BIOLOGY PRACTICAL

Paper Code: **Time Allowed: 03 hours**
Max Marks:50 **Credits: 2**

1. Study of animal house: set up and maintenance of animal house, breeding techniques,

care of normal and experimental animals.

2. Examination of vaginal smear rats from live animals.

3. Surgical techniques: principles of surgery in endocrinology. Ovarectomy,

hysterectorny, castration and vasectomy in rats.

4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.

5. Human vaginal exfoliate cytology.

6. Sperm count and sperm motility in rat

7. Study of modern contraceptive devices

SUGGESTED READINGS

- Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
- Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
- Hatcher, RA. et al. The Essentials of Contraceptive Technology. Population

Information Programme.

Discipline Specific Elective Chemistry-III (OPTIONAL)
ANALYTICAL METHODS IN CHEMISTRY

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of theirexpression, normal law of distribution if indeterminate errors, statistical test of data; F, Q andt test, rejection of data, and confidence intervals.

Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy andselection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry*:* Basic principles of instrumentation (choice of source,monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis*:* estimation of metal ions from aqueous solution,geometrical isomers, keto-enol tautomers. Determination of composition of metal complexesusing Job's method of continuous variation and mole ratio method.

(15 Hours)

SECTION-B

Optical methods of analysis: Basic principles of quantitative analysis:estimation of metal ions from aqueous solution,geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes**using Job's method of continuous variation and mole ratio method.**

Infrared Spectrometry*:* Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling

techniques.Structural illustration through interpretation of data, Effect and importance of isotopesubstitution.

Flame Atomic Absorption and Emission Spectrometry*:* Basic principles of instrumentation(choice of source, monochromator, detector, choice of flame and Burner designs. Techniquesof atomization and sample introduction; Method of background correction, sources ofchemical interferences and their method of removal. Techniques for the quantitativeestimation of trace level of metal ions from water samples. **(16 Hours)**

SECTION-C

Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Separation techniques:Solvent extraction: Classification, principle and efficiency of the technique. **Mechanism of extraction**: extraction by solvation and chelation.**Technique of extraction**: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non aqueous media. (**15 Hours)**

SECTION-D

Chromatography: Classification, principle and efficiency of the technique.**Mechanism of separation**: adsorption, partition & ion exchange.**Development of chromatograms**: frontal, elution and displacement methods.**Qualitative and quantitative aspects of chromatographic methods of analysis**: IC, GLC, GPC,TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). **(14 Hours)**

ANALYTICAL METHODS IN CHEMISTRY LAB

Paper Code: Time Allowed: 3 Hours

Max Marks:50 Credits – 2

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe3+, Al3+, and Cr3+.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex inchloroform, and determine its concentration by spectrophotometry

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.

3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).

5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Suggested readings:

- Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
- Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
- Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
- Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.

Discipline Specific Elective Chemistry-III
INDUSTRIAL CHEMICALS AND ENVIRONMENT

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

(14 Hours)

SECTION-B

Industrial Metallurgy

General Principles of Metallurgy - Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process. Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Environment and its segments: Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO_2, CO_2, CO, NOx, H_2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates. **(16 Hours)**

SECTION-C

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature ofwater pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc.

Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

(16 Hours)

SECTION-D

Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis: Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry **(14 Hours)**

INDUSTRIAL CHEMICALS AND ENVIRONMENT LAB

Paper Code: Time Allowed: 3 Hours

Max Marks:50 Credits – 2

1. Determination of dissolved oxygen in water.

2. Determination of Chemical Oxygen Demand (COD)

3. Determination of Biological Oxygen Demand (BOD)

4. Percentage of available chlorine in bleaching powder.

5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).

6. Estimation of total alkalinity of water samples (CO^{2-}, HCO^{-}) using double titration method.

7. Measurement of dissolved CO_2.

8. Study of some of the common bio-indicators of pollution.

9. Estimation of SPM in air samples.

10. Preparation of borax/ boric acid.

Suggested readings:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. K. De, Environmental Chemistry: New Age International Pvt. Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

Skill Enhancement Course-V (OPTIONAL)
BOTANY
Biofertilizers

Paper Code: Time Allowed: 2 Hours

Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours.

Section-A

General account about the microbes used as biofertilizer -*Rhizobium* — isolation, identification, mass multiplication, carrier based inoculants, Actinomycorrhizal symbiosis. *Azospirillum*- isolation and mass multiplication — carrier based inoculant, associativeeffect of different microorganisms. **8Hrs**

Section-B

Azotobacter: classification, characteristics — crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation. **7Hrs**

Section-C

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield — colonization of VAM — isolationand inoculum production of VAM, and its influence on growth and yield of crop plants.

8Hrs

Section-D

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. **7Hrs**

Suggested Readings

I. 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.

Skill Enhancement Course- V
Zoology
FOOD, NUTRITION AND HEALTH

Paper Code: Time Allowed: 2 Hours
Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours.

SECTION A

Basic concept of food and nutrition 10

Food Components and food-nutrientsConcept of a balanced diet, nutrient needs and dietary pattern for various groupsadults,pregnant and nursing mothers, infants, school children, adolescents and
Elderly

SECTION B

HEALTH: Introduction to health- Definition and concept of healthMajor nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkorand marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodinedeficiency disorders- their causes, symptoms, treatment, prevention andgovernment programmes, if any.

SECTION C

Health 15

Life style related diseases- hypertension, diabetes mellitus, and obesity- theircauses and prevention through dietary and lifestyle modificationsSocial health problems- smoking, alcoholism, drug dependence and AcquiredImmuno Deficiency Syndrome (AIDS) - their causes, treatment and preventionCommon ailments- cold, cough, and fevers, their causes and treatment.

SECTION D

Food hygiene: **15**

Potable water- sources and methods of purification at domestic levelFood and Water borne infections: **Bacterial infection**: Cholera, typhoid fever,dysentery; **Viral infection**: Hepatitis, Poliomyelitis, **Protozoan infection**:amoebiasis, giardiasis; **Parasitic infection**: taeniasis and ascariasis theirtransmission, causative agent, sources of infection, symptoms and preventionBrief account of food spoilage: Causes of food spoilage and their preventivemeasures

SUGGESTED READINGS

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

Skill Enhancement Course- V
Chemistry
CHEMICAL TECHNOLOGY & SOCIETY and BUSINESS SKILLS FOR CHEMISTRY

Paper Code: Time Allowed: 2 Hours
Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours.

Section -A

Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction tocleantechnology. **(9Hours)**

Section-B

Society

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufactureofdrugs.

(9Hours)

Section - C

Business Basics

Key business concepts: Business plans, market need, project management and routes to

market.

Chemistry in Industry Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies

(6Hours)

Section – D

Making money

Financial aspects of business with case studies

Intellectual property

Concept of intellectualproperty,patents.

(6Hours)

Reference Books:

1. www.rsc.org
2. John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13thEd.

SEMESTRE VI

Discipline Specific Elective-IV (OPTIONAL)
Botany
Economic Botany and Biotechnology

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:
1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section- A

Origin of Cultivated Plants
Concept of centres of origin, their importance with reference to Vavilov's work

Cereals, Legumes & Spices
Wheat and Rice & Maize -Origin, morphology, uses
General account with special reference to Gram and soybean
General account with special reference to clove, coriander, fennel, cardamom and black pepper (Botanical name, family, part used, morphology and uses)

14Hrs

Section-B

Fibre Yielding Plants and Wood Sources
General description with special reference to Cotton and jute (Botanical name, family, part used, morphology and uses)General account of sources of firewood, timber and bamboos

Beverages, Oils and Fats Tea and coffee (processing, uses)Generaldescription with special reference to groundnut, mustard and coconut **14Hrs**

Section- C

Plant tissue culture
Overview of plant cells, Totipotency, Tissue culture media-composition, pH and sterilization, Types of tissue cultures- callus, cell-suspension, protoplast, organ, meristem and embryo cultures

Applications of plant tissue culture
Haploid production through androgenesis and gynogenesis, Somatic embryogenesis, organogenesis, somaclonal and gametoclonal variations, Somatic hybridization, clonal propagation, virus-free plants, artificial seeds and production of secondary metabolites

16Hrs

Section- D

Biotechnology
Basics of DNA cloning, Enzymes for DNA manipulation, Vectors, Introduction of DNA into host cell, selectable marker, selection of transformed cells, Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR
Applications of biotechnology Recombinant proteins, Medicine, Gene therapy, Agriculture, Forensic sciences and Archaeology

16Hrs

Practical

Paper Code: Time Allowed: 3 Hours

Max Marks: 50 Credits – 2

I. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

1. Kochhar, S.L. (201I). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, Bit., Pasternak, (2003). **Molecular** Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Discipline Specific Elective-IV
Botany
Bioinformatics

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A

Introduction to Bioinformatics

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

Databases in Bioinformatics

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System. **12 Hrs**

SECTION-B

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. **18 Hrs**

SECTION-C

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). **12Hrs**

SECTION-D

Molecular Phylogeny

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

Phylogenetic Prediction.
Applications of Bioinformatics Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement. **18Hrs**

Practical

Paper Code: Time Allowed: 3 Hours
Max Marks:50 Credits – 2

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.

Discipline Specific Elective-V (OPTIONAL)
Zoology
ANIMAL BIOTECHNOLOGY

Paper Code: Time Allowed: 03 hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

SECTION A

Introduction Concept and scope of biotechnology **8 hrs.**

SECTION B

Molecular Techniques in Gene manipulation

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics) Restriction enzymes: Nomenclature, detailed study of Type II.

Transformation techniques: Calcium chloride method and electroporation.

Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

Southern, Northern and Western blotting; DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

24Hrs

SECTION C

Genetically Modified Organisms

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection Applications of transgenic animals: Production of pharmaceuticals, production of
donor organs, knockout mice.

Production of transgenic plants: *Agrobacterium* mediated transformation. Applications of transgenic plants: insect and herbicide resistant plants.

18 Hrs.

SECTION D

Culture Techniques and Applications

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia) Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

10 Hrs

ANIMAL BIOTECHNOLOGY PRACTICAL

Paper Code: Time Allowed: 3 Hours

Max Marks:50 Credits – 2

1. Genomic DNA isolation from *E. coli*
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs

a) Southern Blotting
b) Northern Blotting
c) Western Blotting
d) DNA Sequencing (Sanger's Method)
e) PCR
f) DNA fingerprinting

7. Project report on animal cell culture

SUGGESTED READINGS

□ □ Brown, T.A. (1998)*Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.

□ □ Glick, B.R. and Pasternak, J.J. (2009)*Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

□ □ Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). *An Introduction to Genetic Analysis*. IX Edition. Freeman and Co., N.Y., USA.

□ □ Snustad, D.P. and Simmons, M.J. (2009)*Principles of Genetics.* V Edition, John Wiley and Sons Inc.

□ □ Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007)*Recombinant DNAGenes*
and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA.

□ □ Beauchamp, T.I. and Childress, J.F. (2008)*Principles of Biomedical Ethics.* VI Edition, Oxford University Press.

Discipline Specific Elective-V (OPTIONAL)
Zoology
Animal Behaviour and Chronobiology

Paper Code: Time Allowed: 03 hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 03 hours.

Course Objective: This course is aimed at understanding the basic concepts of Animal behavior, their regulation with the surroundings and nature; and significance.

Section A

Introduction to Animal Behaviour

Proximate and ultimate causes of behaviour, Methods and recording of a behavior. **Patterns of Behaviour:** Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting. **16Hrs**

Section B

Social and Sexual Behaviour: Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care. **16Hrs**

Section C

Introduction to Chronobiology: Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks. **Biological Rhythm**

Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic

and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin. **16Hrs**

SECTION D

Biological Clocks Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy. **12Hrs**

PRACTICAL

Paper Code: Time Allowed: 3 Hours
Max Marks:50 Credits – 2

1. To study nests and nesting habits of the birds and social insects.

2. To study the behavioural responses of wood lice to dry and humid conditions.

3. To study geotaxis behaviour in earthworm.

4. To study the phototaxis behaviour in insect larvae.

5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

6. Study and actogram construction of locomotor activity of suitable animal models.

7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

SUGGESTED READINGS

- David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Discipline Specific Elective-VI (OPTIONAL)
Chemistry
INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A

Introduction to spectroscopic methods of analysis

Introduction to spectroscopic methods of analysis: Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

Molecular spectroscopy

Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. **(14 Hours)**

SECTION-B

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags) **(14 Hours)**

SECTION-C

Separation techniques Chromatography: Gas chromatography, liquid chromatography,

supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. Immunoassays and DNA techniques

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

(16 Hours)

SECTION-D

Elemental analysis: Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). (8 Lectures)

NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications. Electroanalytical Methods: Potentiometry & Voltammetry

Radiochemical Methods , X-ray analysis and electron spectroscopy (surface analysis)

(16 Hours)

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS LAB

Paper Code: Time Allowed: 3 Hours

Max Marks:50 Credits – 2

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture

13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
16. Use of “presumptive tests” for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Suggested readings:

• Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN
0-495-01201-7).
• Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle
• P.W. Atkins: Physical Chemistry.
• G.W. Castellan: Physical Chemistry.
• C.N. Banwell: Fundamentals of Molecular Spectroscopy. • Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.

Discipline Specific Elective-VI
Chemistry
POLYMER CHEMISTRY

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A

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.

(15 Hours)

SECTION-B

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.

(16 Hours)

SECTION-C

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

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.

(**15 Hours)**

SECTION-D

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)]

(14 Hours)

POLYMER CHEMISTRY LAB

Paper Code: Time Allowed: 3 Hours

Max Marks:50 Credits – 2

I. 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-isobutylonitrile (AIBN)
2. Preparation of nylon 66
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).

II. Polymer characterization

1. Determination of molecular weight by viscometry:

(a) Polyacrylamide-aq.$NaNO_2$ solution

(b) (Poly vinyl proplylidine (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.

***At least 7 experiments to be carried out**

Suggested readings:

1. Seymour, R.B. & Carraher, C.E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.
2. Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, NewYork, 1966

Skill Enhancement Course-VI (OPTIONAL)
Botany
Herbal Technology

Paper Code: Time Allowed: 2 Hours
Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours

Section-A

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.
Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. **8Hrs**

Section-B

Phytochemistry - active principles and methods of their testing - identification andutilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera*(drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centellaasiatica* (memory booster). **7Hrs**

Section-C

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) **8Hrs**

Section-D

Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) **7Hrs**

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.

Skill Enhancement Course- VI
Zoology
MEDICAL DIAGNOSTICS

Paper Code: Time Allowed: 2 Hours
Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours

SECTION A

Introduction to Medical Diagnostics and its Importance &Diagnostics Methods Used for Analysis of Blood 10

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) **(12 Hours)**

SECTION B

Diagnostic Methods Used for Urine Analysis Urine Analysis: Physical characteristics; Abnormal constituents**Non-infectious Diseases** Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type Iand Type II), Hypertension (Primary and secondary), Testing of blood glucose usingGlucometer/Kit **(12 Hours)**

SECTION B

Infectious Diseases

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis **(4 Hours)**

SECTION B

Tumours

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs). **(5Hours)**

SUGGESTED READINGS

- Park, K. (2007)*Preventive and Social Medicine*, B.B. Publishers
- Godkar P.B. and Godkar D.P*Textbook of Medical Laboratory Technology*, II

Edition, Bhalani Publishing House
 Cheesbrough M.*A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
 Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
 Robbins and Cortan,*Pathologic Basis of Disease*, VIIIEdition, Saunders
 Prakash, G. (2012),*Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

Skill Enhancement Course- VI
Chemistry
PESTICIDE CHEMISTY and PHARMACEUTICAL CHEMISTRY

Paper Code: Time Allowed: 2 Hours
Max. Marks: 40 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 2 hours.

SECTION-A

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structureactivity relationship.

(6Hours)

SECTION-B

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl);Quinones (Chloranil), Anilides (AlachlorandButachlor). **(7Hours)**

SECTION - C

Drugs & Pharmaceuticals Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representativedrugsofthe followingclasses:analgesicsagents,antipyreticagents,antiinflammatoryagents(Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine). **(9Hours)**

SECTION -D

Fermentation Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 andVitamin C

(8 Hours)

Suggested readings:

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press,UK
2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. NewDelhi.

5. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978.