



# Jagannath University

Bahadurgarh - NCR

## **BACHELOR OF SCIENCE (B. Sc.) (Medical)**

### **Detailed Scheme and Syllabus**

(w.e.f 2019)

### First Semester

Theory / Practical		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 101	English & Comm. Skills	AECC-1	3	-	-	30	70	100	3
BSM 102	Diversity of Microbes	CORE	3	-	-	30	70	100	3
BSM 103	Cell Biology (Botany)	CORE	3	-	-	30	70	100	3
BSM 104	Life & Diversity from Protozoa to Helminthes	CORE	3	-	-	30	70	100	3
BSM 105	Cell Biology (Zoology)	CORE	3	-	-	30	70	100	3
BSM 106	Inorganic Chemistry	CORE	2	-	-	30	70	100	2
BSM 107	Organic Chemistry	CORE	2	-	-	30	70	100	2
BSM 108	Physical Chemistry	CORE	3	-	-	30	70	100	3
BSM 109	Botany Practical	CORE	-	-	1	-	-	-	-
BSM 110	Chemistry Practical	CORE	-	-	1	-	-	-	-
BSM 111	Zoology Practical	CORE	-	-	1	-	-	-	-
<b>Total</b>			<b>25</b>			<b>240</b>	<b>560</b>	<b>800</b>	<b>22</b>

### Second Semester

Theory Papers		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 201	Environmental Studies	AECC-2	3	-	-	30	70	100	3
BSM 202	Genetics (Botany)	CORE	3	-	-	30	70	100	3
BSM 203	Diversity of Archegoniates	CORE	3	-	-	30	70	100	3
BSM 204	Inorganic Chemistry	CORE	2	-	-	30	70	100	2
BSM 205	Organic Chemistry	CORE	2	-	-	30	70	100	2
BSM 206	Life & Diversity from Annelida to Hemichordata	CORE	3	-	-	30	70	100	3
BSM 207	Genetics (Zoology)	CORE	3	-	-	30	70	100	3
BSM 208	Physical Chemistry	CORE	3	-	-	30	70	100	3
BSM 109	Botany Practical	CORE	-	-	1	30	20	50	1
BSM 110	Chemistry Practical	CORE	-	-	1	30	20	50	1
BSM 111	Zoology Practical	CORE	-	-	1	30	20	50	1
<b>Total</b>			<b>22</b>		<b>3</b>	<b>330</b>	<b>620</b>	<b>950</b>	<b>25</b>

### Third Semester

Theory Papers		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 301	Life and Diversity of Chordates – I	CORE	3	-	-	30	70	100	3
BSM 302	Mammalian Physiology - I	CORE	3	-	-	30	70	100	3
BSM 303	Biology and Diversity of Seed Plants - I	CORE	3	-	-	30	70	100	3
BSM 304	Plant Anatomy	CORE	3	-	-	30	70	100	3
BSM 305	Inorganic Chemistry	CORE	2	-	-	30	70	100	2
BSM 306	Organic Chemistry	CORE	2	-	-	30	70	100	2
BSM 307	Physical Chemistry	CORE	3	-	-	30	70	100	3
BSM 308	Computer Fundamental	SEC-1	3			30	70	100	3
BSM 309	Botany Practical	SEC-2	-	-	1	-	-	-	-
BSM 310	Chemistry Practical	SEC-3	-	-	1	-	-	-	-
BSM 311	Zoology Practical	SEC-4	-	-	1	-	-	-	-
<b>Total</b>			<b>22</b>			<b>210</b>	<b>490</b>	<b>700</b>	<b>22</b>

### Fourth Semester

Theory Papers		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 401	Biology and Diversity of Seed Plants II	CORE	3	-	-	30	70	100	3
BSM 402	Plant Embryology	CORE	3	-	-	30	70	100	3
BSM 403	Life and Diversity of Chordates - II	CORE	3	-	-	30	70	100	3
BSM 404	Mammalian Physiology - II	CORE	3	-	-	30	70	100	3
BSM 405	Inorganic Chemistry	CORE	2	-	-	30	70	100	2
BSM 406	Organic Chemistry	CORE	2	-	-	30	70	100	2
BSM 407	Physical Chemistry	CORE	3	-	-	30	70	100	3
BSM 309	Botany Practical	SEC-2	-	-	1	30	20	50	1
BSM 310	Chemistry Practical	SEC-3	-	-	1	30	20	50	1
BSM 311	Zoology Practical	SEC-4	-	-	1	30	20	50	1
<b>Total</b>			<b>19</b>			<b>210</b>	<b>490</b>	<b>700</b>	<b>22</b>

### Fifth Semester

Theory Papers		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 501	Fish and Fisheries	DSE-1	3	-	-	30	70	100	3
BSM 502	Ecology & Evolution	DSE-2	3	-	-	30	70	100	3
BSM 503	Plant Physiology	DSE-3	3	-	-	30	70	100	3
BSM 504	Plant Ecology	DSE-4	3	-	-	30	70	100	3
BSM 505	Inorganic Chemistry	DSE-5	2	-	-	30	70	100	2
BSM 506	Organic Chemistry	DSE-6	2	-	-	30	70	100	2
BSM 507	Physical Chemistry	DSE-7	3	-	-	30	70	100	3
BSM 508	Botany Practical	SEC-5	-	-	2				-
BSM 509	Chemistry Practical	SEC-6	-	-	1				-
BSM 510	Zoology Practical	SEC-7	-	-	2				-
<b>Total</b>			<b>19</b>	<b>5</b>		<b>210</b>	<b>490</b>	<b>700</b>	<b>19</b>

### Sixth Semester

Theory Papers		Course Type	No. of Teaching Hours			Marks Allocations			Credits
Code	Subject/Paper		L	T	P	IA	EA	Total	
BSM 601	Entomology	DSE-8	3	-	-	30	70	100	3
BSM 602	Developmental Biology	DSE-9	3	-	-	30	70	100	3
BSM 603	Biochemistry & Plant Biotechnology	DSE-10	3	-	-	30	70	100	3
BSM 604	Economic Botany	DSE-11	3	-	-	30	70	100	3
BSM 605	Inorganic Chemistry	DSE-12	2	-	-	30	70	100	2
BSM 606	Organic Chemistry	DSE-13	2	-	-	30	70	100	2
BSM 607	Physical Chemistry	DSE-14	3	-	-	30	70	100	3
BSM 508	Botany Practical	SCE-5	-	-	2	30	20	50	2
BSM 509	Chemistry Practical	SCE-6	-	-	1	30	20	50	1
BSM 510	Zoology Practical	SCE-7	-	-	2	30	20	50	2
<b>Total</b>			<b>19</b>	<b>-</b>	<b>5</b>	<b>300</b>	<b>550</b>	<b>850</b>	<b>24</b>

## PROGRAMME SUMMARY

<b>S.No.</b>	<b>Type of Course / Subject</b>	<b>Number of Courses/ Subjects</b>	<b>Credits</b>
1.	Core Courses (CORE)	31	82
2.	Ability Enhancement Compulsory Courses (AECCs)	02	06
3.	Skill Enhancement Courses (SECs)	07	19
4.	Discipline Specific Electives (DSEs)	14	38
<b>TOTAL</b>		<b>54</b>	<b>145</b>

# BSM 101: English & Communication Skills

**Max. Marks: 70**

**Time: 3 hours**

## UNIT I

**[Lectures-5]**

**An insight into Subject –Verb Agreement:**

**Subject –Verb Agreement:**

- When Subject is placed after the Verb
- When there are intervening words or expressions between the Subject and the Verb
- When the Subject gives the appearance of being plural
- When there are problems in the agreement of Numbers
- When a pronoun is used in the wrong number
- Is used in the wrong case
- Verb classification Main verb Transitive and Intransitive verb, Auxiliary verb,

## UNIT II

**[Lectures-6]**

**Grammar And Usage**

- punctuation
- Articles
- Framing question
- Simple, compound & Phrase preposition

## UNIT III

**[Lectures-6]**

**Sentence synthesis:**

- Phrases and Clauses (Noun, Adjective and Adverb phrases and uses and where and when to use them.)
- Simple, Complex and Compound sentences (how to construct and when to use)
- Usage and purpose of Infinitives, Participles and Gerunds (where and when to use)
- Sequence of Tenses, Moods and Voice (where and when to use)
- Problems with Auxiliaries and Modals (what does each one of them denote)
- Reported Speech (Rewriting conversations in Reported Speech)

## UNIT IV

**[Lectures-5]**

**Playing with words**

- Understanding the role Prefixation and Suffixation in word formation; transformation from one part of the speech to another)
- Vocabulary building activities (Learning words through Roots, Mnemonics and Associations, Analogies)
- Words with similar spellings or sounds and their meanings
- Revisiting the rules of Punctuation and Capitalisation

## UNIT V

**[Lectures-8]**

**Magic of language**

- Idioms
- Phrasal Verbs
- Composition, Reading Skills, Public speaking and Discussions
- Precise writing (How to extract important information and express it in a way that it gives appropriate gist of the given passage)
- Essay writing (Principles of Coherence, Cohesion, Continuity)
- Reading Comprehensions Exercises (with focus on skimming and scanning)
- Extempore (Will be conducted throughout the semester)
- Notice writing, Memo & Circular

# BSM 102: Diversity of Microbes

Max. Marks: 70

Time: 3 hours

## UNIT-I

**Bacteria:** Structure, nutrition, reproduction and economic importance

**Cyanobacteria:** General characters; life-history of Nostoc.

## UNIT-II

**Algae:** General characters, classification (upto classes) and economic importance; General account of algal blooms

## UNIT-III

Important features and life-history (excluding development) of *Volvax*, *Oedogonium* (Chlorophyceae), *Vaucheria* (Xanthophyceae), *Ectocarpus* (Phaeophyceae) and *Polysiphonia* (Rhodophyceae)

## UNIT-IV

**Viruses:** General account of Viruses including structure of TMV and Bacteriophages

**Fungi:** General characters, classification (upto classes) and economic importance; General account of Lichens

## UNIT-V

Important features and life-history of *Phytophthora* (Mastigomycotina), *Mucor* (Zygomycotina), *Penicillium* (Ascomycotina), *Puccinia*, *Agaricus* (Basidiomycotina), *Colletotrichum* (Deuteromycotin)

## **BSM 103: Cell Biology (Botany)**

**Max. Marks: 70**

**Time: 3 hours**

### **UNIT-I**

**The Cell Envelopes:** Structure and functions of Cell Wall, Plasma Membrane, Golgi Apparatus, Endoplasmic Reticulum, Lysosomes, Peroxisomes and Vacuoles

### **UNIT-II**

**Ultra-structure and function:** Chloroplast, Mitochondria, Nucleus and Nucleolus

### **UNIT-III**

**Chromosome:** Morphology, ultra-structure - kinetochore, centromere and telomere

Sex chromosomes and Sex determination in Plants

### **UNIT-IV**

**Cell Cycle:** General account

**Cell Division:** Mitosis and Meiosis - Stages and Significance

### **UNIT-V**

**Chromosomal aberrations:** Structural and Numerical - deletions, duplications, translocations, inversions, aneuploidy, polyploidy.



# BSM 104: Life and Diversity from Protozoa to Helminthes

Max. Marks : 70

Hrs: 03

## UNIT-1

### Phylum- Protozoa

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance
- iii) Type study of *Plasmodium*;
- iv) Parasitic protozoans: Life history, mode of infection and pathogenicity of *Entamoeba*, *Trypanosoma*, *Leishmania* and *Giardia*.

## UNIT-II

### Phylum- Porifera:

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance
- iii) Type study - *Sycon*.
- iv) Canal system in sponges
- v) Spicules in sponges

## UNIT-III

### Phylum - Coelentrata:

- i) General characters and classification up to order level
- ii) Biodiversity, economic importance
- iii) Type Study - *Obelia*
- iv) Corals and coral reefs
- v) Polymorphism in Siphonophores

## UNIT-IV

### Phylum - Helminths:

- i) General characters and classification up to order level
- ii) Biodiversity, economic importance

## UNIT - V

- i) Type study - *Fasciola hepatica*
- ii) Helminths parasites: Brief account of life history, mode of infection and pathogenesis of *Schistosoma*, *Ancylostoma*, *Trichinella*, *Wuchereria* and *Oxyu*

## **BSM 105 : CELL BIOLOGY (Zoology)**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Ultrastructure of different cell organelles of animal cell. Plasma Membrane: Fluid mosaic model, various modes of transport across the membrane, mechanism of active and passive transport, endocytosis and exocytosis. Endoplasmic reticulum (ER): types, role of ER in protein synthesis and transportation in animal

### **UNIT –II**

Goigi complex: Structure, Associated enzymes and role of golgi-complex in animal cell.

Ribosomes: Types, biogenesis and role in protein synthesis. Lysosomes: Structure, enzyme and their role; polymorphism

### **UNIT –III**

Mitochondria: Mitochondrial DNA; as semiautonomous body, biogenesis mitochondrial enzymes (only names), role of mitochondria.

Cytoskeleton: Microtubules, microfilaments, centriole and basal body. Cilia and Flagella

### **UNIT-IV**

Ultrastructure and functions of Nucleus: Nuclear membrane, nuclear lamina, nucleolus, fine structure of chromosomes, nucleosome concept and role of histones,

### **UNIT – V**

Euchromatin and heterochromatin, lampbrush chromosomes and polytene chromosomes . Mitosis and Meiosis (Cell reproduction) Brief account of causes of cancer An elementary idea of cellular basis of Immunity.

# **BSM 106: Inorganic Chemistry**

**Max. Marks: 70**

**Time: 2 Hrs.**

## **UNIT 1**

### **Atomic Structure**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals.

## **UNIT 2**

### **Periodic Properties**

General principles of periodic table: Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge, Slater's rules. Atomic and ionic radii, ionization energy, electron affinity and electronegativity –definition, methods of determination or evaluation, trends in periodic table (in s & p block elements).

## **UNIT 3**

### **Covalent Bond**

Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions ( $\text{BeF}_2$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{PF}_5$ ,  $\text{SF}_6$ ,  $\text{IF}_7$ ,  $\text{SO}_4^{2-}$ ,  $\text{ClO}_4^-$ )

## **UNIT 4**

Valence shell electron pair repulsion (VSEPR) theory to  $\text{NH}_3$ ,  $\text{H}_3\text{O}^+$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{ICl}_2$  and  $\text{H}_2\text{O}$ . MO theory of heteronuclear (CO and NO) diatomic molecules, , bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

## **UNIT 5**

### **Ionic Solids**

Ionic structures ( $\text{NaCl}$ ,  $\text{CsCl}$ ,  $\text{ZnS}$  (Zinc Blende),  $\text{CaF}_2$ ) radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy (mathematical derivation excluded) and Born-Haber cycle, solvation energy and its relation with solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

# BSM 107: Organic Chemistry

Max. Marks: 70

Time: 2 Hrs.

## UNIT 1

### Structure and Bonding

Localized and delocalized chemical bond, vander Waals interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

## UNIT 2

### Stereochemistry of Organic Compounds-I

Concept of isomerism. Types of isomerism. Optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

## UNIT 3

### Stereochemistry of Organic Compounds-II

Relative and absolute configuration, sequence rules, R & S systems of nomenclature.

Geometric isomerism determination of configuration of geometric isomers. E & Z system of nomenclature, Conformational isomerism conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds, Newman projection and Sawhorse formulae, Difference between configuration and conformation.

## UNIT 4

### Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents -electrophiles and nucleophiles. Types of organic reactions. Energy considerations.

Reactive intermediates carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (formation, structure & stability). Assigning formal charges on intermediates and other ionic species.

## UNIT 5

### Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes the alkyl group classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties. Cycloalkanes nomenclature, synthesis of cycloalkanes and their derivatives –photochemical (2+2) cycloaddition reactions, dehalogenation of dihalides, pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations, theory of strainless rings

# BSM 108: Physical Chemistry

Max. Marks: 70

Time: 3 Hrs.

## UNIT 1

### Gaseous States

Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behaviour.

## UNIT 2

Derivation of Vander Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor) Explanation of behaviour of real gases using Vander Waal's equation.

## UNIT 3

### Critical Phenomenon:

Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal's constants. Critical compressibility factor. The Law of corresponding states. Lequifaction of gases.

7

## UNIT 4

### Liquid States

Structure of liquids. Properties of liquids – surface tension, viscosity vapour pressure and optical rotations and their determination.

## UNIT 5

### Solid State

Classification of solids, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals. Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl. Liquid crystals: Difference between solids, liquids and liquid crystals, types of liquid crystals. Applications of liquid crystals.

## BSM 109: Botany Practical

Max. Marks: 70

Time: 1 Hrs.

1. To study bacteria infested plant specimen (Citrus canker/root nodules)
2. To study the specimens of *Phytophthora*, *Mucor*, *Sccharomyces*, *Puccinia*, *Agaricus*, *Cercospora* and *Colletotrichum* using temporary preparations and permanent slides.
3. To study the specimens of Algae: *Volvox*, *Oedogonitam*, *Vanucheria*, *Ectocarpus*, *Sargassum*, and *Polysiphonia* using temporary preparations and permanent slides
4. To study the fungal diseases viz. Late blight of potato, Tikka disease of groundnut, Black stem rust of wheat and Red rot of sugarcane.
5. Survey, collection and submission of plant disease samples.
6. To perform gram staining of bacteria.
7. To study the plant cell structure through temporary mounts.
8. To study prokaryotic cells (bacteria), viruses, eukaryotic cells and cell organelles with the help of charts/permanent slides.
9. To prepare a temporary stained smears from root tips of *Allium cepa* (onion) to study various stages of mitosis.
10. To study karyotypes in somatic cells with the help of charts.
11. To study Polytene and Lampbrush chromosomes from permanent slides.
12. Demonstration of Emasculation from Wheat/Rice/Pea.
13. To study the specimens of Bryophytes: *Marchantia*, *Anthoceros* and *Funaria* using temporary preparations and permanent slides.
14. To study the specimens of Pteridophytes: *Selaginella*, *Equisetian*, *Pteris* and *Marsilea* using temporary preparations and permanent slides.

# BSN 110: Chemistry Practicals

Max. Marks: 50

Time: 1 HRS

(Spread over two sessions)

## Section-A (Inorganic)

### Volumetric Analysis

1. **Redox titrations:** Determination of  $\text{Fe}^{2+}$ ,  $\text{C}_2\text{O}_4^{2-}$  ( using  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ )
2. **Iodometric titrations:** Determination of  $\text{Cu}^{2+}$  (using standard hypo solution).
3. **Complexometric titrations:** Determination of  $\text{Mg}^{2+}$ ,  $\text{Zn}^{2+}$  by EDTA.

### Paper Chromatography

Qualitative Analysis of the any one of the following Inorganic cations and anions by paper chromatography ( $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$  and  $\text{PO}_4^{3-}$  and  $\text{NO}_3^-$ ).

## Section-B (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate, ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
3. To determine the surface tension of a given liquid by drop number method.
4. To determine the viscosity of a given liquid.
5. To determine the specific refractivity of a given liquid

## SECTION – C (Organic)

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
  - (i) Iodoform from ethanol (or acetone)
  - (ii) *m*-Dinitrobenzene from nitrobenzene (use 1:2 conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  mixture if fuming  $\text{HNO}_3$  is not available)
  - iii) *p*-Bromoacetanilide from acetanilide
  - iv) Dibenzalacetone from acetone and benzaldehyde
  - v) Aspirin from salicylic acid
2. To study the process of sublimation of camphor and phthalic acid,

## BSM 111: Zoology Practical (Section – I)

Max. Marks:50

Time: 1Hrs

**(A) Classification up to orders with ecological note and economic importance of the following animal:**

1. Protozoa: Lamination of cultures of *Amoeba*, *Euglena* and *Paramecium*; permanent prepared slides: *Amoeba*, *Euglena*, *Trypanosoma*, *Noctiluca*, *Eimeria*, *Paramecium* (binary fission and conjugation), *Opalina*, *Verticella*, *Balantidium*, *Nyctotherus*, radiolarian and foraminiferan ooze.
2. Parazoa (Porifera) Specimens: *Sycon*, *Grantia*, *Euplectella*, *Hyalonema*, *Spongilla*, *Euspongia*
3. Coelenterata.: Specimens: *Porpita*, *Valella*, *Physalia*, *Aurelia*, *Rhyzostoma*, *Metridium*, *Millipora*, *Alcyonium*, *Tubipora*, *Zoanthus*, *Madrepora*, *Favia*, *Fungia*, and *Astrea*,  
Permanent prepared slides: *Hydra* (W.M.), *Hydra* with buds, *Obelia* (colony and medusa), *Sertularia*, *Plumularia*, *Tubularia*, and *Bougainvillea*, *Aurelia* (sense organs and stages of life history).
4. Platyhelminthes: Specimens: *Dugesia*, *Fasciola*, *Taenia*, *Echinococcus*, Permanent prepared slides: *Miracidium*, *sporocyst*, *redia*, *cercaria*, *scolex* and *proglottids*; *Taenia* (mature and gravid).
5. Aschelminthes: *Ascaris* (male & female), *Trichinella*, *Ancylostoma*, *Meloidogyne*.

**(B) Study of the following permanent stained preparations:**

1. L.S. and T.S. *Sycon*; gemmules, spicules and sponging fibres of *Sycon*, canal system of sponges.
2. T.S. *Hydra* (testis and ovary region).
3. T.S. *Fasciola* (different regions).
4. T.S. *Ascaris* (male and female).

**(C) Preparation of the following slides:**

1. Temporary preparation of *Volvox*, *Paramecium*, Gemmules and spicules of *Sycon*
2. Preparation of permanent stained whole mounts of *Hydra*, *Obelia*, *Sertularia*, *Plumularia* and *Bougainvillea*.
3. **Pathogenic protozoans: *Plasmodium*, *Giardia* or as available**
4. Pathogenic Helminthes: *Ancylostoma*; *Wuchereria* or as available

**(D) Cell biology and Genetics:**

1. Cell division: Prepared slides of stages of mitosis and meiosis.
2. Temporary squash preparations of onion root tip / grasshopper testis for the study of mitosis using acetocarmine stain.

**(E) Project:**

1. Parasitic adaptations (Protozoa to helminthes)
2. DNA: types, structure and its model preparation
3. Survey- Diversity of particular family/taxa in your surrounding area
4. Microscopy: principles and its significance
5. Staining techniques and their significance

**(F) Disaster Management Project Work: (Field Work, Case Studies)**

**For details see the UGC Website**



## **Zoology Practical (Section-II)**

### **(A) Classification up to orders with ecological note and economic importance of the following group of animals:**

1. Annelida Specimens: Pheretima, Heteronereis, Polynoe, Aphrodite, Chaetopterus, Arenicola, Tubifex and Pontobdella.
2. Arthropoda Specimens: Peripatus, Palaemon (Prawn), Lobster, Cancer (crab), Sacculina, Eupagurus (hermit crab), Lepas, Balanus, Cyclops, Daphnia, Lepisma, Periplaneta (cockroach), Schistocerca (locust), Poecilocus (ak-hopper), Gryllus (cricket), Mantis (praying mantis), Cicada, Forficula (earwig), Dragon fly, termite queen, bug, moth, beetle, Polistes (wasp), Apis (honey bee), Bombyx (silk moth), Cimex (bedbug), Pediculus (body louse), Millipedes, Scolopendra (centipedes), Palamnaeus (scorpion), Aranea (spider), Limulus (king crab).
3. Mollusca Specimens: Mytilus, Ostrea, Cardium, Pholas, Solen (razor fish), Pecten, Haliotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus (complete and T.S.), Chiton and Dentalium.

4. Echinodermata Specimens: Asterias, Echinus, Cucumara, Ophiothrix, Antedon and Asterothyton.

5. Hemichordata Balanoglossus

### **(B) Study of the following permanent stained preparations:**

1. T.S. Pheretima (pharyngeal and typhlosolar regions), Setae, septal nephridia and spermathecae of Pheretima.
2. Trachea and mouthparts of cockroach.
3. Statocyst of Palaemon.
4. Glochidium larva of Anodonta; radula and osphradium of Pila.
5. T.S. Star fish (arm)
6. T.S. Balanoglossus (through various regions).

### **(C) Demonstration by C. D.:**

1. Mouth parts and trachea of Periplaneta (cockroach), radula of Pila; pedicellariae of Asterias.
2. setae of earthworm, and mouth parts of Honey bee, House fly and cockroach.

### **(D) Preparation of models of the different systems of the following animals:**

1. Earthworm: Digestive, reproductive and nervous systems.
2. Grasshopper/ cockroach: Digestive, reproductive and nervous systems.
3. Pila: Pallial complex, digestive and nervous systems

### **(E) Cell biology and Genetics:**

1. Salivary gland and polytene chromosomes of Drosophila/Chironomus.
2. Numericals based on three point test cross

### **(F) Project:**

1. Survey- Diversity of particular family/taxa in your surrounding area
  2. Vermicomposting: Earthworm rearing and economics of the project
- Evolutionary significance of larvae belonging to different group of invertebrate

# **BSM 201: Environmental studies**

Maximum marks:70

Time: 3 hrs

## **Unit 1: Introduction to environmental studies**

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere.

Scope and importance; Concept of sustainability and sustainable development.

### **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 : Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

## **Unit -2 : Natural Resources : Renewable and Non---renewable Resources**

Land resources and land use change; Land degradation, soil erosion and desertification.

Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).

Heating of earth and circulation of air; air mass formation and precipitation.

Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

### **Biodiversity and Conservation**

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

India as a mega---biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.

Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

## **Unit 3 : Environmental Pollution**

Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution

Nuclear hazards and human health risks

Solid waste management : Control measures of urban and industrial waste.

Pollution case studies

### **Environmental Policies & Practices**

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.

International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).

Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

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

Human population growth: Impacts on environment, human health and welfare.

Resettlement and rehabilitation of project affected persons; case studies.

Disaster management : floods, earthquake, cyclones and landslides.

Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.

Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

#### **Unit 5 : Field work**

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.

Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Study of simple ecosystems---pond, river, Delhi Ridge, etc.

#### **Suggested Readings:**

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
14. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

## **BSM 202: Genetics (Botany)**

**Max. Marks: 70**  
**Time: 3 Hrs.**

### **UNIT-I**

**Genetic Material:** DNA - the genetic material, DNA structure and replication, DNA Protein interaction, The Nucleosome Model, Genetic Code, Satellite and Repetitive DNA.

### **UNIT-II**

**Genetic Inheritance:** Mendelism: Laws of Segregation and Independent Assortment; Linkage Analysis; Allelic and non-allelic interactions.

### **UNIT-III**

**Extra-nuclear Inheritance:** Presence and function of Mitochondrial and Plastid DNA; Plasmids.

**Genetic Variations:** Mutations - spontaneous and induced; transposable genetic elements.

### **UNIT-IV**

**Gene Expression:** Modern concept of gene; RNA; Ribosomes; Transfer of genetic information - transcription and translation; Structure of proteins;

### **UNIT-V**

Regulation of gene expression in prokaryotes and eukaryotes, DNA damage and repair

## **BSM 203: Diversity of Archegoniates**

**Max. Marks: 70**

**Time: 3 Hrs.**

### **UNIT-I**

**Bryophyta**– General characters, classification (upto classes), alternation of generations, evolution of sporophytes and economic importance

### **UNIT-II**

**Bryophyta:** Structure and reproduction (excluding development) of *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida) and *Funaria* (Bryopsida)

### **UNIT-III**

**Pteridophyta**– General characters, classification (upto classes), alternation of generations, and economic importance

### **UNIT-IV**

General account of stellar evolution, heterospory, apospory and apogamy

### **UNIT-V**

**Pteridophyta:** Structure and reproduction (excluding development) of *Rhynia* (Psilopsida), *Selaginella* (Lycopsida), *Equisetum* (Sphenopsida) and *Pteris* (Pteropsida)

## BSM 204: Inorganic Chemistry

Max. Marks: 70

Time: 2 Hrs.

### UNIT 1

#### Hydrogen Bonding & Vander Waals Forces

Hydrogen Bonding – Definition, Types, effects of hydrogen bonding on properties of substances application Brief discussion of various types of Vander Waals Forces

#### Metallic Bond and Semiconductors

Metallic Bond- Brief introduction to metallic bond, band theory of metallic bond  
Semiconductors- Introduction, types and applications.

### UNIT 2

#### S-Block Elements

Comparative study of the elements including, diagonal relationships salient features of hydrides (methods of preparation excluded), solvation and complexation tendencies including their function in biosystems.

### UNIT 3

#### Chemistry of Noble Gases

Chemical properties of the noble gases with emphasis on their low chemical reactivity, chemistry of xenon, structure and bonding of fluorides, oxides & oxyfluorides of xenon.

### UNIT 4

#### p-Block Elements

Emphasis on comparative study of properties of p-block elements (including diagonal relationship and excluding methods of preparation).

#### Boron family (13<sup>th</sup> gp)

Diborane – properties and structure (as an example of electron –deficient compound and multicentre bonding), Borazene – chemical properties and structure Trihalides of Boron Trends in lewis acid character structure of aluminium (III) chloride.

#### Carbon Family (14<sup>th</sup> group)

Catenation, p-pi d-pi bonding (an idea), carbides, fluorocarbons, silicates (structural aspects), silicon – general methods of preparations, properties and uses.

### UNIT 5

#### Nitrogen Family (15<sup>th</sup> group)

Oxides – structures of oxides of N,P. oxyacids – structure and relative acid strengths of oxyacids of Nitrogen and phosphorus. Structure of white, yellow and red phosphorus.

#### Oxygen Family (16<sup>th</sup> group)

Oxyacids of sulphur – structures and acidic strength H<sub>2</sub>O<sub>2</sub> – structure, properties and uses.

**Halogen Family (17<sup>th</sup> group):** Basic properties of halogen, interhalogens types properties, hydro and oxyacids of chlorine – structure and comparison of acid strength

## **. UNIT 1**

### **Alkenes**

Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction, ozonolysis, hydration, hydroxylation and oxidation with  $\text{KMnO}_4$ ,

## **UNIT 2**

### **Arenes and Aromaticity**

Nomenclature of benzene derivatives : Aromatic nucleus and side chain. Aromaticity: the Huckel rule, aromatic ions, annulenes up to 10 carbon atoms, aromatic, anti-aromatic and non-aromatic compounds. Aromatic electrophilic substitution general pattern of the mechanism, mechanism of nitration, halogenation, sulphonation, and Friedel -Crafts reaction. Energy profile diagrams. Activating ,deactivating substituents and orientation.

## **UNIT 3**

### **Dienes and Alkynes**

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of butadiene, Chemical reactions 1,2 and 1,4 additions (Electrophilic & free radical mechanism),

## **UNIT 4**

Diels-Alder reaction, Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation of alkynes.

## **UNIT 5**

### **Alkyl and Aryl Halides**

Nomenclature and classes of alkyl halides, methods of formation , chemical reactions. Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides , $\text{S}_{\text{N}}2$  and  $\text{S}_{\text{N}}1$  reactions with energy profile diagrams. Methods of formation and reactions of aryl halides, The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and arylhalides.

## **BSM 206 : LIFE AND DIVERSITY OF ANNELIDA TO HEMICHORDATA**

**Max. Marks : 70**

**Time : 3 Hrs.**

### **UNIT-I**

Phylum - Annelida:

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance of Annelida
- iii) Type study - Pheretima (Earthworm)
- iv) Metamerism in Annelida
- v) Trochophore larva: Affinities, evolutionary significance

### **UNIT-II**

Phylum - Arthropoda:

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance of insects
- iii) Type study – Periplaneta

### **UNIT-III**

Phylum - Mollusca:

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance
- iii) Type study - Pila
- iv) Torsion and detorsion in gastropoda
- v) Respiration and foot

### **UNIT-IV**

Phylum - Echinodermata:

- i) General characters and classification up to order level
- ii) Biodiversity and economic importance
- iii) Type Study -Asteries (Sea Star)
- iv) Echinoderm larvae
- v) Aristotle's Lantern

### **UNIT - V**

Hemichordata: Type study: Balanoglossus



## **BSM 207: Genetics (Zoology)**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

1. Elements of Heredity and variations.
2. The varieties of gene interactions
3. Linkage and recombination: Coupling and repulsion hypothesis, crossing-over and chiasma formation; gene mapping.

### **UNIT-II**

1. Sex determination and its mechanism: male and female heterozygous systems, genetic balance system; role of Y -chromosome, male haploidy, cytoplasmic and environmental factors, role of hormones in sex determination.
2. Sex linked inheritance: Haemophilia and colour blindness in man, eye colour in *Drosophila*, Non- disjunction of sex-chromosome in *Drosophila*; Sex-linked and sex influenced inheritance.
3. Extra chromosomal and cytoplasmic inheritance:
  - i) Kappa particles in Paramecium.
  - ii) Shell coiling in snails.
  - iii) Milk factor in mice.

### **UNIT-III**

1. Multiple allelism: Eye colour in *Drosophila*; A, B, O blood group in man.
2. Human genetics: Human karyotype, Chromosomal abnormalities involving autosomes and sex chromosomes, monozygotic and dizygotic twins.
3. Inborn errors of metabolism (Alcaptonuria, Phenylketonuria, Albinism, sickle-cell anaemia).

### **UNIT-IV**

Nature and function of genetic material; Structure and type of nucleic acids; Protein synthesis. spontaneous and induced (chemical and radiations) mutations; gene mutations; chemical basis of mutations; transition, transversion,

### **UNIT - V**

Structural chromosomal aberrations (deletion, duplication, inversion and translocation); Numerical aberrations (autopolyploidy, euploidy and polyploidy in animals)

Applied genetics: Eugenics, eugenics and eugenics; genetic counseling, pre-nataldiagnostics, DNA-finger printing, transgenic animals

## **BSM 208: Physical Chemistry**

Maximum marks:70

Time: 3 hrs

### **UNIT 1**

**Kinetics-I** Rate of reaction, rate equation, factors influencing the rate of a reaction concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half life period of a reaction. Methods of determination of order of reaction,

### **UNIT 2**

#### **Kinetics-II**

Effect of temperature on the rate of reaction – Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision. Transition state theory of Bimolecular reactions.

### **UNIT 3**

#### **Electrochemistry-I**

Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Arrhenius theory of ionization,

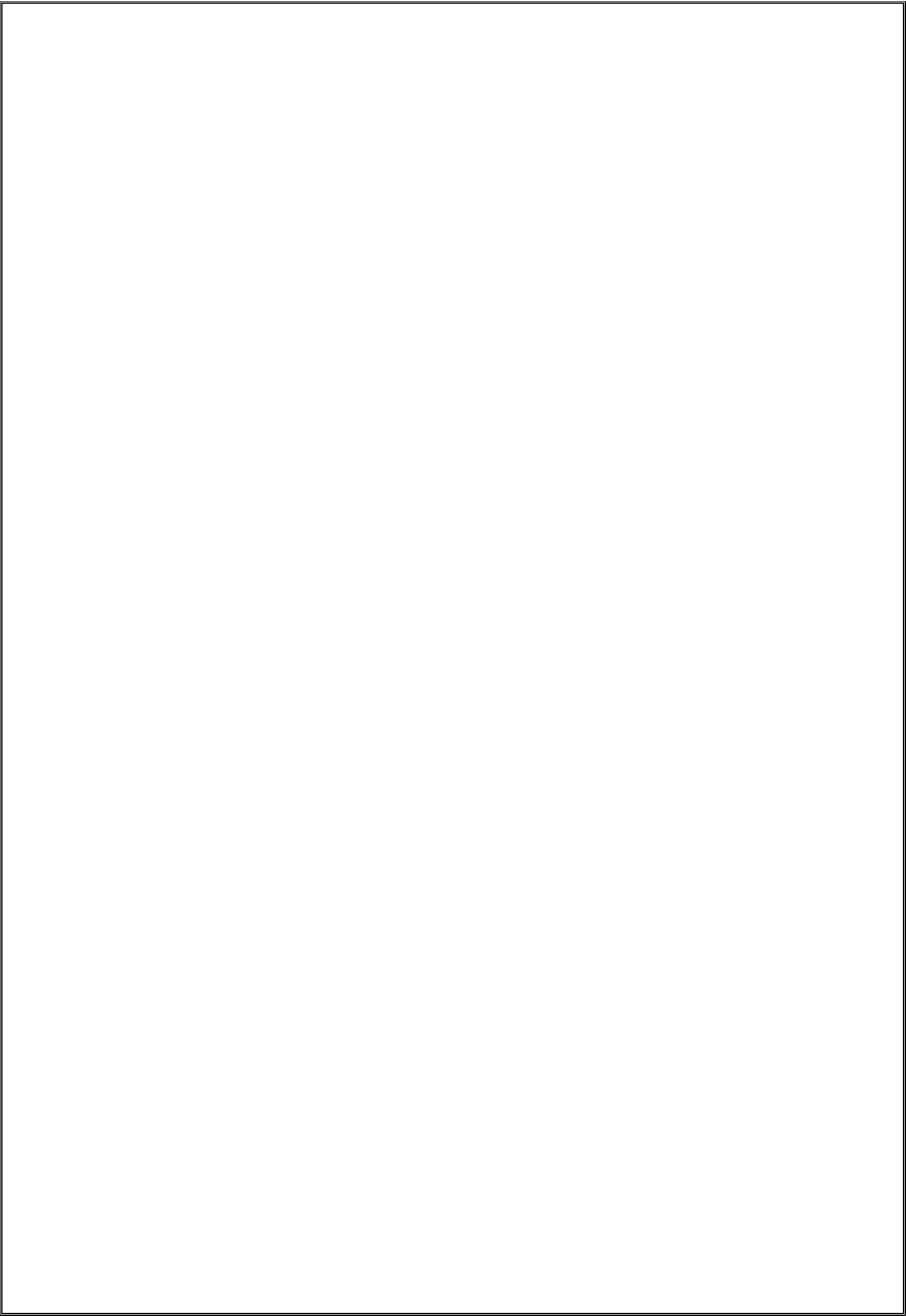
### **UNIT 4**

Ostwald's Dilution Law. Debye -Huckel – Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included),

### **UNIT 5**

#### **Electrochemistry-II**

Kohlrausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Application of Kohlrausch's Law in calculation of conductance of weak electrolytes at infinite dilution. Applications of conductivity measurements: determination of degree of dissociation, determination of  $K_a$  of acids determination of solubility product of sparingly soluble salts, conductometric titrations. Definition of pH and  $pK_a$ , Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action.



## **BSM 301: Life and diversity of Chordates - 1**

**Max.Marks:70**

**Time: 3 Hrs.**

### **UNIT-I**

#### **Chordates:**

Principles of classification; Origin and Evolutionary tree; Role of amnion in evolution; Salient features of chordates; Functional morphology of the types with examples emphasizing their biodiversity, economic importance and conservation measures where required.

### **UNIT-II**

General characters and classification of phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

**Protochordates:** Systematic position, distribution, ecology, morphology and affinities Urochordata: *Herdmania* – type study

Cephalochordata; *Amphioxus* – type study

### **UNIT-III**

General characters and classification of phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required.

**Cyclostomes:** Classification and ecological significance Type study of *Petromyzon*. .

General characters and classification of all phyla upto orders with examples emphasizing their biodiversity,

### **Unit - v**

Economic importance and conservation measures where required.

**Pisces:** Scales & Fins, Parental care in fishes, fish migration. Types study of Labeo.

## **BSM 302: Mammalian Physiology - 1**

**Max.Marks:70**

**Time: 3 Hrs.**

### **UNIT-I**

Introduction, Classification, Structure, function and general properties of carbohydrates and lipids.

### **UNIT-II**

Introduction, Classification, Structure, function and general properties of proteins; Nomenclature, Classification and mechanisms of enzyme action.  
Transport through biomembranes (Active and Passive), buffers

### **UNIT-III**

**Nutrition:** Nutritional components; Carbohydrates, fats, lipids, Vitamins and Minerals. Types of nutrition & feeding, Digestion of dietary constituents, viz. lipids, proteins, carbohydrates & nucleic acids; symbiotic digestion. Absorption of nutrients & assimilation; control of enzyme secretion.

### **UNIT-IV**

**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.

### **UNIT-V**

Structure and types, classification, bone growth and resorption, effect of ageing on skeletal

**Bones** system and bone disorders.

## **BSM 303: Biology and Diversity of Seed Plants**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

General characters, origin and evolution of Gymnosperms Geological Time Table; Evolution of Seed Habit, Pilger and Melchior's (1954) system of classification of Gymnosperms

### **UNIT-II**

Palaeobotany - Fossils and Fossilization (Process involved, types of fossils and importance of fossils). Reconstruction of the following fossil plants: *Lyginopteris*, *Williamsonia* and *Cycadeoidea* (= *Bennettites*)

### **UNIT-III**

Morphology and anatomy of root, stem, leaf/leaflet and reproductive parts including mode of reproduction, life-cycle and economic importance of following plants: *Cycas* and *Pinus*

### **UNIT-IV**

Morphology and anatomy of root, stem, leaf/leaflet and reproductive parts including mode of reproduction, life-cycle and economic importance of *Ephedra*.

### **UNIT-V**

Economic importance of Gymnosperms, General characters, origin and evolution of Angiosperms.

## **BSM 304: Plant Anatomy**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Tissues - meristematic and permanent (simple, complex and secretory) Tissue systems (Epidermal, ground and vascular)

The Shoot system - shoot apical meristem and its histological organizations.

### **UNIT-II**

Cambium - structure and functions, Secondary growth in dicot stem; characteristics of growth rings; sap wood and heart wood, periderm;

Anomalous secondary growth (*Dracaena*, *Boerhaavia* and *Achyranthes*)

### **UNIT-III**

Leaf: Types of leaves (simple and compound); phyllotaxy. Epidermis uniseriate and multiseriate, epidermal appendages and their morphological types.

Anatomy of typical Monocot and Dicot leaf and cell inclusions in leaves,

leaf abscission, Stomatal apparatus and their morphological types

### **UNIT-IV**

Root system: Root apical meristem; histological organization Secondary growth in dicot root.

### **UNIT-V**

Structural modifications in roots: Storage (*Beta*), Respiratory (*Rhizophora*), Epiphytic (*Vanda*).

## **BSM 305: Inorganic Chemistry**

Max. Marks : 70

Time : 2 Hrs.

### **UNIT 1**

#### **Chemistry of Elements of Ist transition series:**

Definition of transition elements, position in the periodic table, General characteristics & properites of Ist transition elements,

### **UNIT 2**

Structures & properties of some compounds of transition elements–TiO<sub>2</sub>,VOCl<sub>2</sub>, FeCl<sub>3</sub>, CuCl<sub>2</sub> and Ni(CO)<sub>4</sub>

### **UNIT 3**

#### **Chemistry of Elements of IInd & IIIRD transition series**

General characteristics and properties of the IInd and IIIRD transition elements

Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic radii, oxidation state, magnetic and Spectral properties and stereochemistry

### **UNIT 4**

#### **Coordination Compounds**

Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes

### **UNIT 5**

#### **Non-aqueous Solvents**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH<sub>3</sub> and liquid SO<sub>2</sub>



## **BSM 306: Organic Chemistry**

Max. Marks : 70

Time : 2 Hrs.

### **UNIT 1**

#### **Alcohols**

Monohydric alcohols: nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol - pinacolone rearrangement.

### **UNIT 2**

#### **Epoxides**

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides

### **UNIT 3**

#### **Phenols**

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions.

### **UNIT 4**

#### **Ultraviolet (UV) absorption spectroscopy**

Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones, Woodward-Fieser rules, calculation of  $\lambda_{\text{max}}$  of simple conjugated dienes and unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds.

### **UNIT 5**

#### **Carboxylic Acids & Acid Derivatives**

Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of carboxylation. Structure, nomenclature and preparation of acid chlorides, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).

## **BSM 307: Physical Chemistry**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT 1**

#### **Thermodynamics-I**

Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. Zeroth Law of thermodynamics,

### **UNIT 2**

First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule – Thomson coefficient for ideal gas and real gas : and inversion temperature.

### **UNIT 3**

#### **Thermodynamics-II**

Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Temperature dependence of enthalpy, Kirchhoff's equation. Bond energies and applications of bond energies.

### **UNIT 4**

#### **Chemical Equilibrium**

Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium. Temperature dependence of equilibrium constant; Van't Hoff reaction isochore, Van't Hoff reaction isotherm. Le-Chatelier's principle and its applications. Clapeyron equation and Clausius – Clapeyron equation its applications.

### **UNIT 5**

#### **Distribution Law**

Nernst distribution law – its thermodynamic derivation, Modification of distribution law when solute undergoes dissociation, association and chemical combination. Applications of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride. (ii) Determination of equilibrium constant of potassium tri-iodide complex and process of extraction.

## **BSM 308: Computer Fundamental**

Max. Marks : 70

Time : 3 Hrs

### **UNIT I**

**[Lectures-6]**

**Basics of Computer:** Characteristics of Computers, Input-output Devices (Hardware, Software, Human ware and Firmware), Functions of Different Units of Computer, Classification of Computers.

**Computer Memory:** Primary memory (ROM and RAM), Secondary Memory (Hard Disk, Optical Disk).

### **UNIT II**

**[Lectures-6]**

**Computer Software:** Types of Software, Introduction to Operating System, Functions of OS, Types off OS, Booting Procedure, Start-up Sequence.

**Windows OS:** Introduction to GUI, Important Terms like directory, File, Volume, Label, and Drive Name.

**Translators & Languages:** Compiler, Interpreter and Assembler, Types of computer languages.

### **UNIT III**

**[Lectures-8]**

**Desktop Components:** Introduction to MS Office, Ms-Word & Ms-Power point, MS-Excel & Ms-Access.

### **UNIT IV**

**[Lectures-8]**

**Internet & Email:** Understanding Internet, Effective use of Internet, Search Engine & study of famous Search Engines, Various techniques of Searching, Web Browser & study of famous Web Browser, WWW & Basics of Email & Email etiquette.

### **UNIT V**

**[Lectures-6]**

**Computer Networks and IT applications:** Data communication, Concept of Computer Networks, Internet, Intranet, Extranet, Network topologies, Networking devices, OSI Model.

### **UNIT VI**

**[Lectures-6]**

**Digital Technology and Society:** Basics of Digital Marketing, Digital Payments- Platforms and process, Effective use of technology in the present era, Application of information technology in Railways, Airlines, Banking, Online Banking System, Insurance, Inventory Control, Financial systems, Hotel management, Education, Entertainment and health, Security issues in information technology.

### **SUGGESTED READINGS**

- Computer Fundamentals, Pradeep K. Sinha, Priti Sinha [BPB]
- Leon and Leon, (2<sup>nd</sup> Ed., 2012), Introduction to Information Technology, Vikas Publishing House.
- Behl R. (2<sup>nd</sup> Ed. 2012), Information Technology for Management, McGraw Hill Education.
- Dhingra S and Tondon A, (1<sup>st</sup> Ed., 2015), Introduction to Information Technology, Galgotia Publishing House.
- Goyal, Anita (2012) Computer Fundamentals, Pearson Education.

**BSM 309: Botany Practicals (2<sup>nd</sup> year)**

Max. Marks : 50

Time : 1 Hrs.

1. Anatomy of *Cycas*
2. Anatomy of *Pinus*
3. Anatomy of *Ephedra*
4. Anatomy of Banyan Leaf
5. Anatomy of Leaf of *Nerium*
6. T.S. of monocot stem of Maize
7. TS. monocot stem of *Asparagus*
8. T.S. of Monocot stem of *Cynodon*.
9. T.S. of Dicot Root of Gram
10. To dissect out the globular embryo.
11. To dissect out and study the heart shaped embryo.
12. To study L.S. of an anatropous Ovule from a permanent slide.
13. To study a monocot embryo in L.S. maize grain slide.
14. To study Floral Characters of following plant families

**a) Family Ranunculaceae**

- *Ranunculus muricatus* (Buttercup)
- *Delphinium ajacis* (Lark spur)

**b) Family Brassicaceae (Cruciferae)**

- *Brassica Compestris* (Sarson)
- *Raphanus sativus* (Radish)

**c) Family Malvaceae (Cotton family)**

- *Hibiscus- rosa-sinensis* (china rose)
- *Gossypium* sp

**d) Family Cucurbitaceae**

- *Luffa Aegyptiaca*
- *Coccinia cordifolia* (Jangli Porwal)

**e) Family Fabaceae**

- *Lathyrus odoratus* (Sweet Pea)
- *Cassia Fistula* (Amaltas)
- *Acacia nilotica*

**f) Family Umbelliferae (Apiaceae)**

- *Coriandrum Sativum* (Coriander)
- *Foeniculum vulgare* (Fennel)

**g) Family Labiatae (Lamiaceae) mintfamily**

- *Salvia officinalis* (Sage)

**h) Asclepiadaceae (Milk-weed family)**

- *Calotropis procera* (Aak)

**i) Solanaceae (Potato family)**

- *Solanum tuberosum*
- *Petunia hybrida*
- *Datura inoxia*

**j) Asteraceae (Compositae)**

- *Helianthus annuus* (Sun flower)
- *Sonchus asper*

**k) Euphorbiaceae**

- *Euphorbia pulcherrima*
- *Ricinus communis* (Arind)

**l) Poaceae (Graminae)**

- *Triticum aestivum*
- *Avena Sativa*

## **SECTION – I (Inorganic)**

### **Gravimetric Analysis**

Quantitative estimations of, Cu<sup>2+</sup> as copper thiocyanate and Ni<sup>2+</sup> as Ni – dimethylglyoxime.

### **Colorimetry:**

To verify Beer - Lambert law for KMnO<sub>4</sub>/K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and determine the concentration of the given KMnO<sub>4</sub>/K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution. Preparations: Preparation of Cuprous chloride, prussian blue from iron fillings, tetraammine cupric sulphate, chrome alum, potassium trioxalatochromate (III).

## **Section-B (Physical)**

1. To determine the CST of phenol – water system.
2. To determine the solubility of benzoic acid at various temperatures and to determine the H of the dissolution process
3. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
4. To determine the enthalpy of solution of solid calcium chloride
- 5 .To study the distribution of iodine between water and CCl<sub>4</sub>.

## **Section-C (Organic)**

Systematic identification (detection of extra elements, functional groups, determination of melting point or boiling point and preparation of at least one pure solid derivative) of the following simple mono and bifunctional organic compounds: Naphthalene ,anthracene, acenaphthene, benzyl chloride, *p*-dichlorobenzene, *m*-dinitrobenzene, *p*-nitrotoluene, resorcinol , hydroquinone, naphthol, benzophenone, ethyl methyl ketone, benzaldehyde, vanillin, oxalic acid, succinic acid, benzoic acid, salicylic acid, aspirin, phthalic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline hydrochloride, *p*-toluidine, phenyl salicylate (salol), glucose, fructose, sucrose, *o*-, *m*-, *p*-nitroanilines, thiourea.

## BSM 311: Zoology Practicals (SECTION-I)

Max. Marks : 50

Time : 1 Hrs.

**1. Classification upto orders, habit, habitats, external characters and economic importance (if any) of the following animals:-**

Protochordata : *Molgula, Hetryllus, Pyrosoma, Doliolum, Olikopleura,*  
and *Amphioxus*.

Cyclostomata : *Myxine, Petromyzon* and *Ammocoetus larva*.

Chondrichthyes: *Zygaena, Pristis, Narcine* (electric ray), *Trygon,*  
*Rhinobatus, Raja* and *Chimaera*.

Osteichthyes : *Acipenser, Lepidosteus, Muraena, Mystus, Catla,*  
*Hippocampus, Syngnathus, Exocoetus, Anabas,*  
*Diodon, Ostracion, Tetradon, Echinus, Lophius,*  
*Solea* and *Polypterus*. Any of the Lung Fishes.

**2. Preparation of models of the different systems of the following animals:**

Herdmania: General anatomy

*Labeo* (locally available fish): Digestive and reproductive systems: cranial nerves

**3. Study of the skeleton of *Scoliodon, Labeo***

**4. Study of the following prepared slides:** Tornaria larva, T.S. *Amphioxus*  
(through different regions). *Oikopleura*, different types of scales.

**5. Make permanent stained preparations of the following:** *Salpa*, Spicules, and Cycloid scales

**6. Zoological excursion and its report PHYSIOLOGY PRACTICALS:**

1. Qualitative tests for identification of simple sugars, disaccharides and polysaccharides.
2. Study of human salivary amylase activity: Effect of temperature, pH, Concentration.

**Project Report:**

1. Migration in fishes
2. Ornamental fishes

**7. Disaster Management Project Work: (Field Work, Case Studies.**

for details see the UGC Website

## Zoology Practical (SECTION-II)

Classification up to orders, habit, habitats, external characters and economic importance (if any) of the following animals:-

Amphibia : *Necturus, Proteus, Amphiuma, Salamandra, Amblystoma, Axolotie larva, Alytes, Bufo, Rana.*

Reptilia : *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Viper, Crocodilus, Gavialis, Chelone (Turtle) and Testudo (Tortoise).*

Aves : *Casuarius, Arden, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo, Halcyon*

Mammalia : *Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaque, Hystrix, Funambulus, Telix, Panthera, Canis, Herpestes, Capra, Pteropus*

**1. Preparation of models of the different systems of the**

**following animals:** *Hemidactylus* : Digestive, arterial, venous and urinogenital systems. Rat : Digestive, arterial, venous and urinogenital systems.

**2. Study of the skeleton of *Rana* (Frog), *Varanus*, Pigeon or Gallus and *Oryctolagus*/rat**

**3. Study of the following prepared slides: Histology of rat (compound tissues).**

**4. Study and collection of Quill, Contour, Filoplume and Down feathers**

**PHYSIOLOGY PRACTICALS:**

1. Estimation of abnormal constituents of urine (Albumin, sugar, ketone bodies).
2. Use of respirometer.
3. Haematein crystal preparation.
4. Estimation of Hb.
5. DLC of Man/RBC count/WBC count.

**Project Report:**

1. Survey of diversity
2. Parental care
3. Dentition in mammals
4. Migration in birds



## **BSM 401: Biology and Diversity of Seed Plants - II**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Taxonomy and Systematics, fundamental components of taxonomy (identification, classification, description, nomenclature and phylogeny).

### **UNIT-II**

Role of chemotaxonomy, cytotaxonomy and taxometrics in relation to taxonomy, Botanical Nomenclature, principles and rules, principle of priority, Keys to identification of plants.

### **UNIT-III**

Type concept, taxonomic ranks, Salient features of the systems of classification of angiosperms proposed by Bentham & Hooker and Engler & Prantl, Floral Terms and Types of Inflorescence

### **UNIT-IV**

Diversity of Flowering Plants: Diagnostic features and economic importance of the following families: Ranunculaceae, Brassicaceae, Malvaceae, Euphorbiaceae, Rutaceae, Fabaceae, Cucurbitaceae

### **UNIT-V**

Diversity of Flowering Plants: Diagnostic features and economic importance of the families: Apiaceae, Asclepiadaceae, Lamiaceae, Solanaceae, Asteraceae, Liliaceae and Poaceae

## **BSM 402: Plant Embryology**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Flower-a modified shoot, Microsporangium, its wall and dehiscence mechanism.

Microsporogenesis, pollen grains and its structure (pollen wall).

### **UNIT -II**

Pollen germination (microgametogenesis), Male gametophyte, Pollen-pistil interaction; self incompatibility, Pollination: types and agencies

### **UNIT-III**

Structure of Megasporangium (ovule), its curvatures; Megasporogenesis and Megagametogenesis, Female gametophyte (mono, bi and tetrasporic).

### **UNIT-IV**

Double fertilization, Endosperm types and its biological importance.

### **UNIT-V**

Embryogenesis in Dicot and Monocot; Polyembryony, Structure of Dicot and Monocot seed, Fruit types; Dispersal mechanisms in fruits and seeds.

## **BSM 403: Life and Diversity of Chordates**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

**Amphibia:** Origin, Evolutionary tree. Type study of frog (*Rana tigrina*), Parental Care in Amphibia

### **UNIT-II**

**Reptilia:** Type study of Lizard (*Hemidactylus*), Origin, Evolutionary tree. Extinct reptiles; Poisonous and non-poisonous snakes; Poison apparatus in snakes.

### **UNIT-III**

**Aves:** Type study of Pigeon (*Columba livia*); Flight adaptation, Principles of aerodynamics in Bird flight, migration in birds.

### **UNIT-IV**

**Mammals:** Classification, type study of Rat;

### **UNIT V**

Adaptive radiations of mammals and dentition.

**Note: Type study includes detailed study of various systems of the animal.**

## BSM 404: Mammalian Physiology - II

Max. Marks : 70

Time : 3 Hrs.

### UNIT-I

**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, haemopoiesis

### UNIT-II

**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.

### UNIT-III

**Excretion:** Urine formation, counter-current mechanism of urine concentration, osmoregulation, micturition.

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

### UNIT-IV

**Chemical integration of Endocrinology:** Structure and mechanism of hormone action; physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads.

### UNIT V

**Reproduction:** Spermatogenesis, Capacitation of spermatozoa, ovulation, formation of corpus luteum, oestrous-anoestrous cycle, Menstrual cycle in human; fertilization implantation and gestation.

## **BSM 405: Inorganic Chemistry**

**Max. Marks:70**

**Time: 2 Hrs.**

### **UNIT 1**

#### **Chemistry of f – block elements Lanthanides**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

### **UNIT 2**

#### **Chemistry of f – block elements Actinides**

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U.

### **UNIT 3**

Comparison of properties of Lanthanides and Actinides and with transition elements.

### **UNIT 4**

#### **Theory of Qualitative and Quantitative Inorganic Analysis-I**

Chemistry of analysis of various acidic radicals, Chemistry of identification of acid radicals in typical combinations, Chemistry of interference of acid radicals including their removal in the analysis of basic radicals.

### **UNIT 5**

#### **Theory of Qualitative and Quantitative Inorganic Analysis-II**

Chemistry of analysis of various groups of basic radicals, Theory of precipitation, co-precipitation, Post- precipitation, purification of precipitates.

**UNIT 1****Infrared (IR) absorption spectroscopy**

Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Applications of IR spectroscopy in structure elucidation of simple organic compounds.

**UNIT 2****Amines**

Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabriel phthalimide reaction, Hofmann bromamide reaction. electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.

**UNIT 3****Diazonium Salts**

Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO<sub>2</sub> and CN groups, reduction of diazonium salts to hydrazines, coupling reaction and its synthetic application.

**UNIT 4****Nitro Compounds**

Preparation of nitro alkanes and nitro arenes and their chemical reactions. Mechanism of electrophilic substitution reactions in nitro arenes and their reductions in acidic, neutral and alkaline medium.

**UNIT 5****Aldehydes and Ketones**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide (Sarett reagent) pyridinium chlorochromate (PCC) and pyridinium dichromate., Physical properties. Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub> and NaBH<sub>4</sub> reductions.

**UNIT 1****Thermodynamics-III**

Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycles and its efficiency, Carnot's theorem, Thermodynamics scale of temperature. Concept of entropy– entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

**UNIT 2****Thermodynamics-IV**

Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function(G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

**UNIT 3****Electrochemistry-III**

Electrolytic and Galvanic cells – reversible & Irreversible cells, conventional representation of electrochemical cells. EMF of cell and its measurement, Weston standard cell, activity and activity coefficients.

**UNIT 4**

Calculation of thermodynamic quantities of cell reaction (G, H & K). Types of reversible electrodes – metal- metal ion gas electrode, metal –insoluble salt- anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. Standard Hydrogen electrode, reference electrodes, standard electrodes potential, sign conventions, electrochemical series and its applications.

**UNIT 5****Electrochemistry-IV**

Concentration cells with and without transference, liquid junction potential, application of EMF measurement i.e. valency of ions, solubility product activity coefficient, potentiometric titration(acid- base and redox). Determination of pH using Hydrogen electrode, Quinhydrone electrode and glass electrode by potentiometric methods.

# **BSM 501: Fish and Fisheries**

**Max. Marks:70**  
**Time: 3 Hrs**

## **Unit I**

**Introduction to world fisheries:** Production, utilization and demand.

**Fresh Water fishes of India:** River system, reservoir, pond, tank fisheries; captive and culture fisheries, cold water fisheries.

## **Unit II**

Fishing crafts and gears.

Fin fishes, Crustaceans, Molluscs and their culture.

## **Unit III**

**Seed production:** Natural seed resources – its assessment, collection, Hatchery production

## **UNIT -IV**

**Nutrition:** Sources of food (Natural, Artificial) and feed composition (Calorie and Chemical ingredients)

## **UNIT -V.**

**Field Culture:** Ponds-running water, recycled water, cage, culture; polyculture.

**Culture technology:**Biotechnology, gene manipulation and cryopreservation of gametes.



## **BSM 502: Ecology and Evolution**

**Max. Marks:70**

**Time: 3 Hrs**

### **UNIT -I**

Basic concepts of ecology: Definition, significance. Concepts of habitat and ecological niche. Factors affecting environment: Abiotic factors (light-intensity, quality and duration), temperature, humidity, topography; edaphic factors; biotic factors.

### **Unit II**

Ecosystem: Concept, components, properties and functions; Ecological energetics and energy flow- food chain, food web, trophic structure; ecological pyramids concept of productivity.

Biogeochemical cycles: Concept, reservoir pool, gaseous cycles and sedimentary cycles.

Population: Growth and regulation.

### **UNIT – III**

Origin of life.

Concept and evidences of organic evolution.

Theories of organic evolution.

### **UNIT – IV**

Concept of microevolution and concept of species. Concept of macro-and mega-evolution.

### **UNIT - V**

**Phylogeny of horse. Evolution of man.**

## **BSM 503: PLANT PHYSIOLOGY**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Plant-water relations: Importance of water to plant life; physical properties of water; imbibition, diffusion and osmosis; absorption and transport of water; transpiration; physiology of stomata.

Mineral nutrition: Essential macro and micro elements and their role; mineral uptake; deficiency symptoms.

### **UNIT –II**

Transport of organic substances: Mechanism of phloem transport; source-sink relationship; factors affecting translocation.

Photosynthesis : significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

### **UNIT-III**

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

### **UNIT –IV**

Plant hormones- auxins, gibberellins, cytokinins, abscissic acid and ethylene, history of their discovery, mechanism of action.

### **UNIT –V**

Photo-morphogenesis; Phytochromes and their discovery, physiological role and mechanism of action.

## **BSM 504: PLANT ECOLOGY**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Introduction to Ecology: Definition; scope and importance; levels of organization.

Environment: Introduction; environmental factors- climatic (water, humidity, wind, light, temperature), edaphic (soil profile, physico-chemical properties), topographic and biotic factors (species interaction).

### **UNIT-II**

Adaptations of plants to water stress and salinity (morphological and anatomical features of hydrophytes, xerophytes and halophytes).

Population ecology: Basic concept; characteristics; biotic potential, growth curves; ecotypes and ecads.

### **UNIT-III**

Community ecology: Concepts; characteristics (qualitative and quantitative analytical and synthetic); methods of analysis; ecological succession.

Ecosystem: Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)

Biogeochemical cycles: Carbon, nitrogen, phosphorus and hydrological cycle.

### **UNIT-IV**

Phyto-geography: Phyto- geographical regions of India; vegetation types of India (forests).

Environmental pollution: Sources, types and control of air and water pollution.

### **UNIT-V**

Global change: Greenhouse effect and greenhouse gases; impacts of global warming; carbon trading; Ozone layer depletion, Biomagnification.

# **BSM 505: Inorganic Chemistry**

**Marks: 70**

**Time: 2 Hrs**

## **UNIT 1**

### **Metal-ligand Bonding in Transition Metal Complexes**

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral complexes.

## **UNIT 2**

Crystal field splitting in tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

## **UNIT 3**

### **Thermodynamic and Kinetic Aspects of Metal Complexes**

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes of Pt(II).

## **UNIT 4**

### **Magnetic Properties of Transition Metal Complexes**

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling,  $\mu_{\text{eff}}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

## **UNIT 5**

### **Electron Spectra of Transition Metal Complexes**

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for  $d_1$  and  $d_9$  states, discussion of the electronic spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

# **BSM 506: Organic Chemistry**

**Mar ks: 70**

**Time: 2 Hrs**

## **UNIT 1**

### **NMR Spectroscopy-I**

Principle of nuclear magnetic resonance, the PMR spectrum, number of signals, peak areas, equivalent and non equivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting, splitting of signals and coupling constants, magnetic equivalence of protons..

## **UNIT 2**

### **NMR Spectroscopy-II**

Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, 1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone..Simple problems on PMR spectroscopy for structure determination of organic compounds.

## **UNIT 3**

### **Carbohydrates-I**

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose in to mannose. Formation of glycosides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D(+)-glucose & D(-) fructose. Mechanism of mutarotation.Structures of ribose and deoxyribose.

## **UNIT 4**

### **Carbohydrates-II**

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

## **UNIT 5**

### **Organometallic Compounds**

Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.

## **BSM 507: Physical Chemistry**

**Mar ks: 70**

**Time: 3 Hrs**

### **UNIT 1**

#### **Quantum Mechanic s-I**

Black-body radiation, Plank's radiation law, photoelectric effect, heat capacity of solids, Compton effect, wave function and its significance of Postulates of quantum mechanics , quantum mechanical operator, commutation relations, Hamiltonian operator, Hermitian operator,

### **UNIT 2**

average value of square of Hermitian as a positive quantity, Role of operators in quantum mechanics, To show quantum mechanically that position and momentum cannot be predicated simultaneously, Determination of wave function & energy of a particle in one dimensional box, Pictorial representation and its significance.

### **UNIT 3**

#### **Physical Properties and Molecular Structure**

Optical activity, polarization – (Clausius – Mossotti equation). Orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetics.

### **UNIT 4**

#### **Spectroscopy-I**

**Introduction:** Electromagnetic radiation, regions of spectrum, basic features of spectroscopy, statement of Born-Oppenheimer approximation, Degrees of freedom.

**Rotational Spectrum:** Diatomic molecules. Energy levels of rigid rotator (semi-classical principles), selection rules, spectral intensity distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigid rotor, isotope effect.

### **UNIT 5**

#### **Spectroscopy-II**

##### **Vibrational spectrum**

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effects of anharmonic motion and isotopic effect on the spectra., idea of vibrational frequencies of different functional groups.

**Raman Spectrum:** Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, Quantum theory of Raman spectra.

## **BSM 508: Botany Practical**

**Max. Marks : 50**

**Time : 2 Hrs.**

1. Demonstration of Imbibition by plaster of Paris method.
2. Demonstration of Osmosis- by potato osmoscope method.
3. Demonstration of Plasmolysis and deplasmolysis.
4. Comparison of stomatal and cuticular transpiration by four leaf /Cobalt chloride method.
5. Demonstration of transpiration by Ganong's/ Farmer's photometer.
6. Separation of photosynthetic pigments by thin layer/ paper chromatography.
7. Rate of photosynthesis under varying CO<sub>2</sub> concentration.
8. Effect of kind of light intensity on oxygen evolution during photosynthesis using Wilmott's bubbler.
9. Determination of pH of soil and water samples.
10. Study of physical properties of soil- soil density, water holding capacity etc.
11. Simple tests for the detection of Carbohydrates(Monosaccharides, Disaccharides and Starch); Proteins and Fats.
12. To prepare any one of the tissue culture medium.
13. Preparation of Petri plates and slants for culture.
14. Study of techniques of sterilization, culturing and sub-culturing of cell, tissues and organs.

Demonstration of anther culture, protoplast isolation and culture using suitable models/ charts/ photographs etc.

## BSM 509: Chemistry Practical

Max. Marks : 50

Time : 1 Hrs.

### SECTION – I (Inorganic)

Semimicro qualitative analysis of mixture containing not more than four radicals (including interfering, Combinations and excluding insolubles):

Pb<sup>2+</sup>, Hg<sub>2</sub><sup>2+</sup>, Hg<sup>2+</sup>, Ag<sup>+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, As<sup>3+</sup>, Sb<sup>3+</sup>, Sn<sup>2+</sup>, Fe<sup>3+</sup>, Cr<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, NH<sub>4</sub><sup>+</sup>, CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>2</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>

#### Section-B (Physical)

1. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
2. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically
3. To determine the strength of given acid solution (mono and dibasic acid)/KMnO<sub>4</sub> – Mohr salt potentiometrically.
4. To determine the molecular weight of a non-volatile solute by Rast method.
5. To standardize the given acid solution (mono and dibasic acid) pH metrically.

### Section-C (Organic)

#### 1. Laboratory Techniques

(a) **Steam distillation** (non evaluative)

Naphthalene from its suspension in water

Separation of *o*- and *p*-nitrophenols

(b) **Column chromatography** (non evaluative)

Separation of fluorescein and methylene blue

Separation of leaf pigments from spinach leaves

#### 2. Chromatography Method

Determination of R<sub>f</sub> values and identification of organic compounds

(a) Separation of green leaf pigments (spinach leaves may be used) by paper chromatographic method

(b) Separation of a mixture of coloured organic compounds using common organic solvents by TLC.

#### 3. Synthesis of the following organic compounds:

(a) To prepare *o*-chlorobenzoic acid from anthranilic acid.

(b) To prepare *p*-bromoaniline from *p*-bromoacetanilide.

© To prepare *m*-nitroaniline from *m*-dinitrobenzene.

(d) To prepare *S*-Benzyl-iso-thiourea chloride from thiourea.



## BSM 510: Zoology Practical (SECTION-I)

Max. Marks : 50

Time : 2 Hrs.

Identification of *Catle*, *Labeo rohita*, *L. calbasu*, *Cirrhius*, *mrigala* *Puntius sarana*, *Channa punctatus*, *C. marulius*, *C. stariatus*, *Trichogaster fasciata*, *Mystus seenghala*, *M. cavausius*, *M. tengra*, *Callichrous pabola*, *C. bimaculatus*, *Wallago attu*, *Prawns*, *Crabs*, *Lobsters*, *Calms*, *Mussels* & *Oysters*.

1. Chemical analysis of pond water and soil for pH, dissolved oxygen, free CO<sub>2</sub> nitrates, phosphates and chlorides.
2. A study of the slides of fish parasites
3. A study of the different types of nets, e.g., cast net, gill net, drift net and drags net
4. A visit to lake/reservoir/fish breeding centre.
5. Evolutionary evidences and/or its demonstration through models/video/CD etc and preparation of working models of the different systems of the following animals:
  - Adaptive modifications in feet and beaks of birds
  - Evolutionary evidences of man and horse.

6. Project report :

- i) Pearl culture
- ii) Prawn culture

## Zoology Practical (SECTION-II)

1. External morphology, identification marks, nature of damage and host of the following pests:
  - i. **Sugarcane:** Sugarcane leaf-hopper, Sugarcane whitefly, Sugarcane top borer, Sugarcane root borer, Gurdaspur borer (any two).
  - ii. **Cotton :** Red Cotton bug
  - iii. **Wheat:** Wheat stem borer
  - iv. **Paddy:** Gundhi bug, Rice grasshopper, Rice stem borer, Rice hispa (any one).
  - v. **Vegetables:** *Aulocophora faveicollis*, *Dacus cucurbitas*, *Tetranychus tecarius*, *Epilachna* (any three).
  - vi. **Pests of stored grains:** Pulse beetle, Rice weevil, Grain & Flour moth, Rust-red flour beetle, lessergrain borer (any three).
2. Preparation of permanent/temporary slides of developmental stages of frog/mosquito
3. Study of permanent slides of WM of chick embryo (13-18h, 24-36h, 36-48h, 48-72h).
4. Window preparation and identification of stages of development in chick egg.
5. Project report:
  1. Apiculture
  2. Sericulture

## BSM 601: Entomology

Marks: 70

Time: 3 Hrs

### Unit I

*Study of important insect pests of crops and vegetables:*

**Sugarcane:** *Sugarcane leaf-hopper (Pyrilla perpusilla), Sugarcane Whitefly (Aleurolobus barodensis, Sugarcane top borer (Sciropophaga novella, Sugarcane root borer (Emmalocera depresella, Gurdaspur borer (Bissetia steniellus) With their systematic position, habits and nature of damage caused. Life cycle and control of Pyrilla perpusilla only.*

**Cotton:** *Pink bollworm (Pestiphora gossypifolia), Red cotton bug (Dysdercus Cingulatus, Cotton grey weevil (Mylocherus undecimpustulatus, Cotton Jassid (Amrasca devastans) With their systematic position, habits and nature of damage caused. Life cycle and control of Pectinophora gossypiella.*

### Unit II

Wheat: Wheat stem borer (*Sesamia inferens*) with its systematics position , habits,nature of damage caused. Life cycle and control

### UNIT III

Paddy :- Gundhi bug (*leptocorisa acuta*), rice grasshopper ( *hieroglyphus banian*),rice hispa (*diceladisa armigeera*).

### UNIT IV

Raphidopalpa faveicollis– The Red pumpkin beetle. Dacus cucurbitas – The pumpkin fruit fly. Tetranychus tecarius – The vegetable mite.

Epilachna – The Hadda beetle. Their systematics position, habits and nature of damage caused. life cycle and control of Aulacophora faveicol

### UNIT V

Stored grains:

Pulse beetle (*Callosobruchu*), Rice weevil (*Sitophilus oryzae*), Wheat weevil (*Trogoderma granarium*), Rust Red Flour beetles (*Tribolium castaneum*), Lesser grain borer (*Rhizopertha dominica*), Grain & Flour moth (*Sitotroga cerealella*), Their systematic position, habits and nature of damage caused. Life cycle and control of *Trogoderma granarium*.

Insect control: Biological control, its history, requirement and precautions and feasibility of biological agents for control.

Chemical control: History, Categories of pesticides. Important pesticides from each category to pests against which they can be used. Insect repellants and attractants. Integrated pest management. Important bird and rodent pests of agriculture & their managemt.

# **BSM 602: Developmental Biology**

**Marks: 70**

**Time: 3 Hrs**

## **Unit I**

Historical perspectives, aims and scope of developmental biology.

Generalized structure of mammalian ovum & sperm. Spermatogenesis and Oogenesis.

## **Unit II**

Fertilization, parthenogenesis, different types of eggs and patterns of cleavage in invertebrates and vertebrates.

Process of blastulation in invertebrates and vertebrates

Fate-map construction in frog and chick.

## **Unit III**

Gastrulation in invertebrates and vertebrates

## **UNIT – IV**

Gastrulation & formation of three germinal layers in frog and chick.

elementary knowledge of primary organizers.

## **UNIT - V**

Extra embryonic membranes: structure & significance in birds and mammals.

Concepts of competence, determination and differentiation. Concept of regeneration.

# **BSM 603: Biochemistry and Plant Biotechnology**

**Marks: 70**

**Time: 3 Hrs**

## **UNIT-I**

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

## **UNIT-II**

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

## **UNIT-III**

Lipid metabolism: Structure and functions of lipids; fatty acid biosynthesis;  $\beta$ -oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Nitrogen metabolism: Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation.

## **UNIT-IV**

Genetic engineering and Biotechnology: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements;

## **UNIT-V**

Aspects of plant tissue culture; cellular totipotency, differentiation and morphogenesis; biology of *Agrobacterium*; vectors for gene delivery and marker genes.

## **BSM 604: Economic Botany**

Max. Marks : 70

Time : 3 Hrs.

### **UNIT-I**

Vavilov's centres of origin of crop plants, Origin, distribution, botanical description, brief idea of cultivation and economic uses of the following:

Food plants - cereals (rice, wheat and maize), pulses ( gram, arhar and pea), vegetables ( potato, tomato and onion).

### **UNIT-II**

Origin, distribution, botanical description, brief idea of cultivation and economic uses of the following:

Fibers- cotton, jute and flax.

Oils- groundnut, mustard, sunflower and coconut.

### **UNIT-III**

Morphological description, brief idea of cultivation and economic uses of the following:

Spices- coriander, ferula, ginger, turmeric, cloves.

### **UNIT-IV**

Morphological description, brief idea of cultivation and economic uses of the following:

Medicinal plants- *Cinchona*, *Rauwolfia*, *Atropa*, *Opium*, *Cannabis*, *Azadirachta*, *Withania*.

### **UNIT-V**

Botanical description, processing and uses of:

Beverages- tea and coffee;

Rubber - *Hevea*;

Sugar- sugarcane

General account and sources of timber; energy plantations and bio-fuels.

## **BSM 605: Inorganic Chemistry**

Max. Marks : 70

Time : 2 Hrs.

### **UNIT 1**

#### **Organometallic Chemistry**

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, and bonding of alkyls of Li, Al, Hg, and Sn a brief account of metal-ethylenic complexes, mononuclear carbonyls and the nature of bonding in metal carbonyls.

### **UNIT 2**

#### **Acids and Bases, HSAB Concept**

Arrhenius, Bronsted – Lowry, the Lux – Flood, Solvent system and Lewis concepts of acids & bases, relative strength of acids & bases,

### **UNIT 3**

Concept of Hard and Soft Acids & Bases. Symbiosis, electronegativity and hardness and softness

### **UNIT 4**

#### **Bioinorganic Chemistry**

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to  $\text{Ca}^{2+}$ . Nitrogen fixation.

### **UNIT 5**

#### **Silicones and Phosphazenes**

Silicones and phosphazenes, their preparation, properties, structure and uses

## **BSM 606: Organic Chemistry**

Max. Marks : 70

Time : 2 Hrs

### **UNIT 1**

#### **Heterocyclic Compounds-I**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole

### **UNIT 2**

#### **Heterocyclic Compounds-II**

Introduction to condensed five and six- membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of, quinoline and isoquinoline

### **UNIT 3**

#### **Organosulphur Compounds**

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyl and aryl sulphonates.

### **UNIT 4**

#### **Organic Synthesis *via* Enolates**

Acidity of hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

#### **Synthetic Polymers**

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

### **UNIT 5**

#### **Amino Acids, Peptides & Proteins**

Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation of  $\alpha$ -amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins: Primary & Secondary structure.

## **BSM 607: Physical Chemistry**

Max. Marks : 70

Time : 3 Hrs

### **UNIT 1**

#### **Spectroscopy-III Electronic Spectrum**

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck- Condon principle. Qualitative description of sigma and pie and n molecular orbital (MO) their energy level and respective transitions.

### **UNIT 2**

#### **Photochemistry**

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthus-Draper law, Stark-Einstein law (law of photochemical equivalence) Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

### **UNIT 3**

#### **Solutions:**

##### **Dilute Solutions and Colligative Properties**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, Colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination, Osmosis law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point,

### **UNIT 4**

Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

### **UNIT 5**

#### **Phase Equilibrium**

Statement and meaning of the terms – phase component and degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component system –Example – water and Sulphur systems. Phase equilibria of two component systems solid-liquid equilibria, simple eutectic Example Pb-Ag system, desilverisation of lead