II Tamaso ma Jyotirgamaya II
Shri Someshwar Shikshan Prasarak Mandal's
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SOMESHWAR VIDNYAN MAHAVIDYALAYA

Someshwarnagar, Tal: Baramati, Dist: Pune Pin - 412 306 , Maharashtra, India
(Afilliated to Savitribai Phule Pune University, Pune)
Estd. : 2007

Govt. Reg. No. N.C.G.2007(189/07) Mashi-3, Dt. 2 July 2007 College Code - 827 University Appvl. No. IDNo. PU/PN/S/284/2007

Ref. No. S.V.M. /

Date : / /20

Integration integrates cross-Cutting issues relevant to Gender, Environment and sustainability, Human Values and Professional Ethics have been included in the curriculum by the university

Sr.NO.	Name of The Course	Course Code	CHAPTERS / UNIT (as example)	ISSUES
1	S.Y.B.Sc	AECC-I	A shadow, La belle dam sans merci, Whether the mind is without fear, My lost Dollar	Human values (Love and Lost), Gender Equality.
2	T.Y.B.Sc	CH-505	Modern Approach to Chemical Industries- Pollution Control, Copyright Act, patent Act , Trade Marks	Environment and sustainability, Professional Ethics
3	S.Y.B.Sc	EL-231	Electromagnetic Spectrum , Concept Of Noise, Environmental Noise, Brief Idea of Frequency allocation for radio Communication System in India (TRAI) , Signal to Noise level Frequency and Amplitude Modulation MAN, WAN Ethernet :100 MBPS Gigabit, 10 Gigabit	Environment and sustainability.
4	F.Y.B.Sc	BO-111	Utilization of Algae In Biofuel Industry , Agricultural Utilization of lichens in Pollution Indicators, Utilization of fungi in Ecological Decomposition,	Environment and sustainability.
5	F.Y.B.Sc	BO-112	Importance of Morphology in plant utilization and anatomy into Ecological interpretation , Pharmacognosy and Wood identification,	Environment and sustainability.

10	M.Sc-II	CHO-450	Chemistry of Natural Products, Green Chemistry and Chemical Biology	Environment and sustainability.
11	M.Sc-I	CHG-190	Introduction to Chemical Biology part -I	Environment and sustainability.
12	S.Y.B.Sc	AECC-I	Introduction to Environmental studies , ecosystem, Natural resource, Biodiversity and conservation, Environmental Pollution, Environmental policies and practices, Human communities and the Environment	Environment and sustainability
12	S.Y.B.Sc	CH-223	Practical course in chemistry -Chemical toxicology	Environment and sustainability

Someshwar Science College, Someshwar COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

F.Y.B.Sc. Zoology

Choice Based Credit System Syllabus

to be implemented from

Academic Year 2019-2020

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of Savitribai Phule Pune University with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC**] have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of F.Y.B.Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B.Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, cocuricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will

be as per the guidelines of the University. The B.Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills. The Syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper
- handling of lab instruments.

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F.Y.B.Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S.Y.B.Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English/Marathi	LA 241- English /Marathi	2+2
T.Y.B.Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 Pest Management	ZO-361 Medical & Forensic Zoology	2+2
DSEC	ZO-352 Histology	ZO-362 Animal Physiology	2+2
DSEC	ZO-353 Biological Chemistry	ZO-363 Molecular Biology	2+2
DSEC	ZO-354 Genetics	ZO-364 Entomology	2+2
DSEC	ZO-355 Developmental Biology	ZO-365 Techniques in Biology	2+2
DSEC	ZO-356 Parasitology	ZO-366 Evolutionary Biology	2+2
DSEC	ZO-357 Zoology Practical Paper 1	ZO-367 Zoology Practical Paper 1	2+2
DSEC	ZO-358 Zoology Practical Paper 2	ZO-368 Zoology Practical Paper 2	2+2
DSEC	ZO-359 Zoology Practical Paper 3	ZO-369 Zoology Practical Paper 3	2+2
SEC	ZO-3510 Aquarium Management	ZO-3610 Environmental Impact Assessment	2+2
SEC	ZO- 3511 Poultry Management	ZO-3611 Project	2+2

Detailed Syllabus of F.Y.B.Sc.

Paper	Semester I Course Code & Course	Credits	No of Lectures	Marks (Internal + University)		SemesterII Course Code & Course	Credits	No of Lectures	Marks (Internal + University)
I	ZO-111 Animal Diversity I	02	30	15+ 35= 50		ZO-121 Animal Diversity II	02	30	15+ 35 = 50
II	ZO-112 Animal Ecology	02	30	15+ 35 = 50		ZO-122 Cell Biology	02	30	15+ 35 = 50
III	ZO-113 Zoology Practical Paper	01	15 practical	15+ 35 = 50		ZO-123 Zoology Practical Paper	01	15 Practical	15+ 35 = 50

Course No.	Course Title	Total Number of lectures/practical per Term	Standard of passing		
			Internal marks	**University marks**	**Total marks**
ZO-111 (First term)	Animal Diversity–I	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-121 (Second term)	Animal Diversity-II	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-112 (First term)	Animal Ecology	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-122 (Second Term)	Cell Biology	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-113 (First term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50
ZO-123 (Second Term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50

Animal Diversity I & II

Objectives:

1. To understand the Animal diversity around us.
2. To understand the underlying principles of classification of animals.
3. To understand the terminology needed in classification.
4. To understand the differences and similarities in the various aspects of classification.
5. To classify invertebrates and to be able to understand the possible group of the invertebrate observed in nature.to understand our role as a caretaker and promoter of life.

Learning outcomes for the course:

1. The student will be able to understand classify and identify the diversity of animals.
2. The student understands the importance of classification of animals and classifies them effectively using the six levels of classification.
3. The student knows his role in nature as a protector, preserver and promoter of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity –I

Course Code-ZO-111

Semester I **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Principles of Classification:**	**(05)**

Taxonomy & Systematics

1.1 Taxonomy: Basic terminology and Introuction

- Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy
- Macro taxonomy: Phenetics (numerical taxonomy, Cladistics (Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics)
- Classical taxonomy and experimental or neo taxonomy (biochemical taxonomy and Cytotaxonomy)
- Significance of Taxonomy

1.2 Systematics: definition introduction

1.3 Linnaean system of classification (Six level classification: Phylum, class, order, family, genus, species)

1.4 Concept of Species: Biological & Evolutionary

1.5 Introduction to Binomial Nomenclature.

1.6 Introduction to Five kingdom system.

2. **General Features of kingdom Animalia** **(02)**

2.1 General characters of Kingdom Animalia, Grades of organization

2.2 Symmetry.

3. **Kingdom Protista (Phylum: Protozoa)** **(07)**

3.1 Introduction to Phylum Protozoa

3.2 Salient features of Phylum Protozoa

3.3 Classification of Phylum Protozoa up to classes with two examples of each class (names only).

Class Rhizopoda (e.g :*Entamoeba histolytica, Arcella*),

Class Mastigophora (e.g: *Euglena viridis, Trypanosoma gambiense*),

Class Ciliata (e.g *Paramoecium caudatum, Opalina ranarum*),

Class Sporozoa (e.g *Plasmodium vivax*, *Toxoplasma gondii*)

3.4 Locomotion in Protozoa: Amoeboid, Ciliary and Flagellar with suitable examples

3.5 Type Study: ***Paramecium caudatum***: Classification, Habit and Habitat, External morphology, Feeding and digestion, Excretion, Reproduction (binary fission and conjugation)

3.6. Economic importance of Protozoa (three harmful and one useful protozoan)

3.6.1**-Harmful Protozoa**:

Plasmodium vivax (malarial parasite),

Entamoeba histolytica (Amoebic dysentery),

Trypanosoma gambiense (Gambian sleeping sickness).

3.6.2**- Useful Protozoa**:

Trichonympha

4. **Origin of Metazoa** **(01)**

4.1 Introduction Origin and importance of Metazoa

5. **Phylum Porifera** **(06)**

5.1. Introduction to Phylum Porifera

5.2 Classification of Phylum Porifera up to classes with two examples of each class (names only, no description of specimens).

Class Calcarea (e.g.: *Leucosolenia, Sycon (Scypha)*

Class Hexactinellida (e.g: *Euplectella* (venus flower basket), *Hyalonema* (glass sponge))

Class Demospongiae (e.g: *Chalina* (Mermaid's gloves, *Spongilla* (fresh water sponge))

5.3 Canal system in sponges: Ascon, Leucon and Rhagon type.

5.4 Skeleton in sponges: Spicules, its types:

Microscleres & Megascleres,

Monoaxon – monactinal, diactinal, Amphidiscs, Triaxon, Polyaxon,

Spongin fibres.

5.5 Regeneration in sponges.

5.6 Economic importance of Phylum Porifera.

6. **Phylum: Cnidaria** **(05)**

6.1 Introduction to Phylum Cnidaria

6.2 Salient features of Phylum Cnidaria

6.3 Classification of Phylum Cnidaria up to class level with given

examples each class (names of examples only)

Class Hydrozoa e.g.: Hydra, *Physalia* (Portuguese man of war)

Class Scyphozoa e.g: *Aurelia* (Jelly fish), *Leucernaria* (trumpet shaped Jellyfish)

Class Anthozoa: e.g; Metridium (Common sea anemone0

6.4 Polymorphism in Hydrozoa: Polyps & Medusa (polyp types: gastrozooids, dactylozooids, gonozooids) and functions

6.5 Economic importance of Cnidarians with reference to Corals and Coral reefs.

7. **Phylum Platyhelminthes** **(04)**

7.1 Introduction to Phylum Platyhelminthes

7.2 Salient features of Phylum Platyhelminthes

7.3 Classification of Phylum Platyhelminthes up to classes with two examples each class (names of examples only).

Class: Turbellaria (e.g: *Dugesia, Bipallium*)

Class: Trematoda (e.g*: Fasciola hepatica, Schistosoma haematobium*)

Class Cestoda: (*Taenia solium* (pork tape worm),*Echinococcus granulosus* (dog tapeworm)

7.4 Parasitic adaptations in Platyhelminthes: structural and physiological.

7.5 Economic importance of Platyhelminthes

Course Title: Animal Ecology

Course Code: ZO 112

Semester I **(2 Credits-30 Lectures)**

Learning outcomes for the course:

- The learners will be able to identify and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics and its impact on ecosystem and biosphere due to the dynamics in population.
- To understand anticipate, analyse and evaluate natural resource issues and act on a lifestyle that conserves nature.
- The Learner understands and appreciates the diversity of ecosystems and applies beyond the syllabi to understand the local lifestyle and problems of the community.
- The learner will be able to link the intricacies of food chains, food webs and link it with human life for its betterment and for non-exploitation of the biotic and abiotic components.
- The working in nature to save environment will help development of leadership skills to promote betterment of environment.

ZO 112: Animal Ecology **(2 Credits-30 Lectures)**

No.	Topic & Content	Number of lectures
1.	**Introduction to Ecology**	**(02)**
	1.1 Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, Autecology and synecology.	
2.	**Ecosystem**	**(08)**
	2.1 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine and terrestrial (Forest, Grassland and Desert)	
	2.2 Structure and Composition of Ecosystem (Abiotic components and biotic components.	
	2.3 Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids: Number, Biomass, and Energy.	
	2.4 concept of Eutrophication in lakes and rivers.	
3	**Population**	**(08)**
	3.1Characteristic of population: Density, Natality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.	
	3.2Exponential and logistic growth,	
	3.3 Population regulation – density-dependent and independent factors.	
	Population interactions, Gause's Principle with laboratory and field interactions,	
	3.4 Quadrate, line and belt transect methods.	
4.	**Community**	**(07)**
	4.1Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Eco tone and edge effect; Ecological succession with one example.	
5.	**Animal interactions**	**(05)**
	5.1Introduction to Animal interactions	
	5.2 Types of Animal interactions with at least to suitable examples of each	
	5.2.1-Competition: Interspecific and intraspecific	

5.2.2- Beneficial Associations:

Commensalism (remora fish on shark, Cattle egrets on livestock),

Mutualism (Termite and *Trichonympha*, bees and flowers, cleaning symbiosis in fish by prawns.

5.3 Antagonistic associations: Parasitism (*Ascaris* and man, lice and humans), Prey predation (Lion and deer).

Course Title: Zoology Practical Paper

Course Code: ZO113

Semester I **(1.5 Credits-45 Hours)**

Animal Diversity –I

1. Museum Study of phylum Protozoa: Euglena, Paramecium, Amoeba, Plasmodium sp.
2. Museum study of Phylum Porifera: *Sycon*, *Euplectella, Chalina*, Spongilla.
3. Museum study of phylum Cnidaria: *Hydra, Physalia, Aurelia, Metridium*.
4 Museum Study of phylum Platyhelminthes: *Planeria, Faciola hepatica, Taenia solium*
5. Study of Paramecium: Culture, External morphology, Conjugation and Binary fission.
6. Study of permanent slides: Spicules and Gemmules in Sponges, T.S. of *Sycon*, T.S. of Hydra, Taeniasolium: Scolex, Gravid proglottid.
7. Identification of any three museum specimen with help of taxonomic identification key.
8. Visit to Zoological survey of India/ Museum/National Park.

Animal Ecology:

1. Estimation of Dissolved oxygen from given water sample.
2. Estimation of Water Alkalinity from given water sample.
3. Study of animal community structure by quadrate method (Field or Simulation).
4. Determination of density, frequency and abundance of species by quadrat method.
5. Study of microscopic fauna of freshwater ecosystem (from pond).
6. Estimation of water holding capacity of given soil sample.
7. Estimation of dissolved and free carbon dioxide from water sample.
8. Study of Eutrophication in lake/river.

Course Title: Animal Diversity –II

Course Code: ZO-121:

Semester II **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Phylum Aschelminthes**	**(04)**
	1.1 Introduction to phylum Aschelminthes 1.2 Salient features of Phylum Aschelminthes 1.3 Classification of Phylum Aschelminthes (Class Nematoda only with two examples – *Ascaris lumbricoides* (common round worm), *Wuchereria bancrofti* (Elephantiasis)). 1.4 Economic importance of class Nematoda.	
2.	**Phylum Annelida**	**(06)**
	2.1 Introduction to Phylum Annelida 2.2 Salient features of Phylum Annelida. 2.3 Classification of Phylum Annelida up to classes with examples of following classes (names of examples only). Class Polychaeta (e.g: *Nereis pelagica (neries/* sand worm, *Aphrodita aculeata* (=Aphrodite/ seamouse) Class Oligochaeta (e.g.: *Pheritima posthuma* (earthworm), Class Hirudinea (e.g: *Hirudinaria granulosa* common cattle leech) 2.4 Economic importance of Annelida with reference to earthworms as friends of farmers and in their role in vermicomposting.	
3.	**Phylum Arthropoda**	**(06)**
	3.1 Introduction to Phylum Arthropoda 3.2 Salient features of Phylum Arthropoda 3.3 Classification of Phylum Arthropoda with specific classes and mentioned examples (names only) Class:Crustacea*:Palaemon palaemon* (Prawn) *Brachyura* spp. crabs) Class: Chilopoda: *Scolopendra* sp. (centipede) Class: Diplopoda: *Julus* sp. (millipede)	

Class Insecta*: Periplaneta americana* (American Cockroach), *Anopheles stephensii* (mosquito).

Class: Arachnida- Spiders, *Buthus sp (*scorpion)

3.4 mouth parts in insects: Mandibulate (cockroach), Piercing and sucking (female Anopheles mosquito), chewing and lapping type (honey bee)

3.5 Economic importance of Arthropoda

Useful Insects: Honey bee, Lac insect, Silkworm.

Harmful insects: Female Anopheles mosquito, Red cotton bug, Rice weevil

4. **Phylum Mollusca** **(06)**

4.1 Introduction to Phylum Mollusca

4.2 Salient features of Phylum Mollusca

4.3 Classification of Phylum Mollusca with specific classes and mentioned examples (names only)

Class Gastropoda e.g *Pila globosa* (apple snail)

Class Pelecypoda e.g *Lamellidens marginalis*(Bivalve)

Class Polyplacophora e.g *Chiton*

Class: Cephalopodae.g: *Octopus vulgaris* (common octopus), *Sepia officinalis* (common Cuttle fish)

4.4 Economic importance of Mollusca.

5. **Study of Phylum Echinodermata** **(08)**

5.1 Introduction to Phylum Echinodermata

5.2 Salient features of Phylum Echinodermata.

5.3 Classification of Phylum Echinodermata with specific classes and mentioned examples (names only)

Class Asteroidea (*Asterias rubens* sea stars or starfish)

Class: Holothuroidea. *Holothuria sp*. sea cucumbers)

Class: Echinoidea *(Echinus esculentis* common sea urchins)

Class: Crinoidea (sea lilies or feather stars)

5.4 **Type study: *Asteriasrubens* (Sea Star):** Classification, Habit

Habitat, External Morphology, Digestive system, Water vascular

System and autotomy and regeneration

5.5 Pedicillaria in Echinodermata: straight, crossed, valvate, tridactylous, globigerous.

5.6 Economic importance of Echinidermata.

Course Title: Cell biology

Course Code: ZO122:

Semester II (2 credits-30 lectures)

Learning outcomes for Cell Biology

- The learner will understand the importance of cell as a structural and functional unit of life.
- The learner understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development.
- The dynamism of bio membranes indicates the dynamism of life. Its working mechanism and precision are responsible for our performance in life.
- The cellular mechanisms and its functioning depends on endo-membranes and structures. They are best studied with microscopy.

ZO122: Cell biology (2 credits-30 lectures)

No.	Title & Contents	Number of lectures
1.	**Introduction:**	**(04)**

1.1 Introduction cell biology,

1.2 Cell as basic unit of life.

1.3 Importance of Cell Biology and its applications in industry.

Overview of Cells

1.3 Introduction to Prokaryotic and Eukaryotic cells.

1.4 Structure and function of Prokaryotic *(E. coli)*

1.5 Structure and function of Eukaryotic cells (Animal and Plant Cell)

2	**Techniques in Cell Biology:**	**(04)**
	3.1 Introduction 3.2 Microscopy: Basic Principle, Simple, Compound and applications of Electron Microscope. 3.3 Stains and dyes: Types of Stain: Acidic, basic and neutral. Dye (Preparation and chemistry of dyes not expected) 3.4 Micrometry.	
3	**Plasma Membrane:**	**(06)**
	4.1Introduction 4.2 Structure of plasma membrane: Fluid mosaic model. 4.3Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport. 4.4 Other functions of Cell membrane in brief Protection, cell recognition, shape, storage, cell signalling. 4.5 Cell Junctions: Tight junctions, gap junctions, Desmosomes.	
4	**Nucleus: Structure and function**	**(04)**
	5.1Introduction to Nucleus 5.2 Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus 5.3 Chromatin: Eu-chromatin and Hetro-chromatin, nature and differences. 5.4 Functions of nucleus	
5.	**Endomembrane System**	**(04)**
	6.1 Introduction 6.2 Structure, location and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes and vacuoles.	
7.	**Mitochondria and Peroxisomes**	**(03)**
	7.1 Introduction 7.2 Mitochondria: ultrastructure and function of mitochondrion.	

7.3 Peroxisomes

Cell Division **(05)**

7.1 Introduction

7.2 Cell cycle (G1, S, G2, M phases),

7.3 Mitosis.

7.4 Meiosis.

Course Title: Zoology Practical Paper

Course Code: ZO123

Semester II **(1.5 Credits-45 Hours)**

Animal Diversity –II

1. Museum study of Phylum Aschelminthes: *Ascaris lumbricoides*,
2. Museum study of phylum Annelida: *Neries*, Earthworm, Leech.
3. Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab
4. Museum study of phylum Mollusca: *Pila*, *Chiton*, Bivalve, Octopus.
5. Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, sea cucumber.
6. Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping.
7. Types of Shells in Mollusca. *Pila*, Bivalve, Chiton, Sepia.
8. Economic importance of honey bees, Lac insects silk worms, red cotton bug, Anopheles mosquito
9. Earthworm: vermicomposting bin preparation and maintenance.
10. Visit to a vermicomposting unit/ field for insect pest collection and its identification

Cell Biology

1. Study of Microscope: Simple and Compound
2. Micrometry: Measurement of microscopic objects
3. Study of cell: Preparation of temporary mount of human buccal epithelial cells.
4. Preparation of blood smears to observe the blood cells
5. Temporary preparation of mitotic cell from onion roots
6. Study of Cell organelles (any three) by using microphotographs

Recommended Reference Books

Animal Diversity – I and II

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2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
4. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
5. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Brusca, R.C andBrusca, G. J (2003): Invertebrate (2^{nd} ed.) Sinauer Associates Inc., Publishers Sunderland.
7. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
8. Hyman, L. H (1940): Invertebrates Vol I, Protozoa through ctenophore.
9. Hyman. L. H (1955): The Invertebrates Vol: IV, Echinodermata, the coelomate bilateria, Mcgraw Hill, Newyork.
10. Modern Text-Book of zoology, Vertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
11. Nigam H.C., Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Phylum Protozoa to Echinodermata (series) by Kotpal, RL. Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell (1972): A text book of Zoology, Vol –I (7^{th} edition by Marshall and Williams) Mcmillan Press ltd.
14. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram Nagar, New Delhi.
15. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. London

Animal Ecology

1. Colinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication

Cell Biology

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI EditionJohn Wiley and Sons. Inc.
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6. Inside the Cell (2005); US Department of Health Sciences, National Institute of Health, Natinal institute of General Medicine Sciences.
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8. Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
9. Powar C B.: Cell Biology, Himalaya Publication, Meerut

Note: Latest editions of the recommended books may be referred.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Botany

(Faculty of Science & Technology)

F.Y.B.Sc. Botany

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc Botany

1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Botany Theory Paper 1	2
			BO 232	Botany Theory Paper 2	2
			BO 233	Botany Practical Paper	2
	4	Compulsory Course	BO 241	Botany Theory Paper 1	2
			BO 242	Botany Theory Paper 2	2
			BO 243	Botany Practical Paper	2
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3510	Botany Theory Paper 7	2
			BO 3511	Botany Theory Paper 8	2
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3610	Botany Theory Paper 7	2
			BO 3611	Botany Theory Paper 8	2

2. Equivalence of Previous Syllabus:

Old Course (2013 Pattern)	**New Course (2019 CBCS Pattern)**
Fundamentals of Botany: PAPER – I Term- I: Plant Diversity	BO 111 Plant life and utilization I
Botany Theory Paper II Term I – Industrial Botany	BO 112 Plant morphology and Anatomy
Fundamentals of Botany: PAPER - I Term- II: Morphology and Anatomy	BO 121 Plant life and utilization II
Botany Theory Paper II Term- II – Industrial Botany	BO 122 Principles of plant science
F. Y. B. Sc. Botany Practical Paper - III based on Theory Paper I and Paper II	BO 113 Practical based on BO 111 & BO 112 and BO 123 Practical based on BO 121 & BO 122

SEMESTER-I: PAPER-I

BO-111: PLANT LIFE AND UTILIZATION I (30 Lectures)

CREDIT-I **15 Lectures (15 Hours)**

1. INTRODUCTION **3 L**

General outline of plant kingdom (**Lower Cryptogams**: Thallophytes- Algae, Fungi & Lichens; **Higher Cryptogams**: Bryophytes and Pteridophytes; **Phanerogams**: Gymnosperms and Angiosperms- Dicotyledons and Monocotyledons). Distinguishing characters of these groups and mention few common examples from each.

2. ALGAE **9 L**

2.1: Introduction
2.2: General Characters
2.3: Classification (Bold and Wynne 1978) up to classes with reasons
2.4: Life Cycle of *Spirogyra* w.r.t. Habit, Habitat, Structure of thallus, structure of typical cell, Reproduction- Vegetative, Asexual and Sexual, systematic position with reasons
2.5: Utilization of Algae in Biofuel Industry, Agriculture, Pharmaceuticals, Food and Fodder

3. LICHENS **3 L**

3.1: Introduction
3.2: General Characters
3.3: Nature of Association, forms- Crustose, Foliose and Fruticose.
3.4: Utilization of lichens.

CREDIT-II **15 Lectures (15 Hours)**

4. FUNGI **9 L**

4.1: Introduction
4.2: General Characters
4.3: Classification (Ainsworth, 1973)
4.4: Life Cycle of Mushroom- *Agaricus bisporus* w.r.t. Habit, Habitat, Structure of thallus, Structure of Sporocarp, Structure of Gill, Reproduction- Asexual and sexual, Systematic position.
4.5: Utilization of Fungi in Industry, Agriculture, Food and Pharmaceuticals.

5. BRYOPHYTES **6 L**

5.1: Introduction
5.2: General Characters
5.3: Classification (G.M. Smith 1955)
5.4: Life Cycle of *Riccia* w.r.t. Habit, habitat, external and internal structure of thallus, Reproduction- vegetative, asexual and sexual- Structure of sex organs, fertilization, structure of mature sporophyte, structure of spore, systematic position with reasons.
5.5: Utilization: Bryophytes as ecological indicators, agriculture, fuel, industry and medicine.

(Development of sex organs not expected for all the above mentioned life cycles).

REFERENCES:

1. Ainswarth, Sussman and Sparrow (1973). The Fungi. Vol. IV-A and IV-B. Academic Press.
2. Bilgrami, K.S. and Saha, L.C. (1992) A Textbook of Algae. CBS Publishers and Distributors, Delhi.
3. Gangulee, Das and Dutta (2002). College Botany. Vol. I, New Central Book Agency (P) Ltd.
4. Dube, H.C. (1990). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
5. Krishnamurty, V. (2000). Algae of India and neighboring countries, Chlorophyta, Oxford and IBH, New Delhi.
6. Parihar, N.S. (1980). Bryophyta, An Introduction of Embryophyta. Vol. I. Central Book Distributors, Allahabad.
7. Puri, P. (1980). Bryophyta: Broad prospective. Atma Ram & Sons, Delhi.
8. Smith, G.M. (1971). Cryptogamic Botany. Vol. I: Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
9. Smith, G.M. (1971). Cryptogamic Botany. Vol. II: Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
10. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Algae, S. Chand Publication.
11. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Fungi, S. Chand Publication.
12. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Bryophytes, S. Chand Publication.

SEMESTER-I: PAPER-II

BO-112: PLANT MORPHOLOGY AND ANATOMY (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. MORPHOLOGY: **2 L**

1.1: Introduction, definition, descriptive and interpretative morphology.
1.2: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

2. MORPHOLOGY OF REPRODUCTIVE PARTS:

2.1: INFLORESCENCE: **3 L**

2.1.1 Introduction and definition
2.1.2 Types:
a) Racemose -Raceme, Spike, Spadix, Corymb, Umbel, Catkin and Capitulum.
b) Cymose -Solitary, Monochasial- Helicoid and scorpiod; Dichasial and Polychasial.
c) Special types -Verticillaster, Cyathium and Hypanthodium.
2.1.3 Significance

2.2: FLOWER: **7 L**

2.2.1 Introduction and definition
2.2.2 Parts of a typical flower: Bract, Pedicel, Thalamus- forms, Perianth- Calyx and Corolla, Androecium and Gynoecium.
2.2.3 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual ands bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny and perigyny, Merous condition-Trimerous, tetrmerous and pentamerous.
2.2.4 Floral whorls:
a) **Calyx:** Nature- Polysepalous, Gamosepalous; Aestivation- types, Modifications of Calyx- Pappus, Petaloid and Spurred.
b) **Corolla:** Forms of Corolla-
i) Polypetalous- Cruciform and Papilionaceous.
ii) Gamopetalous- Infundibuliform, Bilabiate, Tubular and Campanulate.
iii) Aestivation- types and significance.
c) **Perianth:** Nature- Polytepalous, Gamotepalous.
d) **Androecium:** Structure of typical stamen, Variations- cohesion and adhesion.
e) **Gynoecium:** Structure of typical carpel, number, position, cohesion and adhesion; placentation- types and significance.

2.3: FRUITS: **3 L**

2.3.1 Introduction and definition
2.3.2 Types of fruits:
a) **Simple:** Indehiscent - Achene, Cypsela, Nut and Caryopsis.
Dehiscent - Legume, Follicle and Capsule,
b) **Fleshy:** Drupe, Berry, Hespiridium and Pepo.
c) **Aggregate:** Etaerio of Berries and Etaerio of Follicles.
d) **Multiple fruits:** Syconus and Sorosis.

CREDIT- II **15 Lectures (15 Hours)**

3. ANATOMY: **2 L**

3.1 Introduction and definition

3.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacongnosy and Wood identification.

4. TYPES OF TISSUES: **8 L**

Outline with brief description, simple and complex tissues.

4.1: **Meristmatic tissues:** Meristem, characters and types based on origin, position and plane of division, functions.

4.2: **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchyma and sclerenchyma.

4.3: **Complex/Vascular tissues:** Components of xylem and phloem, types of vascular bundles and functions.

4.4: **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells; functions.

5. INTERNAL ORGANIZATION OF PRIMARY PLANT BODY: **5 L**

5.1: Internal structure of dicotyledon and monocotyledon root.

5.2: Internal structure of dicotyledon and monocotyledon stem.

5.3: Internal structure of dicotyledon and monocotyledon leaf.

REFERENCES:

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2. Dutta, A.C. (2003). Botany for Degree students. Oxford University Press, New Delhi.
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9. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
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11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
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14. Sharma, O.P. (1993). Plant Taxonomy. 2nd Edition, McGraw Hill Education, New Delhi.
15. Singh, Gurucharan (2005). Systematics- Theory and Practice. Oxford IBH.
16. Sutaria, R.N.A. Text Book of Systematic Botany.
17. Tayal, M.S. (2012). Plant Anatomy. Rastogi Publications.

BO 113: PRACTICALS BASED ON BO 111 & BO 112 (1.5 CREDITS)

1. Study of Life Cycle of *Spirogyra.* 1 P
2. Study of Life Cycle of *Agaricus.* 1 P
3. Study of Life Cycle of *Riccia* 1 P.
4. Study of forms of Lichens- Crustose, Foliose and fruticose. 1 P
5. Study of Mushroom Cultivation. 1 P
6. One day visit to study Algae, Fungi, Bryophytes and Lichens. 1 P
7. Study of Inflorescence. 2 P
   a. Racemose: Raceme, Spike, Spadix, Catkin, Corymb, Umbel and Capitulum
   b. Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cyme and Multiparous cyme.
   c. Special type: Verticillaster, Hypanthodium and Cyathium.
8. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium. 2 P
9. Study of fruits with suitable examples. 2 P
   a) Simple fruit: Dry: Achene, Cypsella and Legume; Fleshy: Berry and Drupe.
   b) Aggregate fruit: Etaerio of follicles and Etaerio of Berries.
   c) Multiple fruit: Syconus and Sorosis.
10. Study of internal primary structure of dicotyledonous root and stem e.g. Sunflower. 1 P
11. Study of internal primary structure of monocotyledonous root and stem e.g. Maize. 1 P
12. Study of internal primary structure of dicotyledonous and monocotyledonous leaf e.g. Sunflower and Maize. 1 P

SEMESTER-II: PAPER-I

BO-121: PLANT LIFE AND UTILIZATION-II (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants. 3 L
2. **PTERIDOPHYTES:** General characters, Outline classification according to Sporne (1976) up to classes with reasons. Life cycle of *Nephrolepis* w.r.t. Habit, habitat, distribution, morphology, anatomy of stem and leaf, Reproduction – vegetative and sexual. 10 L
3. Utilization and economic importance of Pteridophytes. 2 L

CREDIT-II **15 Lectures (15 hours)**

1. **GYMNOSPERMS:** General characters, Outline classification according to Sporne (1977) up to classes with reasons. Life cycle of *Cycas* w.r.t. Habit, Habitat, Distribution, Morphology and Anatomy of Stem, leaf and reproductive organs- Male cone, Microsporophyll, microspores and megasporophyll, megaspore; structure of seed; Utilization and economic importance of gymnosperms. 8 L
2. **ANGIOSPERMS:** General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons. 4L
3. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines. 3L

REFERENCES:

1. Bendre, Ashok and Kumar, Ashok (1993). A Text Book of Practical Botany, Rastogy Publications, Meerut.
2. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
4. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperms taxonomy. Oliver and Boyd Publ. London.
5. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
6. Eames, E.J. (1983). Morphology of Vascular Plants. Standard University Press.
7. Gangulee and Kar (2006). College Botany. New Central Book Agency (P.) Ltd. Kolkata.
8. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
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14. Smith, G.M. (1955). Cryptogamic Botany Vol. II. McGraw Hill.
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17. Vashishta, P.C., Sinha, A.R. and Kumar, Anil (2006). Gymnosperms. S. Chand and Comp. Ltd. New Delhi.
18. Vashista, B.R., Sinha A.K. and Kumar, A. (2008). Botany for degree students-Pteridophyta, S. Chand and Comp. Ltd. New Delhi.

SEMESTER-II: PAPER-II

BO-122: PRINCIPLES OF PLANT SCIENCE (30 Lectures)

CREDIT-1: PLANT PHYSIOLOGY AND CELL BIOLOGY

15 Lectures (15 Hours)

1. Introduction, definition and scope of plant physiology. 1 L
2. Diffusion – definition, importance of diffusion in plants, imbibition as a special type of diffusion. 1 L
3. Osmosis – definition, types of solutions (hypotonic, isotonic, hypertonic), endosmosis, exo-osmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants. 2 L
4. Plasmolysis – definition, mechanism and significance. 1 L
5. Plant growth - introduction, phases of growth, factors affecting growth, 2 L
6. Structure of plant cell, differences between prokaryotic and eukaryotic cell. 2 L
7. Plant cell wall – components of primary cell wall, structure and functions. 1 L
8. Ultrastructure and functions of chloroplast 2 L
9. Cell cycle in plants- importance of cell cycle in plants, divisional stages of mitosis and meiosis. 3 L

CREDIT-II: MOLECULAR BIOLOGY (15 Lectures) 15 Hours

1. Introduction and scope of molecular biology, central dogma of molecular biology. 2 L
2. Structure of DNA, nucleoside and nucleotide 2 L
3. Watson Crick model of DNA and its characteristic features, types of DNA (A, B and Z DNA). 3 L
4. Types of chromosomes. 2 L
5. Structure and types of RNA. 3 L
6. DNA replication- Types of replication (conservative, semi-conservative and dispersive), enzymes involved, leading and lagging strands, Okazaki fragments. 3 L

REFERENCES:

1. Buchanan, B.B, Gruissem, W. and Jones, R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.
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BO 123: PRACTICALS BASED ON BO 121 & BO 122 (1.5 CREDITS)

1. Study of life cycle of *Nephrolepis*. 1 P
2. Study of life cycle of *Cycas*. 1 P
3. Study of Bentham and Hooker's system of classification outline up to series with example 1 P
4. Study of comparative account of Dicotyledonous and Monocotyledonous plants w.r.t to external morphological characters. 1 P
5. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, horticulture and medicines. 1 P
6. One day visit to study diversity of vegetation. 2 P
7. To observe characteristic features of prokaryotic and eukaryotic plant cell. 1 P
8. Staining of suitable nuclear material by Basic Fuchsin 1 P
9. Study of mitosis- preparation of slides using onion root tips to observe divisional stages. 1 P
10. Study of meiosis- preparation of slides using *Tradescantia/ Rhoeo/* Maize / Onion flower buds to observe divisional stages. 2 P
11. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material. 1 P
12. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using *Rhoeo* leaf peeling and Demonstration of Osmosis- curling experiment. 1 P
13. Study of DPD by using suitable plant sample 1 P

SavitribaiPhule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

S.Y.B.Sc. Zoology

(w.e.f. June 2020)

As per

Choice Based Credit System

Syllabusimplemented from

Academic Year 2020-2021

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of SavitribaiPhule Pune University with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC]** have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of F. Y. B. Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B. Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, cocuricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will be as per the guidelines of the University. The B. Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.

The Syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper • handling of lab instruments.

Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F. Y. B. Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO - 111 Animal Diversity I	ZO-121 Animal Diversity II	2 + 2
CC	ZO - 112 Animal Ecology	ZO-122 Cell Biology	2 + 2
CC	ZO - 113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S. Y. B. Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO - 231 Animal Diversity III	ZO - 241 Animal Diversity IV	2 + 2
CC	ZO - 232 Applied Zoology I	ZO - 242 Applied Zoology II	2 + 2
CC	ZO - 233 Zoology Practical Paper	ZO - 243 Zoology Practical Paper	2 + 2
AECC	EVS 231- Environment Awareness	EVA 241- Environment Awareness	2 + 2
AECC	LA 231 - English/Marathi	LA 241 - English /Marathi	2 + 2
T. Y. B. Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO - 351 Pest Management	ZO - 361 Medical & Forensic Zoology	2 + 2
DSEC	ZO - 352 Histology	ZO - 362 Animal Physiology	2 + 2
DSEC	ZO - 353 Biological Chemistry	ZO - 363 Molecular Biology	2 + 2
DSEC	ZO - 354 Genetics	ZO - 364 Entomology	2 + 2
DSEC	ZO - 355 Developmental Biology	ZO - 365 Techniques in Biology	2 + 2
DSEC	ZO - 356 Parasitology	ZO - 366 Evolutionary Biology	2 + 2
DSEC	ZO- 357 Zoology Practical Paper 1	ZO - 367 Zoology Practical Paper 1	2 + 2
DSEC	ZO- 358 Zoology Practical Paper 2	ZO - 368 Zoology Practical Paper 2	2 + 2
DSEC	ZO- 359 Zoology Practical Paper 3	ZO - 369 Zoology Practical Paper 3	2 + 2
SEC	ZO - 3510 Aquarium Management	ZO- 3610 Environmental Impact Assessment	2 + 2
SEC	ZO - 3511 Poultry Management	ZO - 3611 Project	2 + 2

Detailed Syllabus of S. Y. B. Sc.

Paper	Semester III Course Code & Course	Credits	No of Hours	Marks (Internal + University)		Semester IV Course Code & Course	Credits	No of Hours	Marks (Internal + University)
I	ZO - 231 Animal Diversity III	02	30	15+ 35= 50		ZO - 241 Animal Diversity IV	02	30	15+ 35 = 50
II	ZO - 232 Applied Zoology I	02	30	15+ 35 = 50		ZO - 242 Applied Zoology II	02	30	15+ 35 = 50
III	ZO - 233 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50		ZO - 243 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50
AECC	EVS 231- Environment Awareness	02	30	15+ 35 = 50		EVA 241- Environment Awareness	02	30	15+ 35 = 50
AECC	LA 231- English/ Marathi	02	30	15+ 35 = 50		LA 241- English/ Marathi	02	30	15+ 35 = 50

Animal Diversity III & IV

Objectives –

1. To understand the origin and advancement of higher vertebrates (tetrapoda).
2. To understandgeneral characters of different groups of higher vertebrates.
3. To classify vertebrates and to become able to understand the possible group of vertebrates observed in nature.
4. To understand different behaviours and adaptations in higher vertebrates
5. To understand affinities among different groups of higher vertebrates.

Learning Outcomes for the course -

1. The students will be able to understand, classify and identify the diversity of higher vertebrates.
2. The students will able to understand the complexity of higher vertebrates
3. The students will be able to understand different life functions of higher vertebrates.
4. The students will be able to understand the linkage among different groups of higher vertebrates.
5. The student will become aware regarding his role and responsibility towards nature as a protector, to understand his role as a trustee and conservator of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity - III

Course Code: ZO – 231,

Semester - III (2 credits – 30 Hours)

No. Title & Contents **Number of Lectures**

1. Introduction to Phylum Chordata – (03)

1.1 Origin & Ancestry of Chordates.

1.2 Comparative account of fundamental characters of Chordates with Non Chordates.

1.3 Salient features of Phylum Chordata.

1.4 Classification of Phylum Chordata upto classes – Pisces, Amphibia, Reptilia, Aves, Mammalia.

2. Introduction to Group – Protochordata. (03)

2.1 Salient features of Protochordata.

2.2 Salient features of subphylumswith two example each - Names only.

Hemichordata – *Balanoglossus*and*Rhabdopleura*, Urochordata - *Herdmania*and*Salpa*, Cephalochordata –*Branchiostoma*(Amphioxus) and*Asymmetron*.

3. Introduction to subphylum – Vertebrata (02)

3.1 Salient features of Vertebrata.

3.2 Introduction and General characters of sections with two examples - Names only.

Agnatha–*Petromyzon&Myxine*&Gnathostomata–Frog&*Labeo*.

4. Introduction to Class – Pisces (04)

4.1 Salient features of Class – Pisces.

4.2 Introductaionand Salient features of sections with two examples - Names only.

Class – Chondrichthyes–*Scoliodon*and *Chimaera*&Osteichthyes – *Labeo*and*Catla*

4.3 Types of Scales in Fishes.

4.4 Types of Fins in Fishes.

5. Introduction to Class – Amphibia (03)

5.1 Salient features of Class – Amphibia.

5.2 Introduction to order – Apoda–*Ichthyophis*,Urodela–*Salamandra*(Salamander) and& Annura - *Rana*.

5.3 Parental care in Amphibia.

6. Study of *Scoliodon* (15)

Scoliodon – 6.1 - Systematic position, Geographical distribution, Habit, Habitat 01

6.2 - External characters 01

6.3 - Digestive System, Food and feeding mechanism. 02

6.4 - Respiratory System – Structure of Holobranch only. 02

6.5- External & Internal Structure of heart, Working of heart. 02

6.6 - Nervous System – Brain only. 03

6.7 - Male urinogenital system & Female reproductive System. 03

6.8- Yolk sac placenta. 01

Applied Zoology I and II

Objectives :

1. To understand the basic life cycle of the honeybees, beekeeping tools and equipments.
2. To learnfor managing beehives for honey production and pollination.
3. To understand the basic information about fishery, cultural and harvesting methods of fishes.
4. To understand fish preservation techniques.
5. To understand the biology, varieties of silkworms and the basic techniques of silk production and harvesting of cocoons.
6. To learn the different silkworm species and their host plants.
7. To study types of agricultural pests and Major insect pests of agricultural importance.
8. To study Pest control practices.

Learning Outcomes of the course:

1. The learner understands the basics about beekeeping tools, equipment, and managing beehives.
2. The learner understands the basic information about fishery, cultural and harvesting methods of fishes and fish preservation techniques.
3. The learner understands the biology, varieties of silkworms and the basic techniques of silk production.
4. The learner understands the types of agricultural pests, Major insect pests of agricultural importance and Pest control practices.

Course Title - Applied Zoology I

Course Code - ZO - 232

Semester III **2 Credits - 30 lectures**

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1) Sericulture: **16**

1.1 An introduction to Sericulture, Study of different types of silk moths, their distribution, Taxonomic position and varieties of silk produced in India : Mulberry, Tassar, Eri and Muga silk moths. 02

1.2 ExternalMorphology and life cycle of *Bombyxmori*. 02

1.3 Cultivation of mulberry :

a) Varieties for cultivation,

b) Rain fed and irrigated mulberry cultivation- Fertilizer schedule, Pruning methods and leaf yield. 02

1.4 Harvesting of mulberry : **a)** Leaf plucking, **b)** Branch cutting, **c)** Whole shoot cutting. 01

1.5 Silk worm rearing :

a) Varieties for rearing,

b) Rearing house,

c) Rearing techniques,

d) Important diseases and pests. 03

1.6 Preparation of cocoons for marketing. 01

1.7 Post harvest processing of cocoons :

a) Stiffling, sorting, storage, deflossing and riddling,

b) Cocoon cooking, reeling equipment and rereeling, washing and polishing. 03

1.8 Biotechnological and biomedical applications of silk. 02

2) Agricultural Pests and their control: **14**

2.1 An introduction to Agricultural Pests, types of pests (agricultural, store grain, veterinary). 01

2.1 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures). 06

a) Jowar stem borer,

b) Red cotton bug,

c) Brinjal fruit borer,

d) Mango stem borer,

e) Blister beetle,

f) Rice weevil,

g) Pulse beetle,

h) Tick.

2.3 Non insect pests: Rats, Crabs, Snails, and Squirrels 01

2.4 Pest control practices in brief: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Pheromonal control, Autocidal control and Concept of IPM in brief. 04

2.5 Plant protection appliances: Shoulder type Rotary duster, Knapsack sprayer, Cynogas Pump. 02

Course Title: Zoology Practical Paper

Course Code: ZO – 233

Semester - III **(2 credits – 60 Hours)**

Animal Diversity - III

1. Museum study of Group Protochordata : *Balanoglossus*, *Herdmania*, *Petromyzon*. (D)
2. Museum study of Class Pisces: Labeo, *Scoliodon*, *Hippocampus.* (D)
3. Museum study of Class Amphibia :*Salamandra*, *Rana*, *Ichthyophis*. (D)
4. Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)
5. Study of types of tail fins in fishes: Homocercal, Heterocercal &Diphycercal. (D)
6. Study of external characters & digestive system of locally available fish. (E) - Compulsory
7. Study of brain of locally available fish. (D)
8. Temporary preparation of scales & its identification from locally available fish. - (E) Compulsory
9. Compulsory field visit to study pond ecosystem with reference to Pisces and amphibians, report writing and submission. (**2 P**)

Sericulture –

1. Study of external morphology and life-cycle of *Bombyx mori.* (D)
2. Study of five equipments in Sericulture. (E) - Compulsory
3. Preparation of a map showing distribution of silk moth and rearing/ sericulture practices in India. (E)
4. Compulsory submission of Photographs/ sketches of Mulberry, Tassar, Eri and Muga silkmoths. (E)

Agricultural Pests and their control -

1. Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Jowar stem borer,
   b) Red cotton bug,
   c) Brinjal fruit borer,
   d) Mango stem borer.
2. Study of following pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Blister beetle,

b) Rice weevil,

c) Pulse beetle,

d) Tick.

3. Study of any two non insect pests corresponding to theory course. (D)
4. Compulsory submission of at least five Insect Pests/ Photographs/ Sketches. (E)
5. Study of pest control appliances (as per theory course). (D)
6. Compulsory field visit to Sericulture farm/ Agricultural farm, report writing and submission. **(2 P).**

Minimum 14 practicals must be conducted with at least Seven practicals from each paper.

Course Title: Animal Diversity - IV

Course Code: ZO – 241

Semester - IV (2 credits – 30 Hours)

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1. Introduction to class –Reptilia (04)

1.1 Salient features of class Reptilia with one example (name only) – *Chelone*, *Calotes*.

1.2 Venomous and Non-venomous snakes – Cobra, Russell's viper, Rat snake, Grass snake.

1.3 Snake venom, symptoms, effect and cure of snake bite, first aid treatment of snakebite.

1.4 Desert adaptations in reptiles in brief.

2. Introduction to class –Aves (05)

2.1 Salient features of class Aves with two examples (names only) – Sparrow, Parrot.

2.2 Flight adaptations in birds.

2.3 Types of Beaks and feet in birds.

2.4 Migration in birds – Altitudinal, Latitudinal.

3. Introduction to class - Mammalia. (04)

3.1 Salient features of class Mammalia with two examples (names only) – Rat, Rabbit.

3.2 Egg laying mammals.

3.3 Aquatic adaptations in mammals.

3.4 Flying adaptations in mammals.

3.5 Cursorial and fossorial adaptation in mammals

4. Study of Rat (17)

4.1 Systematic position, habit and habitat.	01
4.2 External characters.	01
4.3 Digestive system, food and feeding.	02
4.4 Respiratory system.	02
4.5 Blood vascular system – Structure of Heart.	02
4.6 Nervous system – Central Nervous system only.	03
4.7 Sense organs – Structure and functions of Eye & Ear.	03
4.8 Reproductive system.	03

Course Title - Applied Zoology II

Course Code - ZO-242

Semester IV **2 Credits- 30 lectures**

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1. Apiculture: **16**

1.1 An introduction to Apiculture, Systematic position, Study of habit, habitat and nesting behaviour of *Apisdorsata*, *Apisindica*, *Apis florae* and *Apismellifera*. 02

1.2 Life cycle, Colony organization and Division of labour. 02

1.3 Bee behaviour and communication (Round Dance and Wag-Tail Dance) . 02

1.4 Bee keeping equipments :

a) Bee box (Langstroth type),

b) Honey extractor,

c) Smoker,

d) Bee-veil,

e) Gloves,

f) Hive tool,

g) Bee Brush,

h) Queen excluder. 02

1.5 Bee keeping and seasonal management. 02

1.6 Bee products (composition and uses) :

a) Honey,

b) Wax,

c) Bee Venom,

d) Propolis,

e) Royal jelly,

f) Pollen. 02

1.7 Diseases and enemies of Bees :

a) Bee diseases - Protozoan (Nosema), Bacterial (American foul brood), Viral (Sac brood), Fungal (Chalk brood).

b) Bee pests - Wax moth (Greater and Lesser), Wax beetle.

c) Bee predators - GreenBee eater, King crow, Wasp, Lizard. 02

1.8 Bee pollination and management of bee colonies for pollination. 02

2. Fisheries : **14**

2.2 An introduction to fisheries and its types (in brief) : Freshwater fisheries, Marine fisheries, Brackish water fisheries. 02

2.3 Habit, habitat and culture methods of following freshwater forms : 03

a) Rohu (*Labeo rohita*) ,

b) Catla (*Catla catla*) ,

c) Mrigal (*Cirrhinus mrigala*).

2.3 Harvesting methods of following marine forms: 03

a) *Harpodon*,

b) Mackerel,

c) Pearl oyster.

2.4 Crafts and Gears in Indian Fishery: 02

a) Crafts – Catamaran, Machwa, Dinghi.

b) Gears – Gill net, Dol net, Rampani net, Cast net.

2.5 Fishery byproducts: 02

a) Fish meal,

b) Fish flour,

c) Fish Liver oil,

d) Fish manure,

e) Fish fin soup.

2.6Fish preservation technique: 02

a) Chilling,

b) Freezing,

c) Salting,

d) Drying,

e) Canning.

Course Title: Zoology Practical Paper

Course Code: ZO – 243

Semester - IV **(2 credits – 60 Hours)**

Animal Diversity - IV

1. Museum study of Class Reptilia: Venomous & Non-venomous snake – Two each. (D)
2. Identification of Venomous & Non-venomous snakes with the help of pictorial taxonomic keys. – (D) -Compulsory
3. Museum study of Class Aves: Crow, *Kingfisher*& Duck. (D)
4. Study of types of beaks &feets in birds – Any two each. (D)
5. Museum study of Class Mammalia: Rat, Shrew & Bat. (D)
6. Study of external characters & digestive system of Rat. (D)
7. Study of Heart of Rat. - (D) -Compulsory
8. Study of brain of Rat. (D)
9. Study of reptilian / avian diversity in and around the campus (**2 P**) - (E) -Compulsory
10. Compulsory visit to Zoo / Wildlife sanctuary / Bird sanctuary, report writing and submission. (**2 P**)

Apiculture –

1. Study of external morphology, life cycle and polymorphism in Honey Bee. (D)
2. Temporary mountingof mouth parts, legs, wings and sting apparatus of worker bee. (E)
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker**,** Bee-veil, queen excluder. (D)- Compulsory
4. Study of Bee products: Honey, Wax, Venom, Royal jelly, Pollen. (D)
5. Estimation of carbohydrates from Honey in different samples. (D)- Compulsory
6. Study of Bee enemies: Wax moth, Bee eater, ant. (D)

Fisheries –

1. Identification, Classification and study of habit, habitat and economic importance of **a)** Rohu (*Labeo rohita*), **b)** Catla (*Catla catla*), **c)** Mrigal (*Cirrhinus mrigala*). (D)
2. Identification, Classification and study of habit, habitat and economic importance of **a)** Prawn, **b)** Crab, **c)** Lobster, **d)** Pearl Oyster. (D)
3. Study and maintenance of Aquarium. (D) - Compulsory

4. Study of crafts: **a)** Catamaran, **b)** Machwa, **c)** Dinghi (Photographs/models/line drawings). (D)

5. Study of gears in fishing: **a)** Gill net, **b)** Dol net, **c)** Rampani net, **d)** Cast net. (Photographs/models/line drawings). (D)

7. Study of nutritional value of fish: Biochemical estimation of fish muscle proteins by using Biuret method. (E) - Compulsory

7. Compulsory study tour/field visit to Apiculture institute / Fish farm/ Aquarium. (E) **(2 P)**.

Minimun 14 practicals must be conducted with at least Seven practicals from each paper.

Recommended Reference Books

Animal Diversity – III & IV

1. Text Books of Zoology, Invertebrates Vol- II, 1992, T.J.Parker and W.A. Haswel, Edited by Marshall and Williams,CBS publications and distribution, New Delhi.
2. Integrated Principles of Zoology, Eleventh Edition, Hickman CP, Roberts LS & Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
3. Modern Text Book of Zoology, Vertebrates. R. L. Kotpal, 3rd edn. Rastogi Publications, Meerut.
4. Chordate Zoology, 1982, P.S.Dhami and J.K.Dhami, R. Chand and Co., New Delhi.
5. Biology, Campbell nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.
6. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
7. Pough H. Vertebrate life, VIII Edition, Pearson International.
8. Integrated Principles of Zoology, Eleventh Edition, Hickman C. P., Roberts L. S.& Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
9. Arora M.P. Chordates I. Himalya Publications.
10. Organic Evolution. R.S. Lull. Light & Life Publishers.
11. Jordan E. L.&Verma P. S. 2003. Chordates Zoology. S. Chand & Company Ltd. New Delhi.
12. Biology, Campbell Nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.

Applied Zoology I & II

1. Principal of Sericulture, 1994. HisaoArguo, Oxford & Co.
2. An Introduction of Sericulture, 1995. G.Ganga, J. Sulochana, Oxford & IBH Publication Co. Bambay.
3. FAQ Manual of Sericulture. Vol I - Mulberry Cultivation, Vol II - Silkworm Rearing. Central Silk Board, Bangalore.
4. Mane, P.C., Chaudhari R. D. et al. Highly sensitive label-free bio-interfacial colorimetric sensor based on silk fibroin-gold nanocomposite for facile detection of chlorpyrifos pesticide. Scientific Reports2020,10, 4198. https://doi.org/10.1038/s41598-020-61130-y
5. Entomology & Pest Management. Pedigo L. P. Prentice Hall, India 1996.
6. General & Applied Entomology, Nayar K. K. & T. N. Ananthkrishnan& B. V. Davis, Tata McGraw Hill Publication, New Delhi.
7. Insects. M. S. Mani, National Book Trust, India, 2006.
8. Insects & Mites of Crops in India. M. R. G. K. Nair – by ICAR, New Delhi.
9. The Science of Entomology. W. S. Romosor and J. G. Stoffolano, McGraw Hill Publication, 1988.

10. Agricultural Insect Pests of India and their Control, Dennis S. Hill, Cambridge University Press.
11. Applied Entomology. Vol. I & II. K. P. Srivastava. Kalyani Publication, Ludhiana, New Delhi.
12. Principles of Insect Pest Management. G. S. Dhaliwal and Ramesh Arora, Kalyani Publications, Ludhiana.
13. Pest Management and Pesticides: Indian Scenario. Editor- B. Vasantaraj David, Namrutha Publications, Madras (Chennai).
14. Concepts of Insect Control. Ghosh M. R. Wiley Eastern Ltd. New Delhi.
15. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. P. Flint, Tata McGraw Hill Publications, New Delhi.
16. A Text Book of Entomology, 1974. V. K. Mathur and K. D. Upadhayay, Goel Printing Press, Barani.
17. Imm's general Text Book of Entomology, Vol I & II, Richard and Davis Owen.
18. Biology of Insects, 1992. S. C. Saxena. Oxford and IBH Publishing Co., New Delhi, Bombay, Calcutta.
19. Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
20. The Behaviour& Social Life of Honey Bees, C. R. Ribbandas, Dover Publication inc. New York.
21. Fishes. Mary Chandy. National Book Trust India, 2005.
22. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
23. Fisheries Developments, K. K. Trivedi, Oxford and IBH Pub. Co.
24. Marine Fishes in India, 1990, D.V. Bal & K. Virabhdra, Tata McGraw Hill Publication.
25. Fishery Management, 1990, S. C. Agarwal, Avinash Publication House, New Delhi.

Note – Use latest editions of the books.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Botany

(Faculty of Science & Technology)

S.Y.B.Sc Botany

Choice Based Credit System Syllabus

To be implemented from Academic Year 2020- 2021

Title of the Course: B. Sc Botany

1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	**3**	**Compulsory Course**	**BO 231**	**Taxonomy of Angiosperms and Plant Ecology**	**2**
			BO 232	**Plant Physiology**	**2**
			BO 233	**Practical based on BO 231 & BO 232**	**2**
	4	**Compulsory Course**	**BO 241**	**Plant Anatomy and Embryology**	**2**
			BO 242	**Plant Biotechnology**	**2**
			BO 243	**Practical based on BO 241 & BO 242**	**2**
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3510	Botany Theory Paper 7	2
			BO 3511	Botany Theory Paper 8	2
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3610	Botany Theory Paper 7	2
			BO 3611	Botany Theory Paper 8	2

2. Equivalence of Previous Syllabus:

Old Course (2014 Pattern)	**New Course (2020 CBCS Pattern)**
BO-211: Taxonomy of Angiosperms and Plant community	BO 231: Taxonomy of Angiosperms and Plant Ecology
BO-212:Plant Physiology	BO 232: Plant Physiology
BO-221: Plant Anatomy and Embryology	BO 241: Plant Anatomy and Embryology
BO-222: Plant Biotechnology	BO 242: Plant Biotechnology
Practical based on theory courses (Paper I and Paper II)	Semester III: Practical based on BO 231 & BO 232 Semester IV: Practical based on BO 241 & BO 242

S.Y.B.Sc. Botany CBCS Pattern
(Semester III, Paper I) 2020-2021
BO 231: Taxonomy of Angiosperms and Plant Ecology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Introduction to Angiosperms Taxonomy** Definition, scope, objectives and importance of taxonomy Exploration, Description, Identification, Nomenclature and classification Concept of Systematics with brief historical background	**02**
2.	**Systems of classification** Comparative account of various systems of classification Artificial system- Carl Linnaeus Natural system- Bentham and Hooker Phylogenetic system- Engler and Prantl APG system- A brief review	**05**
3.	**Study of Plant Families** Study of following families with reference to systematic position (As per Bentham and Hooker's system of classification), salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Brassicaceae, Myrtaceaee, Rubiaceae, Solanaceae, Apocynaceae, Nyctaginaceae and Amaryllidaceae	**08**
	Credit-II	**15**
4.	**Botanical Nomenclature** Concept of nomenclature, brief history, Binomial nomenclature International Code for Nomenclature of Algae, Fungi and Plants (ICN)-Principles, Rules and Recommendations; 'Type' specimen and its types (Holotype, Paratype, Isotype, Lectotype, Neotype). Concept of Typification. Ranks and endings of taxa names, Coining of Genus and Species names Single, double and multiple authority citations	**05**
5.	**Introduction to ecology** Definition, concept, scope, and interdisciplinary approach, autecology and synecology. Species diversity: definition, concept, scope, and types: Alpha, Beta and Gamma diversity. Methods of vegetation sampling: quadrat method, transect method, plot less method Genetic Diversity: definition, nature and origin of genetic variations Species Diversity: definition, origin of species diversity, diversity indices, species abundance Ecosystem Diversity: definition, major ecosystem types of the world, Hotspots in India – concept and basis of 'hotspot' identification.	**06**
6.	**Ecological grouping of the plants** Ecological grouping of the plants with reference to their significance of adaptive external and internal features: a) Hydrophytes, b) Mesophytes c) Xerophytes d) Halophytes with examples.	**04**

References-

1. Balfour Austin (2016). Plant Taxonomy. Syrawood Publishing House
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3. Chopra G.L. (1984). Angiosperms: Systematics and Life-Cycle., Pradeep Publications
4. Cooke, Theodore (1903-8). The Flora of the Presidency of the Bombay Vol. I, II, III (Repr. ed), Botanical Survey of India.
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8. Heywood V.H. (1967). Plant Taxonomy, Hodder & Stoughton Educational, London.
9. Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. (2008). Plant Systematics- A Phylogenetic Approach. Sinauer Associates, INC, Publishers.Sunderland, Massachusetts, USA.
10. Kormondy Edward (1995). Concepts of Ecology, Pearson Publ.
11. Lawrence G.H.M. (1955). An Introduction to Plant Taxonomy. McMillan, New York.
12. Lawrence, G.H.M. (1951). Taxonomy of Vascular Plants. McMillan, New York.
13. Michael P. (1984). Ecological Methods for field and Laboratory investigations TMH Co. ltd. Bombay.
14. Mondol A.K. (2016) Advanced Plant Taxonomy, New Central Book Agency (NCBA)
15. Naik V.N. (1988) Taxonomy of Angiosperms. Oxford and IBH
16. Odum E.P., (2004). Fundamentals of Ecology, Publ. Cengage Learning, Australia
17. Pande B.P. (1997). Taxonomy of Angiosperms. S. Chand.
18. Pande B.P. (2001) Taxonomy of Angiosperms. S. Chand.
19. Radford A.E. 1986. Fundamentals of Plant Systematics, Harper and Row N Y.
20. Santapau H. (1953). The Flora of Khandala on the Western Ghats of India. BSI
21. Sharma O.P. (2011), Plant Taxonomy, Tata Mc grow Hill
22. Shivrajan V.V. & N.K.P. Robson (1991). Introduction to Principles of Plant Taxonomy. Cambridge Univ. Press
23. Shukla Priti and Shital Mishra (1982). An introduction to Taxonomy of angiosperms. Vikas Publ.
24. Simpson, M.G. (2010). Plant Systematics. Elsevier, Amsterdam.
25. Singh Gurucharan (2005). Systematics: Theory and Practice. Oxford IBH.
26. Singh J.S., S.P. Singh, and S.R. Gupta (2006). Ecology, Environment and Resource Conservation. Anamaya Publ. New Delhi.
27. Singh N.P. (2001) Flora of Maharashtra Volume-II BSI, Kolkatta
28. Singh N.P. (2003) Flora of Maharashtra Volume-III BSI, Kolkatta
29. Singh N.P., S. Karthikeyan (1996) Flora of Maharashtra Volume-I, BSI, Kolkatta
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IMPORTANT WEBSITES

THE FAMILIES OF FLOWERING PLANTS- L. Watson and M.J. Dallwitz
https://www.delta-intkey.com/angio/index.htm
ANGIOSPERM PHYLOGENY WEBSITE, version 14.
http://www.mobot.org/MOBOT/research/APweb/
THE PLANTS OF THE WORLD ONLINE PORTAL
http://www.plantsoftheworldonline.org/
INTERNATIONAL PLANT NAME INDEX (IPNI)
https://www.ipni.org/
TROPICOS
https://www.tropicos.org/home
BIODIVERSITY HERITAGE LIBRARY
https://www.biodiversitylibrary.org/
BOTANICUS DIGITAL LIBRARY
https://www.botanicus.org/
INTERNET ARCHIVE- DIGITAL LIBRARY
https://archive.org/
DATABASE OF PLANTS OF INDIAN SUBCONTINENT
https://sites.google.com/site/efloraofindia/
BOTANICAL SURVEY OF INDIA
https://bsi.gov.in/content/1416_1_FloraofIndia.aspx
FLOWERS OF INDIA
http://www.flowersofindia.net/
eFLORAS OF WORLD
http://www.efloras.org/

S.Y.B.Sc. Botany CBCS Pattern
(Semester III, Paper II) 2020-2021
BO 232: Plant Physiology - 2 Credits (30 Lectures)

Credit I:

1. Introduction to Plant Physiology **2L**

Scope and applications of plant physiology

2. Absorption of water **3L**

2.1 Role of water in plants
2.2 Mechanisms of water absorption with respect to crop plants
2.3 Factors affecting rate of water absorption

3. Ascent of sap **3L**

3.1 Introduction and definition.
3.2 Transpiration pull or cohesion-tension theory, evidences and objections
3.3 Factors affecting ascent of sap

4. Transpiration **7L**

4.1 Definition
4.2 Types of transpiration – cuticular, lenticular and stomatal
4.3 Structure of stomata
4.4 Mechanism of opening and closing of stomata –Steward's hypothesis, active K+ transport mechanism
4.5 Factors affecting the rate of transpiration
4.6 Significance of transpiration
4.7 Antitranspirants
4.8 Guttation
4.9 Exudation

Credit II:

5. Nitrogen metabolism **7L**

5.1 Introduction and role of nitrogen in plants
5.2 Nitrogen fixation by *Rhizobium* and BGA
5.2.1 Symbiotic nitrogen fixation, nitrogenase enzyme- structure and function
5.2.2 Non-symbiotic nitrogen fixation
5.3 Importance and production technique of BGA
5.4 Denitrification, ammonification and nitrification
5.5 Reductive amination and transamination

6. Seed dormancy and germination **4L**

6.1 Definition, types of seed dormancy and germination
6.2 Methods to break seed dormancy
6.3 Metabolic changes during seed germination
6.4 Role of phytohormones to improve seed germination
6.5 Vigor Index

7. Physiology of flowering **4L**

7.1 Photoperiodism – Concept, definition, short day plants, long day plants and day neutral plants.

7.2 Phytochrome theory, role of phytohormones in induction and inhibition of flowering
7.3 Applications of photoperiodism
7.4 Vernalization–concept and definition, mechanism of vernalisation, applications of vernalisation and devernalization

References:

1. Bidwell, R.G.S. 1974. Plant Physiology. Macmillan Pub. Co., N.Y.
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10. Devlin, R.M. and F.H. Witham. 1983. Plant Physiology. Willard Grant Press. U.S.A.
11. Hans-Walter Heldt. 1997. Plant Biochemistry and Molecular Biology. Oxford University Press, New York.
12. Moore, T.C. 1979. Biochemistry and Physiology of Plant Hormones. SpringerVerlag. Berlin.
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15. Pandey, S.N. 1991: Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
16. Verma, V. 200): Text Book of Plant Physiology, Ane Books India, New Delhi.
17. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology.4th edition Academic Press, UK.

S.Y.B.Sc. Botany CBCS Pattern
Practical (Semester III Paper III) 2020-2021
BO 233: Practical based on BO 231 & BO 232

Practical based on Taxonomy of Angiosperms and Plant Ecology, and Plant Physiology

Sr. No.	Title	No. of Practical
	Taxonomy of Angiosperms and Plant Ecology	
1	Study of tools of taxonomy and ecological instruments (any four each)	1
2	Description of flowering plant in botanical terms	1
3	Study of plant families (any four)	3
4	Study of ecological adaptations in Hydrophytes with any two examples	1
5	Study of ecological adaptations in Xerophytes with any two examples	1
6	Study of vegetation by list count quadrat method.	1
	Plant Physiology	
7	Perform phytochemical test for starch and protein in germinating and non germinating seeds	1
8	Isolation of Leaf Protein Concentration (LPC) from suitable plant material.	1
9	Determination of Diffusion Pressure Deficit (DPD)	1
10	Determine rate of transpiration under different conditions of Sunlight, Shade and Wind	1
11	Demonstration of the following **a.** Commercial biofertilizers **b.** Imbibition in seeds **c.** Ringing experiment **d.** Arc Auxanometer **e.** Spectrophotometer **f.** Nitrogen fixing bacteria / BGA (specimen/ slide)	1
12	Calculate seed germination percentage and vigor index	1
13	Botanical excursion tour and visit to Floriculture industry / Soil testing center / Seed testing center	1

N.B. Botanical excursion tour and submission of report along with herbarium of any five weeds of the following (List of Weeds attached).

List of weeds

Acanthospermun hispidum DC. Asteraceae

Aerva javanica (Burm.f.) Juss. ex Schult. Amaranthaceae

Aeschynomene americana L. Fabaceae Tropical America

Ageratum conyzoides L. Asteraceae America

Alternanthera paronychioides St. Hill. Amaranthaceae Tropical America

Alternanthera philoxeroides (Mast.) Griseb. Amaranthaceae America

Alternanthera pungens Kunth Amaranthaceae Tropical America

Alternanthera sessilis (L.) R.Br. ex DC. Amaranthaceae Tropical America

Amaranthus spinosus L. Amaranthaceae Tropical America

Antigonon leptopus Hk. & Arn. Polygonaceae America

Argemone mexicana L. Papaveracae West Indies

Asclepias curassavica L. Apocynaceae Tropical America
Bidens pilosa L. Asteraceae Tropical America
Blainvillea acmella (L.) Philipson Asteraceae Tropical America
Blumea eriantha DC. Asteraceae Tropical America
Blumea lacera (Burm.f.) DC. Asteraceae Tropical America
Boerhavia erecta L. Nyctaginaceae Tropical America
Cardamine hirsuta L. Brassicaceae Tropical America
Cassia absus L. Caesalpiniaceae Tropical America
Cassia occidentalis L. Caesalpiniaceae South America
Cassia pumila Lam. Caesalpiniaceae Tropical America
Cassia tora L. Caesalpiniaceae South America
Celosia argentea L. Amaranthaceae Tropical America
Chrozophora rottleri (Geis.) Spreng. Euphorbiaceae Tropical Africa
Cleome viscosa L. Capparaceae Tropical America
Conyza canadensis (L.) Cronquist Asteraceae South America
Coronopus didymus (L.) Smith Brassicaceae South America
Cronton bonplandianum Baillon Euphorpiaceae South America
Crotalaria pallida Dryand Fabaceae Tropical America
Crotalaria retusa L. Fabaceae Tropical America
Cryptostegia grandiflora R.Br. Apocynaceae Madagascar
Cuscuta chinensis Lam. Cuscutaceae Mediterranean
Cuscuta reflexa Roxb. Cuscutaceae Mediterranean
Cyperus difformis L. Cyperaceae Tropical America
Cyperus iria L. Cyperaceae Tropical America
Datura innoxia Mill. Solanaceae Tropical America
Dicoma tomentosa Cass. Asteraceae Tropical America
Digera muricata (L.) Mart. Amaranthaceae North America
Eclipta prostrata (L.) L. Asteraceae Tropical America
Eichhornia crassipes (Mart.) Solms Pontederiaceae Tropical America
Emilia sonchifolia (L.) DC. Asteraceae Tropical America
Eupatorium adenophorum Spreng. Asteraceae Central America
Eupatorium odoratum L. Asteraceae South America
Euphorbia heterophylla L. Euphorbiaceae Tropical America
Euphorbia hirta L. Euphorbiaceae Tropical America
Galinsoga parviflora Cav. Asteraceae Tropical America
Hyptis suaveolens (L.) Poit. Lamiaceae South America
Ipomoea carnea Jacq. Convolvulaceae Tropical America
Ipomoea hederifolia L. Convolvulaceae Tropical America
Ipomoea obscura (L.) Ker Gawl. Convolvulaceae Tropical Africa
Ipomoea pes-tigridis L. Convolvulaceae Tropical Africa
Lagascea mollis Cav. Asteraceae Tropical America
Lantana camara L. Verbenaceae Tropical America
Malachra capitata (L.) L. Malvaceae Tropical America

Malvastrum coromandelianum (L.) Garcke Malvaceae Tropical America
Martynia annua L. Pedaliaceae Tropical America
Mecardonia procumbens (Mill.) Small Scrophulariaceae Tropical America
Mikania micrantha Kunth Asteraceae Tropical America
Oxalis corniculata L. Oxalidaceae Europe
Parthenium hysterophorus L. Asteraceae Tropical America
Physalis minima L. Solanaceae Tropical America
Pistia stratiotes L. Araceae Tropical America
Portulaca oleracea L. Portulacaceae South America
Prosopis juliflora (Sw.) DC. Mimosaceae Mexico
Ruellia tuberosa L. Acanthaceae Tropical America
Scoparia dulcis L. Scrophulariaceae Tropical America
Solanum nigrum L. Solanaceae Tropical America
Solanum torvum Sw. Solanaceae West Indies
Sonchus oleraceus L. Asteraceae Mediterranean
Spilanthes radicans Jacq. Asteraceae South America
Synedrella nodiflora (L.) Gaertn. Asteraceae West Indies
Tridax procumbens L. Asteraceae Tropical America
Waltheria indica L. Sterculiaceae Tropical America
Xanthium indicum Koenig Asteraceae Tropical America
Youngia japonica (L.) DC. Asteraceae South America

SEMESTER IV

S.Y.B.Sc. Botany CBCS Pattern
(Semester IV, Paper I) 2020-2021
BO 241: Plant Anatomy and Embryology- 2 Credits (30 Lectures)

Credit-I Plant anatomy: (15 Lectures)

1. Introduction 2L

1.1 Definition

1.2 Scope of plant anatomy

2. Epidermal tissue system 3L

2.1 Structure, types and functions of epidermis

2.2 Structure, types and functions of Stomata

2.3 Epidermal outgrowths- non-glandular and glandular

2.4 Motor cells

3. Mechanical tissue system 3L

3.1 Principles involved in distribution of mechanical tissues with one example each

a) Inflexibility,

b) Incompressibility,

c) Inextensibility and

d) Shearing stress

3.2 Vascular tissue system: Structure and function of xylem, phloem and cambium

4. Normal secondary growth 3L

4.1 Introduction

4.2 Normal secondary growth in dicotyledonous stem

4.3 Development of annual rings, periderm, bark, tyloses and lenticel

5. Anomalous secondary growth 4L

5.1 Introduction

5.2 Causes of anomalous secondary growth

5.3 Anomalous secondary growth in:

a) Dicotyledonous stem (*Bignonia*),

b) Dicotyledonous root (*Raphanus*),

c) Monocotyledonous stem (*Dracaena*)

Credit-II Plant Embryology (15 Lectures)

7. Introduction 1L

7.1 Definition and scope of plant embryology

8. Microsporangium and male gametophyte 4L

8.1 Structure of tetrasporangiate anther

8.2 Types of tapetum

8.3 Sporogenous tissue

8.4 Microsporogenesis: process and its types

8.5 Types of microspore tetrad

8.6 Male gametophyte: structure and development of male gametophyte

9 Megasporangium and female gametophyte **4L**

9.1 Structure
9.2 Types of ovules
9.3 Types of megaspore tetrads
9.4 Female gametophyte: structure of typical embryo sac
9.5 Types of embryo sacs – monosporic, bisporic and tetrasporic

10. Pollination and Fertilization: **3L**

10.1 Introduction and definition
10.2 Types of pollination
10.3 Germination of pollen grain
10.4 Entry of pollen tube- porogamy, mesogamy and chalazogamy
10.5 Double fertilization and its significance.

11. Endosperm and embryo **3L**

11.1 Endosperm: Types – nuclear, helobial and cellular.
11.2 Structure of Dicotyledonous and Monocotyledonous embryo.

References:

1. Plant Anatomy, Chandurkar P J, Plant Anatomy Oxford and IBH publication Co. New Delhi 1971
2. B P Pandey, Plant Anatomy. S Chand and Co. Ltd, New Delhi 1978
3. Greulach V A and Adams J E Plant- An introduction to Modern Biology, Toppen Co. Ltd, Tokyo,
4. Eams and Mc Daniel,An Introduction to Plant Anatomy, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
5. Adriance S Foster Practical Plant Anatomy, D Van Nostrand Co. INC, New York
6. Esau, Plant Anatomy, Wiley Toppan Co. California, USA
7. Pijush Roy, Plant Anatomy. New Central Book Agency Ltd, Kolkata
8. Pandey S N and Ajanta Chadha, Plant Anatomy and Embryology, Vikas Publishing House, Pvt, Ltd, New Delhi
9. Bhojwani S S and Bhatnagar S P, An Embryology of Angiosperms
10. Maheshwari P, An introduction to Embryology of Angiosperm
11. Nair P K K Essentials of Palynology.

S.Y.B.Sc. Botany CBCS Pattern
(Semester IV, Paper II) 2020-2021
BO 242: Plant Biotechnology (2 Cr- 30 Lectures)

Credit I:

Chapter 1 Introduction to Plant Biotechnology 3L

1.1 History and definition
1.2 Scope and importance of plant biotechnology
1.3 Current status of biotechnology in India.

Chapter 2 Plant Tissue Culture 8L

2.1 Concept of plant tissue culture and cellular totipotency
2.2 Basic techniques: Types of culture, Media preparation, sterilization, inoculation, incubation, hardening
2.3Applications with reference to: Micropropagation, Somaclonal variation, Haploid production, Protoplast fusion & Somatic hybrids, Embryo rescue, Production of secondary metabolites.
2.4 Commercial Plant Tissue culture laboratories in Maharashtra and India.

Chapter 3 Single Cell Protein (SCP) 4L

3.1 Concept and definition
3.2 Importance of proteins in diet
3.3 Production of SCP from *Spirulina* and Yeast
3.4 Importance & acceptability of SCP

Credit II:

Chapter 4 Plant Genetic Engineering 5L

4.1 Introduction, concept
4.2 Tools of genetic engineering (restriction enzymes, ligases, plasmid vectors)
4.3 Gene cloning Technique
4.4 Applications of plant genetic engineering: insect pest resistance, abiotic stress tolerance, herbicide resistance

Chapter 5 Genomics, Proteomics and Bioinformatics 5L

5.1 Genomics- concept, types, methods used for whole genome sequencing
5.2 Proteomics-concept, types, methods used in proteome analysis
5.3 Bioinformatics-concept, database and its classification, data retrieval tools.

Chapter 6 Bioremediation 2L

6.1 Introduction and concept
6.2 Microbial remediation
6.3 Phytoremediation

Chapter 7 Biofuel technology 3L

7.1 Definition, Concept and types of Renewable and nonrenewable energy sources
7.2 Definition and concept of Biogas, Bioethanol, Biobutanol, Biodiesel & Biohydrogen

References

1. B.D. Singh (4th Edn 2012) Biotechnology-expanding horizons, Kalyani Publishers.
2. K.S. Bilgrami & A.K. Pandey (2007) Introduction to Biotechnology CBS Publishers and Distributors PVT LTD
3. M.K. Razdan (2002) Introduction to Plant Tissue Culture. Oxford and IBH Publishing Co., New Delhi.
4. H.S. Chawla (2005) Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. New Delhi.

S.Y.B.Sc. Botany CBCS Pattern
Practical (Semester IV Paper III) 2020-2021
BO 243: Practical based on BO 241 & BO 242

Sr. No.	Title	No. of Practical
	Plant Anatomy and Embryology	
1	Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (Dicotyledonous and Monocotyledonous).	2
2	Study of mechanical tissues and their distribution in root, stem and leaves.	1
3	Study of normal secondary growth in dicot stem – *Annona* /*Moringa* (Double stained temporary preparation).	1
4	Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem (Double stained temporary preparation).	1
5	Study of tetrasporangiate anther and types of ovules with the help of permanent slides	1
6	Study of dicot and monocot embryo.	1
	Plant Biotechnology	
7	Instruments/equipments used in plant tissue culture laboratory: Principle and working of Autoclave, oven, laminar air flow cabinet, micropipette, culture bottles/tubes with cotton plug	1
8	Preparation & sterilization of MS medium	1
9	Surface sterilization and Inoculation of nodal sector, leaf, anther and maize embryo	2
10	Laboratory cultivation of *Spirulina*	1
11	Demonstration practical on transgenic crops viz; Bt-Cotton, Golden rice	1
12	Demonstration of principle and working of agarose gel electrophoresis, centrifuge, spectrophotometer	1
13	Visit to plant tissue culture laboratory	1

UNIVERSITY OF PUNE

REVISED SYLLABUS FOR S.Y. B.Sc. CHEMISTRY FROM 2014-2015

(According to Semester system 2014-2015)

Course structure: There will be four theory papers of 50 Marks each, (40 marks external + 10 marks internal) and one practical course of 100 marks. (80 marks External + 20 marks Internal). The examination will be held semester-wise for theory papers whereas the examination for practical course CH-223 will be held at the end of **SEMETER-II**

SEMESTER	PAPER	COURSE TITLE	MARKS
I	CH-211	PHYSICAL & ANALYTICAL CHEMISTRY	50
I	CH-212	ORGANIC & INORGANIC CHEMISTRY	50
II	CH-221	PHYSICAL & ANALYTICAL CHEMISTRY	50
II	CH-222	ORGANIC & INORGANIC CHEMISTRY	50

Practical Course in Chemistry: CH-223 - 100 Marks

Equivalence of Previous Syllabus:

Semester	Old Course (2009-10)	New Course (2014-15)
I	CH-211 : Physical Chemistry	CH-211 : Physical & Analytical Chemistry
I	CH-212 : Organic Chemistry	CH-212 : Organic & Inorganic Chemistry
II	CH-221 : Inorganic Chemistry	CH-222 : Organic & Inorganic Chemistry
II	CH-222 : Analytical Chemistry	CH-221 : Physical & Analytical Chemistry
	CH- 223: Practical	CH- 223: Practical

S. Y. B. Sc. (Chemistry) Syllabus

Semester - I

Paper 1: CH-211: Physical and Analytical Chemistry

Paper 2: CH-212: Organic and Inorganic Chemistry

Semester - II

Paper 3: CH-221: Physical and Analytical Chemistry

Paper 4: CH-222: Organic and Inorganic Chemistry

Practical Course in Chemistry CH-223 (To be conducted during both semesters)

SEMESTER – I

Paper 1: CH-211

Section – I

Physical Chemistry

Chapter 1: Elementary Chemical Kinetics **[10]**

Introduction to Chemical kinetics, molecularity and order of reaction , reaction rates, rate laws, rate constant and its significance, Integrated rate law expression and its characteristics–first order, second order (single reactant, two reactants involved), examples of 1^{st} and 2^{nd} order reaction, pseudomolecular reactions, factors affecting rate of reaction, measurement of rate of reaction, numericals.

Aim: To introduce concept of kinetics at undergraduate level.

Objectives: Student should learn

i. Concept of kinetics , terms used , rate laws , types of order
ii. Discuss examples of first order and second order reaction
iii. Pseudo molecular reactions
iv. Factors affecting on rate of reaction
v. Techniques of measurement of rate of reaction
vi. To solve problems

Chapter 2: Photochemistry **[10]**

Introduction, thermal reactions and photochemical reactions, laws of photochemistry, quantum yield, measurement of quantum yield, types of photochemical reactions-photosynthesis, photolysis, photocatalysis, photosensitization, photophysical process–fluorescence, phosphorescence, quenching, chemiluminiscence, numericals.

Aim: To impart basic knowledge of photochemistry and its applications

Objectives: After studying the chapter student should be able to

i. Know about photochemistry
ii. Understand difference between thermal and photochemical reactions
iii. Understand laws of photochemistry
iv. Learn what is quantum yield and it's measurement
v. Know Types of photochemical reactions and photophysical process
vi. Know about quenching and chemiluminence
vii. To solve numericals

Chapter 3: Distribution law **[04]**

Nernst distribution law, Statement and thermodynamic proof for Nernst distribution law, association and dissociation of solute in solvent, application of distribution law, Numericals.

Aim: To understand Nernst Distribution Law and its applications

Objectives: Students should learn

i. Concept of distribution of solute amongst pair of immiscible solvents
ii. Distribution law and it's thermodynamic proof
iii. Distribution law and nature of solute in solution state
iv. Application – Solvent extraction
v. To solve numericals

Ref.1: Page no. 298 to 302 and 775-800

Section – II

Analytical Chemistry

Chapter 4: Introduction to Analytical Chemistry **[3]**

Introduction, Chemical analysis, applications of chemical analysis, sampling, types of analysis, Common techniques, Instrumental methods, other techniques, factors affecting on choice of method

Aim: To introduce basics of analytical chemistry

Objectives: Students should learn

i. What is Analytical Chemistry
ii. Chemical analysis and its applications
iii. Sampling
iv. Common techniques
v. Instrumental methods and other techniques
vi. Choice of method

Ref: Vogel chapter 1 (Page 1 - 11) up to section 1.9 except use of literature.

Chapter 5: Errors in Quantitative Analysis **[5]**

Introduction, Error, Accuracy, precision, methods of expressing accuracy and precision, classification of errors, significant figures and computations, distribution of random errors, mean and standard deviations, reliability of results, Numericals.

Aim: To understand errors and its interpretation

Objectives: Students should learn

i. Meaning of error and terms related to expression & estimation of errors
ii. Methods of expressing accuracy and precision
iii. Classification of errors
iv. Significant figures and computations
v. Distribution of errors
vi. Mean and standard deviations
vii. Reliability of results

Ref: Vogel, 5thedn chapter 4 (127-137 up to section 4.10) extended up to 4.13

Chapter 6: Inorganic Qualitative Analysis **[8]**

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals.

Aim: To study the theory underlying Inorganic Qualitative analysis

Objectives: A student should know

i. Basic principles in qualitative analysis
ii. Meaning of common ion effect
iii. Role of common ion effect and solubility product
iv. Different groups for basic radicals
v. Group reagent and precipitating agents
vi. Interfering anions and its removal
vii. Separation for basic radicals
vii. Method of detection of acidic radicals

Chapter 7: Analysis of Organic Compounds (Qualitative & Quantitative) **[8]**

I. Qualitative

A. Types of organic compounds, Characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.

II Quantitative

B. Analysis–estimation of C, H, (O) by combustion tube, detection of nitrogen, sulfur, halogen and phosphorous by Lassigen's test.
C. Estimation of nitrogen by Dumas's Kjeldahl's method, estimation of halogen, sulphur and phosphate by Carious method.
D. Determination of empirical and molecular formula, numerical problems.

Aim: To disseminate knowledge of qualitative & quantitative analysis of organic compounds

Objectives: A student should know-

i. Classification of compounds with different functional groups
ii. Different tests for detection of elements like C, H, (O), N, S & P.
iii. Characteristic tests for different functional groups
iv. Different colour tests and the reactions
v. Quantitative analysis of C, H by Liebig's method
vi. Kjeldahl's method with example
vii. Carius tube method with example
vii. Empirical and molecular formula
vii. To solve numericals.

Name of the reference book:

1. Analytical Chemistry by G.D. Christian, sixth edition. Pages: 1-10
2. Vogel's textbook of Quantitative Analysis, sixth edition
   J. Mendham, R.C. Denney, J.D. Barnes, MJK Thomas
3. A textbook of macro & semi micro qualitative analysis by
   A.J. Vogel, fifth edition
4. Quantitative Organic Analysis, fourth edition, A.J. Vogel, ELBS

Paper 2: CH-212

Section – I

Organic Chemistry

Chapter 1: Stereoisomerism **[12]**

Introduction to optical isomerism: Chirality, optical activity and polarimetry, enantiomers, absolute configuration, R/S system nomenclature with wedge and Fischer representation of two chiral centres, erythro, threo, meso-diastereomers with R/S configuration. Stereoisomerism Baeye'rs strain theory, heat of combustion, cycloalkanes, factors affecting the stability of conformation, Conformation of cyclohexane - equatorial and axial bonds, Monosubstituted cyclohexane stability with $-CH_3$ and $-C(CH_3)_3$ substitutes. Structures of geometrical isomers of dimetylcyclohexane only.

Ref. 3

Aims and Objectives

Students should be able to –

i) Identify chiral center in the given organic compounds.

ii) Define Erythro, threo, meso, diasteroisomers with suitable examples.

iii) Able to find R/S configuration in compounds containing two chiral centers.

iv) Explain Bayer's strain theory, Heat of combustion and relates stability of cycloalkanes.

v) Explain the stability of cyclohexanes.

vi) Draw the structure of boat and chair configuration of cyclohexane.

vii) Draw axial and equatorial bonds in cyclohexane.

viii) Draw structure of conformations of mono- & disubstituted cyclohexanes

ix) Explain the stability of axial and equatorial conformation of monosubstituted cyclohexanes.

Chapter 2: Organic reaction Mechanism **[12]**

Introduction, types of reagents–electrophile, nucleophile and free radical.

Types of organic reactions: Addition, Elimination (β-elimination and Hofmann elimination), substitution (aliphatic electrophilic and nucleophilic, aromatic electrophilic) and rearrangement.

Mechanism: (i) Aldol condensation (ii) Markovnikov and anti-Markovnikov addition reaction (iii) Saytzeff and Hoffmann elimination (iv) S_N^1 and S_N^2 reactions (v) Hofmann rearrangement.

Ref. 1 & 4

Aims and Objectives

Students should be able to –

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd,New Delhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley 1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel

Ref. 4: Reactions, rearrangements and reagents – S N Sanyal

Section – II

Inorganic Chemistry

Chapter 3: General Principles of Metallurgy: **[6]**

Introduction, occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, connotation, various methods of concentration such as hand picking, gravity separation, magnetic separation. Froth flotation, Calcinations, Roasting etc. Reduction, various methods of reduction such as smelting, Aluminothermic process and electrolytic reduction, Refining of metals, various methods of refining such as poling, liquation, electrolytic and vapour phase refining (Van Arkel Process).

Aims: To study principles and process of metallurgy.

Objectives: A student should be able -

i) To differentiate between ore and minerals.

ii) To differentiate between calcination and roasting and smelting.

iii) To know the different methods for separation of gangue or matrix from metallic compounds.

iv) To know the terms smelting, flux.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu, pages 262-271.

ii) Text book of Inorganic Chemistry, P.L. Soni, pages 2.3-2.8, 2.13-2.17.

Chapter 4: Metallurgy of Aluminium (Electrometallurgy): [4]

Occurrence, Physiochemical principles, Extraction of Aluminium, Purification of bauxite by Baeyer's process, Electrolysis of alumina, application of aluminum and its alloys.

Aims: To study metallurgy of Aluminium.

Objectives: A student should be able -

i) To know physico-chemical principles involved in electrometallurgy.

ii) To understand electrolysis of alumina and its refining.

iii) To explain the uses of Aluminum and its alloys.

iv) To know purification of bauxite ore.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.

ii) Text book of Inorganic Chemistry, P.L. Soni pages 2.209 to 2.211

Chapter 5: Metallurgy of Iron and Steel (Pyrometallurgy) [8]

Occurrence, concentration, calcination, smelting physio-chemical principles, reactions in the blast furnace, wrought iron, manufacture of steel by Bessemer and L.D. process, its composition and applications.

Aims: To study metallurgy of Iron.

Objectives: A student should be able -

i) To explain the term pyrometallurgy and to explain the physico chemical principles involved in the reduction process by carbon monoxide.

ii) To know different reactions in the blast furnace.

iii) To differentiate between properties of pig iron and wrought iron.

iv) To explain the basic principles of different methods for preparation of steel.

v) To explain the merits and demerits of different methods.

Reference:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849.

Chapter 6: Corrosion and Passivity: [6]

(a) Corrosion : Definition of corrosion, Types of corrosion, Atmospheric, Immersed, Mechanism of electrochemical corrosion, Factors affecting corrosion - position of metal in E. C. S., purity effect of moisture, effect of oxygen, pH, physical state of metal, methods of protection of metal from corrosion- alloy formation, making metal cathodic, controlling

external condition. Coating-galvanising, Tinning, electroplating, metal cladding, organic coating.

(b) Passivity : Definition, Theories of passivity - (i) Oxide film theory (ii) Gaseous film theory (iii) Physical film theory, Valence theory, Catalytic theory, Allotropic theory, Electrochemical passivity.

A student should know -

i) Definition of corrosion.

ii) Types of corrosion.

iii) Mechanism of corrosion.

iv) Factors affecting corrosion.

v) Methods of prevention of metal from corrosion.

vi) Meaning of passivity.

vii) Different theories of passivity.

viii) Galvanising, Tinning, Electroplating from corrosion.

Reference:

i) Introduction to Electrochemistry by S. Glasstone, 2nd Ed. pages 491-503.

SEMESTER – II

Paper 3: CH-221

Section – I

Physical Chemistry

Chapter 1: Free Energy and Equilibrium **[12]**

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free change energy for chemical reaction,Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction, Free energy change for physical transitions, Free energy change for an ideal gas; standard free energy change, Gibb's-Helmholtz equation, Properties and significance of Gibb's free change, Van't Hoff reaction isotherm, thermodynamic equilibrium constants, Relation between Kp and Kc for gaseous reactions, variation of equilibrium constant with temperature, Criteria for chemical equilibrium, Physical equilibrium, Clapeyron equation, Clausius–Clapeyron equation, Application of Clausius–Clapeyron equation, numericals.

Aim: To conceptualize phenomenon of free energy and equilibria.

Objectives: The student should able to know

i. Free energy concepts, types and its variation
ii. Free energy change for chemical reaction and physical transition
iii. Free energy change for ideal gases
iv. Gibb's Helmholtz equations and its properties & significance
v. van't Hoff reaction isotherm and thermodynamic equilibrium constants,
vi. Chemical and physical equilibrium
vii. Clausius –Clapeyron equation and its applications
vii. To solve numericals.

Ref. 1: Page no. 189 to 200, 206

Ref. 2: Relevant pages.

Chapter 2: Solutions of Liquids in Liquids **[12]**

Types of solutions, Ideal solutions, Raoult's law, ideal and non ideal solutions, Henry's law, Application of Henry's law with example CS_2 in acetone, problems based on Raoult's law and Henry's law, vapor pressure–composition diagram of ideal and non ideal solution, temperature composition diagram of miscible binary solutions, distillation from temperature–composition diagram, Azeotropes, Partially immiscible liquids.

Aim: To distinguish behavior of liquid phase solutions.

Objectives: The student should to know

i. Ideal and non ideal solutions and laws governing these solutions
ii. Interpretation of vapor pressure–composition diagram
iii. Interpretation of temperature composition diagram.
iv. Distillation from temperature – composition diagram,
v. Azeotropes
vi. Partially immiscible liquids.
vii. To solve numericals

Ref.2: Pages 229 to 247, 254 to 258

Reference books:

1. Principles of Physical Chemistry by S.H. Maron & C. Prutton 4th edition.
2. Physical Chemistry by W.J. Moore 5th edition.
3. Physical Chemistry by P.W. Atkin 4th edition
4. Physical Chemistry by D. Alberty 3rd edition.

Section – II

Analytical Chemistry

Chapter 3: Introduction to volumetric analysis **[6]**

Introduction, methods of expressing concentrations, primary and secondary standard solutions. Apparatus used and their calibration: burettes, microburettes, volumetric pipettes, graduated pipettes, volumetric flask, methods of calibration, Instrumental & non-instrumental analysis – principles & types.

Aim: To provide basic knowledge essential for volumetric analysis

Objectives: A student should be able to know

i. Meaning of equivalent weight, molecular weight, normality, molality, primary and secondary standards.
ii. Different way to express concentrations of the solution.
iii. Preparation of standard solution.
iv. To solve numerical problems.
v. Calibrate various apparatus such as burette, pipette, volumetric flask, barrel pipette etc.
vi. Types instrumental and non instrumental analysis

Chapter 4: Non Instrumental volumetric analysis **[18]**

Indicators–theory of indicators, acid base indicators, mixed and universal indicators [3]

Acid–Base titrations: Strong acid–Strong base, Weak acid–strong base, Weak acid-Weak base titration, Displacement titrations, polybasic acid titrations. (Discuss titration with respect to neutralization and equivalence point determination and limitations) [6]

Redox titrations: Principle of redox titration, detection of equivalence point using suitable indicators. [3]

Complexometric titrations: Principle, EDTA titrations, choice of indicators [6]

Iodometry and Iodimetry: Principle, detection of end point, difference between iodometry and iodimetry, Standardization of sodium thiosulphate solution using potassium dichromate and iodine method, Applications – estimation of Cu , estimation of Cl_2.

Aim: To learn and equip with non instrumental volumetric techniques

Objectives: The student should able to

i. Explain role of indicators.
ii. Know mixed and universal indicators.
iii. Know neutralization curves for various acid base titration
iv. Know principle of complexometric precipitation and redox titrations.
v. Know the definitions and difference between iodometry and iodimetry.
vi. To know standardization of sodium thiosulphate and EDTA.
vii. Reactions between $CuSO_4$ and Iodine and liberated I_2 and $Na_2S_2O_3$
viii. Choice of suitable indicator.
ix. Estimate copper from $CuSO_4$ and available chlorine in bleaching powder.
x. Prepare standard silver nitrate solution.
xi. Mohr's and Fajan's method.
xii. Determine the amount of halides separately and in presence of each other.

Paper 4: CH-222

Section – I

Organic Chemistry

Chapter 1: Reagents in Organic Synthesis **[8]**

Catalytic hydrogenation including liquid phase hydrogenation, Birch reduction, $NaBH_4$, $LiAlH_4$, Sn/HCl

Oxidation reagents: $KMnO_4$, $K_2Cr_2O_7$, Jones reagent, PCC, Per acids, OsO_4.

Student should understand:

i) Concept of different reagents used in the one type of conversion

ii) Merits & demerits of different reagents

iii) Reagent based mechanisms

iv) Use of different hydrogen donors for hydrogenation

Ref. 1 & 4

Chapter 2: Chemistry of heterocyclic compounds with one hetero atom. **[6]**

Definition and classification of heterocyclic compounds, nomenclature and aromatic character. Synthesis of Pyrrole, Furan, Thiophene, Pyridine and their reactions: Nitration, Sulphonation, Acylation and Catalytical reduction. Structure and synthesis of quinoline and Isoquinoline.

Student should know:

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products.

Ref. 1

Chapter 3: Introduction of Bio-molecules **[10]**

Carbohydrates: Definition, classification, reaction of monosaccharide (glucose)- oxidation, reduction, osazone and ester formation, isomerization, Killiani-Fischer synthesis and Ruff

degradation, Configuration of D/L configuration of (+) Glucose, Fischer-Haworth and chair formulae, Brief account of disaccharides: Sucrose, cellobiose, maltose and lactose.

Polysaccharides: Starch, cellulose and glycogen.

Amino acids: Fischer projection, relative configuration, classification, structures and reactions of amino acids, Properties and chemical reactions with amino and carboxylic group.

Proteins: Formation of Peptide linkage, α-helical conformation, β-plated structure, primary, secondary, tertiary and quaternary structure of proteins.

Ref. 2 & 3

Student should know

i) Know different biomolecules.

ii) Appreciate the role of biochemistry in the day to day life.

iii) Understand the importance of biochemistry.

iv) Define carbohydrates.

v) Classify carbohydrates giving suitable examples.

vi) Write and complete various reactions of glucose.

vii) Explain optical activity in carbohydrates.

viii) Write Fischer projection and perspective formula with glyceraldehydes as reference compound.

ix) Explain the principle in Killani Fischer synthesis.

x) Explain stereoisomerism in monosaccharide.

xi) Draw structure of some common aldoses and ketoses.

xii) Distinguish between diastereomers and epimers.

xiii) Write cyclic structure of glucose in Fischer, Haworth and chair form.

xiv) Know the phenomenon of mutaroatation.

xv) Draw the structure and bonding in maltose, lactose, cellobiose and sucrose.

xvi) Know about polysaccharide, structures of starch and cellulose.

xvii) Classify the naturally occurring amino acids.

xviii) Explains the amphoteric nature of amino acids.

xix) Know the important reactions of α-amino acids.

xx) Outline the formation of peptide bond.

xxi) Explain the hydrogen bonding in α-helical structure.

xxii) Relate the stability of α-helical chain and their R-groups.

xxiii) Define primary, secondary, tertiary and quaternary structure of proteins.

xxiv) Classify proteins.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd, New Delhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley 1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel

Ref. 4: Reactions, rearrangements and reagents – S N Sanyal

Section – II

Inorganic Chemistry

Chapter 4: Chemistry of d-block elements **[6]**

Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t.(a) size of atoms & ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex formation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density, melting & boiling points.

Student should know:

i) To know position of d-block elements in periodic table.

ii) To know the general electronic configuration & electronic configuration of elements.

iii) To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ablility, colour, magnetic properties, non-stoichiometry, density, melting point, boiling point.

Chapter 5: Organometallic Chemistry **[6]**

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, methods of synthesis; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis. Molecular and electronic structures (18 electron rule) of metal carbonyls. Homogenous catalysis-Hydroformylation (Oxo Process) and Wacker Process.

Aim: To study the metal carbonyl complexes and their uses in the homogenous catalysis.

Objectives:

Students should be able:

i) To understand M-C bond and to define organometallic compounds

ii) To define organometallic chemistry

iii) To understand the multiple bonding due to CO ligand.

iv) To know methods of synthesis of binary metal carbonyls.

v) To understand the structure and bonding using valence electron count (18 electron rule)

vi) To understand the catalytic properties of binary metal carbonyls.

vii) To understand the uses of organometallic compounds in the homogenous catalysis.

References:

1. Concise Inorganic Chemistry by J. D. Lee-relevant pages.

2. General Chemistry-Raymond Chang- relevant pages.

Chapter 6: Acids, Bases and Solvents **[6]**

Definition of acids and bases, Arrhenius theory, Lowry-Bronsted theory, Lewis concept, Lux-Flood theory, strength of acids and bases, trends in the strength of hydracids and oxyacids, Properties of solvents, M.P-B.P range, dipole moment, dielectric constant, Lewis acid-base character and types of solvents.

Ref: Basic Inorganic Chemistry – F. A. Cotton (Pages- 163-173)

(6) Acids, Bases, Solvents and reactions in non-aqueous solvents:

Aims: To study different solvents and to know the different theories of acids and bases.

Objectives: A student should be able -

i) To define acids and bases according to Arrhenius theory Lowery- Bronsted concept, Lewis concept.

ii) To explain the merits and demerits of different theories of acids and bases.

iii) To define the conjugate acid and base pairs.

iv) To explain the leveling effect of solvents.

v) To demonstrate the trends in the strength of hydracids, oxyacids.

vi) To define hard and soft acids.

vii) To know the trends in the strength of hydra and oxyacids.

viii) To know the rules governing the strength of oxyacids.

ix) To explain the properties of a solvent that determines their utility.

x) To know some useful solvents.

xi) To explain the reactions in non-aqueous solvents like HF and NH3.

Chapter 7: Chemical Toxicology **[6]**

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes.

Biochemical effect of Arsenic, Cadmium, Lead, Mercury, Biological methylation.

A student should be able -

i) To know toxic chemical in the environment.

ii) To know the impact of toxic chemicals on enzyme.

iii) To know the biochemical effect of Arsenic, Cd, Pb, Hg.

iv) To explain biological methylation.

Reference:

i) Fundamental Chemistry by A. K. Dee. (3^{rd} Ed.)

Practical Course in Chemistry CH – 223

A) Physical Chemistry practicals (Any Five)

i. To determine critical solution temperature of phenol water system

ii. To determine molecular weight of given organic liquid by steam distillation

iii. Determination of solubility of benzoic acid at different temperature and to determine ΔH of dissociation process.

iv. To study neutralization of acid (HCl) base (NaOH) and CH_3COOH by NaOH and H_2SO_4 by NaOH.

v. To determine the rate constant (or to study kinetics) of acid catalyzed ester hydrolysis.

vi. To determine the rate constant of base catalyzed ester hydrolysis.

vii. Partition coefficient of iodine between water and carbon tetrachloride.

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

B) Inorganic Qualitative Analysis (Minimum Five mixtures)

i. One simple mixture (without phosphate or borate)

ii. Two Mixtures containing PO_4^{3-} (With PO_4^{3-} removal)

iii. Two Mixtures containing BO_3^{3-} (With BO_3^{3-} removal)

Inorganic Qualitative Analysis of Binary Mixtures (including phosphate and borate removal).

Sodium carbonate extract is to be used wherever necessary for detecting acidic radicals.

C) Organic Chemistry Practical

a. Organic qualitative analysis of Binary Mixtures without ether separation (**Four only**)

Two: solid-solid, one: solid-liquid, one: liquid-liquid

b. Organic Preparation: (**Any two including Crystallization, MP, TLC**)

i) Pthalic anhydride to pthalamide

ii) Glucose to osazone

iii) Acetanilide to p-bromoactanilide

iv) Benzaldehyde to dibenzylidene acetone

After completion of practical course student should be able to –

i) Verify theoretical principles experimentally.

ii) Acquire skill of crystallisation, record correct m. p. / b. p.

iii) Perform the complete chemical analysis of the given organic compound and should be able to recognize the type of compound.

iv) Write balanced equation for all the reactions, they carry in the laboratory.

v) Perform the given organic preparation according to the given procedure.

vi) Follow the progress of the reaction by using TLC technique.

vii) Set up the apparatus properly for the given experiments.

viii) Perform all the activities in the laboratory with neatness and cleanness.

Ref. 1 Organic Qualitative Analysis: A. I. Vogel

D) Analytical Chemistry Practicals (Any Five)

i. Estimation of sodium carbonate content of washing soda.
(Vogel 5thEdition: 10.30 page 295).

ii. Determination of Ca in presence of Mg using EDTA.
Ref.2: Page 412

iii. a) Preparation of standard 0.05 N oxalic acid solution and standardization of approx. 0.05N $KMnO_4$ solution.
b) Determination of the strength of given H_2O_2 solution with standard 0.05 N $KMnO_4$solution.

iv. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.

v. Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black–T indicator (Back titration method)

vi. Iodometric estimation of copper.

vii. Report on one day industrial educational visit.

Reference books

1. Analytical Chemistry by G.D. Christian 6th edition.
2. Vogel's Textbook of Quantitative chemical analysis 6th edition R.C. Denney, J.D. Barnes, M.J.K. Thomas

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

N.B. - Industrial visit during the academic year is compulsory.

SAVITRIBAI PHULE PUNE UNIVERSITY

(Formerly University of Pune)

S.Y. B. Sc. (Computer Science), Electronics

Choice Based Credit System Syllabus

To be implemented from

Academic Year 2020-2021

(Under the faculty of Science and Technology

)

Savitribai Phule Pune University

(Formerly University of Pune)

SYLLABUS OF

S. Y. B. Sc. (Computer Science), Electronics

Choice Based Credit System

To be implemented from A.Y. 2020-21

Structure of S. Y. B. Sc.(Computer Science) Electronics

Semester	Paper Code	Paper	Paper title	No. of Credit	Lectures/Week	Evaluation		
						CA	UE	Total
III	ELC-231	I	Microcontroller Architecture & Programming	2	3 (each lecture of 50 minutes)	15	35	50
	ELC-232	II	Digital Communication and Networking	2	3 (each lecture of 50 minutes)	15	35	50
	ELC-233	III	Practical Course I	2	1 pract / week (each practical of 04 hours & 20 minutes)	15	35	50
IV	ELC-241	I	Embedded System Design	2	3 (each lecture of 50 minutes)	15	35	50
	ELC-242	II	Wireless Communication and Internet of Things	2	3 (each lecture of 50 minutes)	15	35	50
	ELC-243	III	Practical Course II	2	1 pract / week (each practical of 04 hours & 20 minutes)	15	35	50

S.Y.B.Sc.(Computer Science), Electronics- Semester III

Paper-I: Microcontroller Architecture & Programming (ELC 231)

Objectives:

1. To study the basics of 8051microcontroller
2. To study the Programming of8051microcontroller
3. To study the interfacing techniques of 8051microcontroller
4. To design different application circuits using 8051microcontroller

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

1. To write programs for 8051 microcontroller
2. To interface I/O peripherals to 8051 microcontroller
3. To design small microcontroller based projects

COURSE CONTENTS

UNIT- 1: Basics of Microcontroller & Intel 8051 architecture [08]

Introduction to microcontrollers, difference in controller and processor.
Architecture of 8051, Internal block diagram, Internal RAM organization, SFRS, pin functions of 8051, I/O port structure & Operation, External Memory Interface.

UNIT-2: Programming model of 8051 [10]

Instruction classification, Instruction set, Addressing Modes: Immediate, register, direct, indirect and relative, assembler directives (ORG, END), features with examples, I/O Bit & Byte programming using assembly language for LED and seven segment display (SSD) interfacing.
Introduction to 8051 programming in C.

UNIT- 3: Timer /Counter, Interrupts [10]

Timer / counter: TMOD, TCON, SCON, SBUF, PCON Registers, Timer modes, programming for time delay using mode 1 and mode 2.
Interrupts: Introduction to interrupt, Interrupt types and their vector addresses, Interrupt enable register and interrupt priority register (IE, IP)

UNIT- 4: Interfacing, Serial Communication **[08]**

Programming of serial port without interrupt, Serial Communication: Synchronous and asynchronous serial communication, Use of timer to select baud rate for serial communication. Interfacing : ADC, DAC, LCD, stepper motor.

Recommended books:

1. 8051 microcontroller and Embedded system using assembly and C : Mazidi and McKinley, Pearson publications
2. The 8051 microcontroller – Architecture, programming and applications: K.Uma Rao and Andhe Pallavi, Pearson publications.

S.Y.B.Sc. Computer Science), Electronics, Semester III

Paper-II, Digital Communication and Networking, ELC- 232

Objectives:

1. To introduce to all aspects of data communication system
2. To introduce various digital modulation schemes
3. To identify the need of data coding and error detection/correction mechanism.
4. To study bandwidth utilization techniques : multiplexing and Spectrum spreading
5. To know data link layer protocol: Media Access Control
6. To study OSI and TCP/IP models of Networking.

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

1. Define and explain terminologies of data communication
2. Understand the impact and limitations of various digital modulation techniques
3. To acknowledge the need of spread spectrum schemes.
4. Identify functions of data link layer and network layer while accessing communication link
5. To choose appropriate and advanced techniques to build the computer network

.

COURSE CONTENTS

UNIT 1: Introduction to Electronic Communication (9)

Introduction to Communication: Elements of Communication system, types of noise sources, Electromagnetic spectrum, signal and channel bandwidth,

Types of communication: simplex, half duplex, full duplex, baseband and broadband,

Serial communication: asynchronous and synchronous,

Information Theory: Information entropy, rate of information (data rate, baud rate), channel capacity, Nyquist theorem, Signal to noise ratio, Noise Figure, Shannon theorem,

Error handling codes: Necessity, Hamming code, CRC

UNIT 2: Modulation and Demodulation (5)

Introduction to modulation and demodulation: Concept and need of modulation and demodulation,

Digital Modulation techniques: Pulse Code Modulation (PCM), FSK, QPSK, QAM.

UNIT 3: Multiplexing, Spectrum Spreading and Media Access Control (12)

Multiplexing techniques: Frequency division multiplexing, wavelength division multiplexing, Time division multiplexing

Spread Spectrum techniques: Frequency hopping Spread Spectrum, Direct Sequence Spread Spectrum

Media Access Control (MAC):

Random Access Protocol: ALOHA, CSMA, CSMA/CD, CSMA/CA,
Controlled Access Protocols: Reservation, Polling, Token passing,
Channelization Protocols: FDMA, TDMA, CDMA.

UNIT 4: Computer Networking (10)

Introduction to computer networks

Types of networks : LAN, MAN, WAN, Wireless networks, Switching, Internet,

Network topology : point to point, Star, Ring, Bus, Mesh, Tree, Daisy Chain, Hybrid

Network devices : Repeater, Switch, Networking cables, Router, Bridge, Hub, Brouter, Gateway.

Wired LANs:-

Ethernet: Ethernet protocol, standard Ethernet, 100 MBPS Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet,

Computer network model: OSI and TCP/IP.

Recommended books:

1. Communication Electronics: Principles and Applications, Frenzel, Tata Mc Graw Hill publication, 5th edition.
2. Data Communication and Networking, Forouzan, Mc Graw Hill publication, 5th edition
3. Computer Networks, Tanenbaum, pHI publication, 5th edition

S.Y.B.Sc.(Computer Science), Electronics, Semester III
Paper III, Practical Course (ELC-233)

Objectives:

1. To get hands on training of Embedded C
2. To study experimentally interfacing of microcontroller
3. To design, build and test modulator and demodulators of digital communication
4. To build and test experimentally various techniques of wired communication
5. To develop practical skills of network setup

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

1. To design and build his/her own microcontroller based projects.
2. To acquire skills of Embedded C programming
3. To know multiplexing and modulation techniques useful in developing wireless application
4. Do build and test own network and do settings.

Guidelines for Practical:

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- At least five practical from each Group
- Electronics lab should have set up for embedded programming (Computers and microcontroller target and interfacing boards)

COURSE CONTENTS

Group A: (Any 5)

1. Arithmetic, logical & code conversion problems using assembly/C programming
2. Interfacing of thumbwheel & seven segment display to 8051 microcontroller
3. Traffic light controller using 8051 microcontroller
4. Interfacing LCD to 8051Microcontroller
5. Waveform generation using DAC Interface to 8051Microcontroller

6. Event counter using opto-coupler, seven segment LED/LCD display interface to 8051Microcontroller
7. Speed Control of stepper motor using 8051 microcontroller

Group B: (Any 5)

1. Study of 3 or 4 Bit Pulse Code Modulation technique
2. Study of Frequency Shift Keying
3. Study of Time Division Multiplexing
4. Study of Frequency Division Multiplexing
5. Study of Code Division Multiple Access System
6. Study of Error detection and correction by using Hamming Code technique
7. Study of Computer network components : Cables, Connectors, Routers, Switches, Ethernet and related interfacing cards
8. To study Configuration of IP and MAC address and to study Local Area Network setup

S.Y.B. Sc. (Computer Science), Electronics, Semester IV

Paper I : Embedded System Design (ELC-241)

Objectives:

1. To understand the concept of Embedded systems.
2. To study the design flow and available tools for an Embedded system.
3. To understand the implementation of embedded system using firmware and hardware components.
4. To acquire programming skills for the development of Embedded system design.
5. To develop practical skills for designing embedded system Applications.

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

1. To understand the difference between general computing and the Embedded systems.
2. To know the fundamentals of embedded systems.
3. Understand the use of Single board Computer (Such as Raspberry Pi) for an embedded system application.
4. Familiar with the programming environment to develop embedded systems and their interfaces with peripheral devices.
5. To develop familiarity with tools used to develop in an embedded environment.

COURSE CONTENTS

Unit 1:Introduction to Embedded systems using single board computers (SBC) (08)

Single boards computer block diagram, types, Comparison of SBC models, Specifications, I/O devices (Storage, display, keyboard and mouse), Network access devices

Unit 2: Architecture of System on Chip (SOC) (08)

Architecture of SoC, Basic version Broad Coprocessor, Pin Description of Raspberry Pi, Architectural features: CPU Overview, CPU Pipeline stages, CPU Cache Organization, Branch Prediction & Folding (Concept), GPU Overview

Unit 3:Programming using Python (10)

Overview of Rasberian OS (Operating System), Installation, different types of Operating Systems

Basic Python Programming (Script programming):Variable & data types, Flow Control structures, Conditional statements (If…Then…else),
Functions: I/O function (GPIO, Digital),Time functions, Library functions
Basic Arithmetic Programs: Addition, Subtraction, Multiplication, Division

Unit 4 : Interfacing of devices using Python Programming (10)

Basic interfacing: LED, Switch, LCD
Internal Advanced: Bluetooth, Wifi, Ethernet,
External advanced: Camera, Serial Communication GSM, Ultrasonic Sensor, PIR, Finger Print reader.

Recommended Books:

1. Rasberry Pi CookBook: Software & Hardware problems and Solutions By Simon Monk(O'Reilly Media Inc.)
2. Raspberry Pi Hardware Reference by Warren Gay (Apress)
3. Rasberry Pi User Guide By Eben Upton, Greath Halfacree (John Wiley & Sons, Inc.)
4. Learning Python with Rasberry Pi, by Alex Bradbury, Ben Everard, John Wiley & Sons, Inc
5. Learn Raspberry Pi programming with Python By Wolfram Donat (Apress)

S.Y.B.Sc.(Computer Science), Electronics, Semester IV

Paper II: Wireless Communication and Internet of Things (ELC242)

Objectives:

1. To learn and understand applications of wireless communication system
2. To learn and understand cellular system
3. To learn and understand architecture of short range Wireless Technologies
4. To learn and understand basics of Internet of Things
5. To study applications of IoT

Course Outcomes: Students will be able to

1. Know working of wireless technologies such as Mobile communication, GSM, GPRS
2. Become familiar with 3G and 4G Cellular Network Technologies for Data Connections.
3. Understand working principles of short range communication application
4. Get introduce to upcoming technology of Internet of Things
5. Explore themselves and develop new IoT based applications

COURSE CONTENTS

Unit1: Wireless Communication: Cellular Telephony (12)

Overview of wireless communication,

Introduction of cellular telephony system: Frequency reuse, handoff strategies, Co-channel and adjacent channel interference, block diagram of mobile handset

Overview of Cellular Telephony generations: 1G to 5G,3G (W-CDMA, UMTS), 4G(LTE)

GSM: architecture, frame structure, mobility management,

GPRS : architecture, application

Unit 2 : Short Range Wireless Technologies and Location Tracking (12)

Short range Technologies :

Bluetooth: Bluetooth architecture, Bluetooth protocol stack, Bluetooth frame structure
Zigbee: Architecture, topologies, applications, Z wave: Protocol architecture, applications
RFID: working of RFID system, types of RFID tags, RFID frequencies, applications

Location Tracking: GPS system**:** components of GPS system (space segment, control segment, user segment), GPS receiver, Applications

Unit 3: IoT Architecture (08)

Introduction to IOT : Evolution of IOT, M2M and/or IOT, Seven layer architecture of IoT, Role of cloud in IoT, cloud topologies, Cloud access, Protocols in IoT, Cross connectivity across IoT system components:

- Device to Gateway-short range Wireless: cellphone as gateway, dedicated wireless Access points
- Gateway to cloud: Long range connectivity, (wired, cellular, Satellite, WAN)
- Direct Device to Cloud connectivity ,

Networking technologies: Low power local area networking (LPLAN), Low power wide area networking (LPWAN) technologies, comparison of LoRa, sigfox NB-IoT, Cat –M.

Unit 4: IoT Applications (04)

Application domains,

Challenges in IoT : Power consumption, Physical security, durability, Secure Connectivity, Secure Data Storage, Data volume, Scalability

Case studies:

Case Study 1: Smart Irrigation system for Agricultural field
Case Study 2:Home Automation
Case Study 3: Smart Cities

Recommended books:

1. Wireless Communications Principles and Practice, Rappaport, Pearson publication
2. Mobile Communications, Jochen Schiller, Pearson publication
3. Internet of Things : Principles and Paradigms, Rajkumar Buyya and Dastjerdi, MK publishers
4. Internet of Things, Mayur Ramgir, Pearson publication

S.Y.B.Sc.(Computer Science), Electronics, Semester IV
Paper III, Practical Course (ELC-243)

Objectives:

1. To use basic concepts for building various applications of embedded electronics.
2. To build experimental setup and test the circuits.
3. To develop skills of analyzing test results of given experiments.
4. Developing Trained Personals for educating and training for upcoming graduates in wireless communication.
5. Implement basic IoT applications on embedded platform

Course Outcomes : On completion of the course, students will be able

1. To design and develop own smart applications using Rasberry-Pi
2. To write Python program for simple applications
3. To build own IoT based system

Guidelines :

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- Eight compulsory experiments: At least four practical from each Group
- One activity equivalent to 2 experiments by the student.
  a. Continuation of F. Y. activity.
  b. Electronics project Based on the Theory Courses learnt
  c. Documentation type experiments
  d. Presentation/Seminar on Electronics /advanced topic/research topics.

Prerequisite: Rasberry Pi boards, Arduino / LoRa boards

COURSE CONTENTS

Group A (any 4)

1. Programming of Raspberry Pi to control LEDs attached to the GPIO pins
2. Programming of Raspberry Pi to get feedback from a switch connected to the GPIO pins

3. Programming of Raspberry Pi to detect temperature using temperature sensor

4. Programming of Raspberry Pi to detect light intensity using photocell sensor
5. Programming of Raspberry Pi for Motion detection
6. Programming of Raspberry Pi for image detection

Group B (any 4)

1. Study of GSM system (Message transmission & Reception).
2. To study working of SIM card in GSM handset
3. Study of GPRS system
4. Study of Zig-bee for one application
5. Study of RFID system
6. Introduction to Python programming.
7. To study Arduino based LED switching using mobile
8. Temperature and humidity sensing using Arduino
9. LoRa Interfacing.

Savitribai Phule Pune University [SPPU]

B.Sc. (Chemistry)

(Three Years Integrated Degree Program)

Choice Based Credit System [CBCS]

2019 Pattern

Third Year Bachelors of Science

(T. Y. B. Sc.CHEMISTRY)

From
Academic Year 2021-22

Board of Studies in Chemistry

Savitribai Phule Pune University [SPPU]
Pune-411007

Structure of T. Y. B. Sc. Chemistry

(According to CBCS – 2019 Pattern of SPPU)

Semester	DSEC/SEC	Nature	Paper Code	Code and Title	Credits/Lectures
V	DSEC-I	Theory	CH-501	Physical Chemistry-I	Credit-2, 36 L
		Theory	CH-502	Analytical Chemistry-I	Credit-2, 36 L
		Practical	CH-503	Physical Chemistry Practical-I	Credit-2, 73 L
	DSEC-II	Theory	CH-504	Inorganic Chemistry-I	Credit-2, 36 L
		Theory	CH-505	Industrial Chemistry	Credit-2, 36 L
		Practical	CH-506	Inorganic Chemistry Practical-I	Credit-2, 73 L
	DSEC-III	Theory	CH-507	Organic Chemistry-I	Credit-2, 36 L
		Theory	CH-508	Chemistry of Biomolecules	Credit-2, 36 L
		Practical	CH-509	Organic Chemistry Practical-I	Credit-2, 73 L
	SEC- I	Theory	CH-510	**(A)** Introduction of Medicinal Chemistry **OR** **(B)** Polymer Chemistry	Credit-2, 36 L
	SEC- II	Theory	CH-511	**(A)** Environmental Chemistry **OR** **(B)** Chemo informatics	Credit-2, 36 L
VI	DSEC-IV	Theory	CH-601	Physical Chemistry-II	Credit-2, 36 L
		Theory	CH-602	Physical Chemistry -III	Credit-2, 36 L
		Practical	CH-603	Physical Chemistry Practical-II	Credit-2, 73 L
	DSEC-V	Theory	CH-604	Inorganic Chemistry-II	Credit-2, 36 L
		Theory	CH-605	Inorganic Chemistry-III	Credit-2, 36 L
		Practical	CH-606	Inorganic Chemistry Practical-II	Credit-2, 73 L
	DSEC-VI	Theory	CH-607	Organic Chemistry-II	Credit-2, 36 L
		Theory	CH-608	Organic Chemistry-III	Credit-2, 36 L
		Practical	CH-609	Organic Chemistry Practical-II	Credit-2, 73 L
	SEC III	Theory	CH-610	**(A)** Chemistry of Soil and Agrochemicals **OR** **(B)** Introduction of Forensic Chemistry	Credit-2, 36 L
	SEC IV	Theory	CH-611	**(A)** Analytical Chemistry-II **OR** **(B)** Chemistry of Cosmetics and Perfumes	Credit-2, 36 L

Important points:

i. Each credit is equivalent to 18 lectures of 50 minutes for theory courses and 36 lecture of 50 minutes for practical courses.
ii. There will be12 practical sessions per semester of 4 hours 20 minutes each.
iii. Total weeks for teaching and internal evaluation are15. Out of the 15 weeks, 12 weeks for teaching and 03 weeks for internal evaluation. (Theory as well as Practical).
iv. For more details refer to UG rules and regulations (CBCS for Science program under Science & Technology) on SPPU website.

Evaluation Pattern (As per CBCS rules, SPPU, 2019 Pattern)

1. Each theory and practical course carry 50 marks equivalent to 2 credits.
2. Each course will be evaluated with Continuous Internal Assessment (CIA) and University Assessment (UEX) mechanism.
3. Continuous internal assessment shall be of 15 marks (30%) while university Evaluation shall be of 35 marks (70%).
4. To pass each course, a student has to secure 40% mark in continuous assessment as well as university assessment i.e. minimum 6 marks in continuous assessment and 14 in university assessment in the respective course.
5. For Continuous internal assessment minimum two tests per paper must be organized, of which one must be written test of 10 marks.
6. Method of assessment for internal exams: written test, MCQ type test, Viva-Voce, Project, survey, field visits, tutorials, assignments, group discussion, etc. (on approval of the head of centre).
7. Theory - University Assessment Question Paper Pattern (According to CBCS - 2019 Pattern of SPPU) Note that in theory question paper weightage will be given to each topics equivalent to number of lectures assigned in the syllabus.

Preamble:

The syllabus of Chemistry for third year has been redesigned for **Choice Based Credit System** (**CBCS**: 2019 pattern) and to be implemented form academic year 2021-22. In CBCS pattern semester system has been adopted for B. Sc. degree programme. Different types of courses are introduced at degree level viz. **Discipline Specific Core Course (DSCC)**, **Ability Enhancement Compulsory Course (AECC)**, **Discipline Specific Elective Course (DSEC)** and **Skill Enhancement Course (SEC)**. DSCC courses has been introduced at FY/SY level and AECC courses at SY level. At TY level DSEC and SEC courses are to be introduced. Third year syllabus comprises of six theory and three practical courses of DSEC type and two theory SEC per semester.

Equivalence with Previous Syllabus (2013 Pattern)

2013 Pattern	2019 Pattern
Sem-III (T.Y.B.Sc.)	**Sem-V (T.Y.B.Sc.)**
Core courses	**Discipline Specific Elective Courses (DSEC)**
CH-331: Physical Chemistry	CH: 501: Physical Chemistry-I
CH-332: Inorganic Chemistry	CH: 504: Inorganic Chemistry-I
CH-333: Organic Chemistry	CH: 507: Organic Chemistry-I
CH-334: Analytical Chemistry	CH: 502: Analytical Chemistry-I
CH-335: Industrial Chemistry	CH: 505: Industrial Chemistry
CH-336: Optional course (Any one) A- Nuclear Chemistry, B- Polymer Chemistry C- Intro. To Biochemistry ,D- Env. And Green Chemistry, E- Agriculture Chemistry	CH:508: Chemistry of Biomolecules
----	**Skill Enhancement Courses (SEC)** CH:510 (A): Introduction of Medicinal Chemistry **OR** CH:510 (B): Polymer Chemistry
----	CH:511(A): Environmental Chemistry **OR** CH:511(B): Cheminformatics
Sem-IV (T.Y.B.Sc.)	**Sem-VI (T.Y.B.Sc.)**
Core courses	**Discipline Specific Elective Courses (DSEC)**
CH-341: Physical Chemistry	CH: 601: Physical Chemistry-II
CH-342: Inorganic Chemistry	CH: 604: Inorganic Chemistry-II
CH-343: Organic Chemistry	CH: 607: Organic Chemistry-II
CH-344: Analytical Chemistry	CH-602: Physical Chemistry -III
CH-345: Industrial Chemistry	CH: 605: Inorganic Chemistry-III
CH-346: Optional course (Any one) A- Nuclear Chemistry, B- Polymer Chemistry C- Intro. To Biochemistry, D- Env. And Green Chemistry, E- Dairy Chemistry	CH: 608: Organic Chemistry-III
	Skill Enhancement Courses (SEC) CH-610 (A): Chemistry of Soils and Agrochemicals **OR** CH-610 (B): Introduction of Forensic Chemistry
	CH-611 (A): Analytical Chemistry-II **OR** CH-611 (B): Chemistry of Cosmetics and Perfumes
CH-347: Physical Chemistry Practical	CH 503 and 603: Physical Chemistry Practical-I and II
CH-348: Inorganic Chemistry Practical	CH 506 and 606: Inorganic Chemistry Practical I and II
CH-349: Organic Chemistry Practical	CH 509 and 609: Organic Chemistry Practical-I and II

The Detailed Semester and Course Wise Syllabus as follows:

SEMESTER-V

DSEC-I: CH-501: Physical Chemistry- I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Quantum Chemistry	10
2	Investigation of Molecular structure	16
3	Photochemistry	10
	Total	**36**

1. Quantum Chemistry [10 L]

Introduction, de Broglie hypothesis, The Heisenberg's uncertainty principle, quantisation of energy, Operators, Schrodinger wave equation, well behaved function, Particle in a one-, two and three-dimensional box (no derivation), Physical interpretation of the ψ and ψ2, sketching of wave function and probability densities for 1D box, degeneracy, applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical

Expected learning Outcome:

After successfully completion, students will be able to:

1. Know historical of development of quantum mechanics in chemistry.
2. Understand and explain the differences between classical and quantum mechanics.
3. Understand the idea of wave function
4. Understanding of De Broglie hypothesis and the uncertainty principle
5. Understanding the operators: Position, momentum and energy
6. Solving Schrodinger equation for 1D, 2D and 3D model
7. Physical interpretation of the ψ and ψ2 and sketching the wave function
8. Applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical Problems

Reference books:

1) Principles of Physical Chemistry by Puri, Sharma, Pathania,; (Page No: 21-110)
2) Essential of Physical Chemistry, Bahl and Tuli (S. Chand).; (Page No: 50-58)

2. Investigation of Molecular structure [16 L]

Introduction: Molar refraction and molecular structure, Dipole moment and molecular structure, electromagnetic spectrum, energy of molecules, Types of molecular spectra.

Microwave Spectroscopy: Introduction, Classification of molecules on the basis of moment of Inertia, Rotational spectra of rigid diatomic molecules, relative intensities of spectral lines, effect of isotopic substitution on the rotational spectra, Determination of bond length and moment of inertia from rotational spectra, Problems

Infrared Spectroscopy: Introduction, Simple Harmonic oscillator, Modes of vibration, force constant, Vibrational spectrum of a diatomic molecule: Vibrational Energy expression, Allowed vibrational energies, zero-point energy, Selection rule, Vibrational energy level diagram with transitions, spectrum depiction, Vibration-rotation Spectra: Born-Oppenheimer approximation, Energy expression for vibrational rotor, Selection rules, Vibrational-rotational energy level diagram with transitions, Nature of vibrational spectra, P, Q and R branches of lines of the IR spectra, Problems

Raman Spectroscopy: Introduction, Classical and Quantum theory of Raman effect, Rayleigh, Stokes and anti-stokes lines, Pure rotational Raman spectra of linear diatomic molecules

Expected learning Outcome: After studying this chapter, the student will be able to:

1. Understand the term additive and constitutive properties.
2. Understand the term specific volume, molar volume and molar refraction.
3. Understand the meaning of electrical polarization of molecule, induced and orientation polarization.
4. Dipole moment and its experimental determination by temperature variation method.
5. Electromagnetic spectrum, Nature of wave and its characteristics such as wavelength, wave number, frequency and velocity, Energy level diagram,
6. Classification of molecules on the basis of moment of Inertia,
7. Rotational spectra of rigid diatomic molecules, selection rules, nature of spectral lines.
8. Simple Harmonic oscillator model, Born-Oppenheimer approximation. Vibrational spectra of diatomic molecules selection rules, nature of spectral lines.
9. Explain the difference between Rayleigh, Stokes and anti-Stokes lines in a Raman spectrum.
10. Justify the difference in intensity between Stokes and anti-Stokes lines.
11. Draw the Stokes and anti-Stokes lines in a Raman spectrum
12. Raman spectra: Concept of polarizability,
13. Pure rotational Raman spectra of diatomic molecules, Energy Expression, Selection rule, Rotational energy level diagram, Rotational Raman spectrum and Problems

Reference books:

1. Fundamentals of molecular spectroscopy by C.N. Banwell and E. M. McCash.

(Page No: 33-59, 60-75, 111-119)

2. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000.
(Page No: 413-455)

3. Photochemistry [10 L]

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grothus - Draper law ii) Stark-Einstein law, Quantum yield, Reasons for high and low quantum yield., Factors affecting Quantum yield, Experimental method for the determination of quantum yield, types of photochemical reactions - photosynthesis, photolysis, photocatalysis, photosensitization, Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Problems

Expected learning Outcome:

After studying this chapter, the student will be able to know and understand:

1. Difference between thermal and photochemical processes.
2. photochemical laws: Grothus - Draper law, Stark-Einstein law,
3. Quantum yield and reasons for high and low quantum yield,
4. factors affecting the quantum yield,
5. Experimental method for the determination of quantum yield
6. Photochemical reactions: photosynthesis, photolysis, photocatalysis, photosensitization
7. Various photochemical phenomena like fluorescence and phosphorescence, Chemiluminescence,
8. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).; (Page No: 1154-1178)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania,; (Page No: 1112-1135)
3. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000.
(Page No: 262-2810)

Additional Reference Books:

1. Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.
6. Quantum Chemistry by Donald A McQuarrie, Viva Student Edition

7. Quantum Chemistry by I. Levine.
8. Quantum Chemistry by R.K. Prasad

DSEC-I: CH-502: Analytical Chemistry- I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Gravimetry	09
2	Inorganic Qualitative Analysis	07
3	Thermal methods of analysis	06
4	Parameters of instrumental analysis	04
5	UV-Visible spectroscopy	10
	Total	**36**

1. Gravimetry (9 L)

Introduction to gravimetric analysis; Precipitation methods; The colloidal state; Supersaturation and precipitate formation; The purity of the precipitate: Co-precipitation; ; Conditions of precipitation; Precipitation from homogeneous solution; Washing the precipitate; Ignition of the precipitate: quantitative separations based upon precipitation methods: Fractional precipitation; Organic precipitants (8-hydroxyquinoline, DMG, Cupferron, Nitron, and Benzoin-alfa oxime, Anthanilic acid), Gravimetric Calculations—How Much Analyte is there (Ref-3)

Applications of Gravimetry: Determination of Al(III) by 8-hydroxyquoline, Determination of calcium as oxalate; Determination of potassium as potassium tetraphenylborate, Determination of phosphate as ammonium molybdophosphate, Numericals,

Key Reference-1: 417-428, 433-444, 446, 451, 464, 485; [Supplementary Ref-2: Pp-342 to 362]

2. Inorganic Qualitative Analysis (7 L)

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals. Ref-6

3. Thermal methods of analysis (6 L)

General discussion, Thermogravimetry, Experimental factors affecting TG analysis, Instruments for thermogravimetry, Applications: Thermogravimetric analysis of CaC_2O_4 H_2O, $CuSO_4$ $5H_2O$, Differential Thermal Analysis: Introduction, instrumentation for DTA and DSC, experimental and instrumental factors, applications: DTA of copper sulphate pentahydrate, Purity of

pharmaceutical by DSC, Key Reference-2: 503-522, [Supplementary reference, Ref-4: 884-890, Ref-1: 428-433]

3. Parameters of instrumental analysis (4 L)

Techniques, Methods, Procedures, and Protocols, Selecting an Analytical Method, Accuracy, Precision, Sensitivity, Selectivity, Robustness and Ruggedness, Scale of Operation, equipment, Time, and Cost, Making the Final Choice, Developing the Procedure, Calibration and Standardization, Sampling, Validation, Protocols, Key Reference -5: 35-48

4. UV-Visible spectroscopy (10 L)

Introduction, Theory of spectrophotometry and colorimetry-Beer's law, Application of Beer's Law, Spectrophotometry: Wavelength selection by prism and diffraction grating, Radiation source, cells, data presentation, single-beam spectrophotometer, Double-beam spectrophotometers, Choice solvent, general procedure for colorimetric estimation, simultaneous analysis, Applications: Estimation of metal ions from aqueous solution: Boron in steel, Chromium in steel with diphenyl carbazide reagent, ammonia in water, Chloride, Primary amine, Determination of phenol, spectrophotometric titration (example Cu(II) with EDTA), Determination of pKa value of indicator, Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method., Numericals Key Reference-2: 658-717 and Ref-1: 645-725

References:

Ref-1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

Ref-2: Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6th Ed, Pearson education

Ref-3: Analytical Chemistry by G. D. Christian, et al , Wiley, 6th Ed.

Ref-4: Principles of Instrumental Analysis: Holler, Skoog, Crouch 6th Ed. Thomson Publication

Ref-5: Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education

Ref-6: Vogel's Qualitative Inorganic Analysis, G. Svehla, Pearson, 7th Ed.

Course outcome: After completion of the course student should be able to

1. Define basic terms in gravimetry, spectrophotometry, qualitative analysis and parameters in instrumental analysis. Such as: Gravimetry, precipitation, solubility product, ionic product, common ion effect, precipitating agent, washing of ppt., drying and ignition of ppt., linearity range, detection limit, precision, accuracy, Sensitivity, Selectivity, Robustness and Ruggedness, electromagnetic radiations, spectrophotometry, Beers law, absorbance, transmittance, molar absorptivity, monochromator, wavelength of maximum absorbance,

metal ligand ration, qualitative analysis, group reagent, dry tests, wet test, confirmatory test, precipitation, thermogravimetry, thermogram, percent wt. loss, differential thermal analysis, etc.

2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration in particular analysis (gravimetry, spectrophotometry, thermogravimetry), reagent for particular analysis, reaction condition to convert analyte into measurable form, drying and ignition temperature for ppt in gravimetry, heating rate thermogravimetry, wavelength in spectrophotometry, group reagent, removal borate and phosphate in qualitative analysis, etc.
3. Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis.
4. Perform quantitative calculations depending upon equations student has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.
5. Discuss / Describe procedure for different types analyses included in the syllabus.
6. Select particular method of analysis if analyte sample is given to him.
7. Differentiate / distinguish / Compare among the different analytical terms, process and analytical methods.
8. Demonstrate theoretical principles with help of practical.
9. Design analytical procedure for given sample.
10. Apply whatever theoretical principles he has studied in theory during practical session in laboratory.

DSEC-I: CH-503: Physical Chemistry Practical - I [Credit -2, 73 L]

Total 12 experiments to be completed.

1. Refractometry: (any two)

1) To determine the specific refractivity's of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C.
2) To determine the molecular refractivity of the given liquids A, B, C and D.
3) To determine the molar refraction of homologues methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by -CH2 group.
4) Determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution

2. Spectrophotometry and Colorimetry (any three)

1) To titrate Cu^{2+} ions with EDTA photometrically.
2) To determine the indicator constant of methyl red indicator

3) To estimate of Fe^{3+} ions by thiocyanate method.
4) Cobalt by using R-nitroso salt method.
5) To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium calorimetrically.
6) Simultaneous determination of Cu^{2+} and Ni^{2+} ions by colorimetry/spectrophotometry method

3. Conductometry (any four)

1) Titration of a mixture of weak acid and strong acid with strong alkali.
2) To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
3) To determine the normality of citric acid in given fruit by titrating it against standard NaOH solution by conductometric method.
4) To determine $\lambda\infty$ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.
5) To estimate the amount of lead present in given solution of lead nitrate by conductometric titration with sodium sulphate.
6) To determine the relative strength of monochloro acetic acid and acetic acid conductometrically

4. Viscosity: (any one)

1. To determine the molecular weight of a high polymer by using solutions of different concentrations.
2. Determine the radius of glycerol molecule from viscosity measurement.

5. Photoflurometry

1. Analysis of Riboflavin from vitamin supplementary capsules / syrup / tablet sample by Photoflurometry

6. Table work

1. Analysis of the given vibration-rotation spectrum of HCl(g)

DSEC-II: CH-504: Inorganic Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Molecular Orbital Theory of Coordination Compounds	08
2	Inorganic Reaction Mechanism	06
3	Chemistry of transition elements	06
4	Chemistry of f-block elements	08
5	Metals, Semiconductors and Superconductors	08
	Total	**36**

1. Molecular Orbital Theory of Coordination Compounds (8L)

Electro-neutrality principle, multiple bonding (dπ-pπ and dπ-dπ), Nephelauxetic effect and Nephelauxetic series (Recapulation from VBT and CFT), Need and introduction of MOT, Assumptions, MO treatment to octahedral complexes with sigma bonding, Formation of MO's from metal orbitals and Composite Ligand Orbitals (CLO), MO correlation diagram for octahedral complexes with sigma bonding, effect of π bonding on MO correlation diagram, Charge transfer spectra, Advantages of MOT over VBT and CFT.

Aims and objective/Learning Outcomes: A student should know:

i. Explain electroneutrality principle and different types of pi bonding.
ii. Able to explain Nephelauxetic effect towards covalent bonding.
iii. Explain MOT of Octahedral complexes with sigma bonding.
iv. Able to explain Charge Transfer Spectra.
v. Able to compare the different approaches to bonding in Coordination compounds.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 4th Edition pp226-231
2. Physical Inorganic Chemistry A Coordination Chemistry Approach S. F. A. Kettle Springer-Verlag Berlin Heidelberg GmbH, 1996 pp 95-120
3. Theoretical Inorganic Chemistry by Day and Selvin (Relevant Pages)

2. Inorganic Reaction Mechanism (6L)

Basic concepts of stability and lability, stability constants, Factors affecting lability, chelate effect. Classification of inorganic reactions, ligand substitution reactions: Intimate and stoichiometric mechanism of ligand substitution. Substitution Reactions in Four Coordinated

square planar complexes: Trans effect and Trans effect series, applications of trans effect, stereochemistry of substitution.

[**Further reading:** Student should also read about the relation between kinetics and mechanism. Reaction mechanisms in complexes with C.N.4, 5 and 6]

Aims and objective: A student should know:

i. To understand about inert and labile complexes and stability of complexes in aqueous solutions
ii. Classification of reactions of coordination compounds
iii. The basic mechanisms of ligand substitution reactions.
iv. Substitution reactions of square planer complexes.
v. Tran's effect and applications of Trans effect
vi. Stereochemistry of mechanism
vii. Gain the knowledge of inorganic reaction mechanisms available in the literature to solve chemical problems.

References:

1. Inorganic Chemistry – Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter & R. L. Keiter, 4th Edn. Harper Collins College Publ. New York, Chapt.13, p.537-576, (1993).
2. Martin L. Tobe and John Burgess, Inorganic Reaction Mechanisms, Addison Wesley Longman Inc., 1999.
3. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Lamgford – Oxoford, 5th Edn., 1994, pp507-517.
4. Inorganic Chemistry - Messler and Tarr - Pearson Publishers pages 412-420, 434-440

3. Chemistry of Transition elements [6L]

Position in periodic table, electronic configuration, trends in properties w.r.t.(a) size of atoms and ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex formation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density, melting & boiling points. [Ref.-1]

Aims and objective: A student should know:

1. To know position of d-block elements in periodic table.
2. To know the general electronic configuration & electronic configuration of elements.
3. To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ability, color, magnetic properties, non-stoichiometry, density, melting point, boiling point.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th edition. Pages 859-863, 865-866,

4. Chemistry of f-block elements [8L]

Introduction of f-block elements- on the basis of electronic configurations, occurrence and reactivity, F-block elements as Lanthanide and Actinide series

I. Lanthanides:

Position in periodic table, Name and electronic configuration of lanthanides, Oxidation States, atomic and ionic radii, Lanthanide contraction, its causes and consequences on chemistry of Lanthanides and post lanthanide elements, Occurrence and separation: Bulk separation, Individual separation by modern methods *viz.,* Ion exchange and solvent extraction method, applications of lanthanides. [Reference-1]

II. Actinides:

Position in periodic table, names and their electronic configurations. IUPAC nomenclature system for super heavy elements, Oxidation States, Occurrence and general methods of preparation of transuranic elements *viz.,* Neutron Bombardment, Accelerated projectile bombardment and Heavy ion bombardment. Nuclear Fuels-Nuclear fission and fusion fuels, comparison between Lanthanides and Actinides. [Reference-1]

Aims and objective: A student should know:

1. The meaning of term f-block elements, Inner transition elements, lanthanides, actinides.
2. Electronic configuration of lanthanides and actinides.
3. Oxidation states of lanthanides and actinides and common oxidation states.
4. Separation lanthanides by modern methods.
5. Lanthanide contraction and effects of lanthanide contraction on post-lanthanides.
6. Use of lanthanide elements in different industries.
7. Transuranic elements.
8. Preparation methods of transuranic elements.
9. Nuclear fuels and their applications.
10. Why transuranic elements are called as the synthetic elements?
11. IUPAC nomenclature for super heavy elements with atomic no. 100 onwards.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th Edn. 874 – 875, 879-886, 891-893, 898-900.

5. Metals, Semiconductors and Superconductors [8L]

Introduction, Metallic bonding, Band theory in metals with respect to Na along with n (E) and N(E) diagrams, Electrical conductivity of metals (Na, Mg, Al), Valence electrons and conductivity of metals, Effect of temperature and impurity on electrical conductivity of metals,

Semiconductors, types of Semiconductors: I. Intrinsic II. Extrinsic, effect of temperature and impurity on semiconductivity, n & p type semiconductors ZnO and NiO, Superconductivity: Discovery, property, models, structure and superconductivity, low and high temperature superconductors, applications of superconductors.

Aims and Objectives: A student should be able –

1. The meaning of metal & semiconductor.
2. The difference between metal, semiconductor and insulator.
3. Metallic bond on the basis of band theory.
4. The energy band and energy curve.
5. Draw n (E) & N (E) curves.
6. Explain the electrical conductivity of metals with respect to valence electrons.
7. Explain the effect of temperature and impurity on conductivity of metals and semiconductors.
8. Intrinsic and extrinsic semiconductor.
9. The term valance band and conduction band.
10. n and p type of semiconductors.
11. Non-stoichiometry and semi conductivity.
12. Insulators on the basis of band theory.
13. The difference between Na, Mg, and Al in terms of valence electrons and conductivity.
14. Meaning of super conductors and their structure. o. Discovery and applications of superconductors.

References:

1. Solid State Chemistry: An Introduction, Lesley E. Smart, Elaine A. Moore, 3rd Edn. Relevant pages from Chapter 10, pp394-411
2. Solid State Chemistry and its Applications, Anthony R. West, Second Edition, Wiley 2014, PP 359-391
3. Chemistry by Raymond Chang - 5th edition (Related Pages)
4. New Guide to Modern Valence Theory by G.I. Brown - 3rdedition Pages 209-221

DSEC-II: CH-505: Industrial Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Modern Approach to Chemical Industry	06
2	Manufacture of Basic Chemicals	07
3	Sugar and Fermentation Industry	07
4	Soap and Detergents Industry	08
5	Dyes and Pigments	08
	Total	**36**

1. Modern Approach to Chemical Industry (6 L)

Introduction, basic requirements of chemical industries, chemical production, unit process and unit operations, Quality control and quality assurance, process control, research and development, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity and yield, copy-right act, patent act, trademarks.

Ref. No.-7, Relent pages, Ref. - 10: www.wikipedia.org/wiki/copyright_act_of1976/patent act/ trademark

Aims and Learning objectives: The students are expected to learn;

i. Importance of chemical industry,

ii. Meaning of the terms involved,

iii. Comparison between batch and continuous process,

iv. Knowledge of various industrial aspects

2 Manufacture of Basic Chemicals (7 L)

a) Ammonia: Manufacture of ammonia by modified Haber-Bosch process, Physico-chemical principles involved and uses of ammonia.

b) Nitric acid: Manufacture of nitric acid by Ostwald's process, Physico-chemical principles involved and uses of nitric acid.

c) Sulphuric acid: Manufacture of sulphuric acid by contact process, Physico-chemical principles involved and uses of sulphuric acid.

Reference No.-1: Page No. 731 to 761, 809 to 844, Reference-3: 1128-1175, 1253-1263

Aims and Learning objectives: The students are expected to learn

i. Concept of basic chemicals,

ii. Their uses and manufacturing process.

iii. They should also know the physico-chemical principals involved in manufacturing process

3. Sugar and Fermentation Industry (7 L)

a. Sugar: Introduction, manufacture of cane sugar, extraction of juice, purification of juice, sulfitation and carbonation, evaporation, crystallization, separations of crystals, drying refining, grades, recovery of sugar from molasses, by-product of sugar industry,

Reference No.-1: Page No.1208- 1218

b. Fermentation Industry: Introduction, importance, conditions favorable for fermentation, Characteristics of enzymes, short account of some fermentation processes, Alcohol beverages, Manufacture of beer, manufacture of sprit, manufacture of wines, manufacture of vinegar, manufacture of power alcohol, ethyl alcohol from molasses.

Reference No.-1: Page No. 1176-1184

Aims and Learning objectives: The students are expected to learn

Sugar Industry: The students are expected to learn

i. Importance of sugar industry,

ii. Manufacture of direct iii. Consumption (plantation white) sugar with flow diagram.

iii. Cane juice extraction by various methods,

iv. Clarification by processes like carbonation, vi. Sulphitation, vii. Phosphatation, etc.

v. Concentration of juice by using multiple effect evaporator system,

vi. Crystallization of sucrose by using vacuum pan.

Fermentation Industry- The students are expected to learn

i. Importance,

ii. Basic requirement of fermentation process,

iii. Manufacturing of ethyl alcohol by using molasses and fruit juice.

4. Soap and detergents (8 L)

(a) Soap: Soap and Fatty Acids: Introduction, Chemistry, Manufacturing Technology, Raw Materials, Functional Properties of Soap, Manufacturing Processes, Saponification Reactor, Cooling, Soap Separator, Soap Extraction, Centrifugation, Neutralization, Direct Neutralization, Carbonate Neutralization, Partial Neutralizing with Soda Ash, Carbon Dioxide Separation, Raw Material Dosing, Caustic Soda, Completion of Neutralizing with Caustic Soda, Neutralization Soap Viscosity,

Reference-5: 980-997, Reference-1: 1243 -1250

(b) Detergents: Synthetic Detergents: Introduction, Characteristic Features of Surfactants, Raw Materials for Surfactant Production, intermediates for Surfactant Production, Anionic Surfactants, Non-ionic Surfactants, Amphoteric Surfactants, Cationic Surfactants, Detergent Additives, Production of Synthetic Detergents, and Washing action of soap and detergents.

Reference-5: 1006-1029, Reference-1: 252 – 1279

Aims and Learning objectives: The students are expected to learn

i. Different types of soap products,

ii. Chemistry of soap.

iii. Raw materials required for soap manufacture

iv. Meaning of the term's Surfactants, Types of surfactants

v. Raw materials for detergents

vi. Detergent builders, additives

vi. Washing action of soap and detergents

5. Dyes and Pigments (8 L)

(a) Dyes: Introduction, qualities of good dye, Colour constituents (Chromophore, auxochrome), classification of dyes according to their application, Synthesis and uses of following dyes: Nitroso dye-martius yellow, Azo dyes-Methyl orange and aniline yellow, Triphenylmethane dye-Crystal violet, Phthalein dye - Phenolphthalein, Xanthane-Fluorescein, Antha-quinnoe-Alizarin and Indigo dyes - Indigo.

Reference -1: pp 1545-1595

(b) Pigments: Introduction, classification and general properties of pigments.

Inorganic pigments:

i) Zinc oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process)

ii) Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process),

Reference-9: 80-87, 97 to 109.

Aims and Learning objectives: The students are expected to learn

Dyes - Students should know about

i. Dyes: introduction,

ii. Dye intermediates,

iii. Structural features of a dye;

iv. Classification of dyes,

v. Synthesis, Structures, properties and applications of dyes

Pigments: Students should know about

i. Introduction,

ii. Classification and general properties of pigment

iii. Production processes of zinc oxide and iron oxide

References:

1. Industrial Chemistry, B. K. Sharma, Goel publishing House, 18th Ed. (2014)
2. Riegeal's Hand book of industrial chemistry, James A. kent. 9th Ed. CBS publishers
3. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.
4. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849
5. Handbook of Industrial Chemistry and Biotechnology, James A. Kent, Tilak V. Bommaraju, Scott D. Barnicki, Thirteenth Edition, Springer.
6. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
7. Shreeve's chemical process industries 5th Edition, G.T. Austin, TATA McGraw-Hill Edition, chemical engineering series
8. Industrial Chemistry, Part-II, R. K. Das, Kalyani Publisher, Second Ed.
9. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.

www.wikipedia.org/wiki/copyright_act_of1976 , www.wikipedia.org/wiki/patentact and www.wikipedia.org/wiki/trademark

Industrial visit:

Visit to any one of the Chemical / Pharmaceutical / Polymer / Research Institutes / Sugar Factories / waste water treatment plant, etc. is essential and a systematic report is to be submitted by the student to the Department of Chemistry.

DSEC-II: CH-506: Inorganic Chemistry Practical - I [Credit -2, 73 L]

Total 12 experiments to be completed.

A. Gravimetric estimations (Any 3)

1. Gravimetric estimation of Fe as Fe2O3. Ref-1: 457
2. Gravimetric estimation of Ba as BaSO4 using homogeneous precipitation method. Ref-1: 448
3. Gravimetric estimation of Nickel as Ni – DMG. Ref-1: 462
4. Analysis of sodium bicarbonate from mixture by thermal decomposition method. Ref.-6
5. Determination of water of crystallization by thermal decomposition. Reference-5
6. Analysis of Food/Pharmaceutical sample for ash and sulphated ash example-Aspirin, Ref. -2.

B. Inorganic preparations (Any 3) (Ref-7, 8, 9)

Preparation of inorganic complexes and spot tests for metal ions and ligands:

1. Preparation of hexamminenickel(II) chloride, $[Ni(NH_3)_6]Cl_2$.
2. Preparation of Potassium trioxalatoferrate(III), $K_3[Fe(C_2O_4)_3]$.
3. Preparation of Manganese (III) acetylacetonate, $[Mn(acac)_3]$.
4. Preparation of tris(glycinato)nickelate(II), $[Ni(gly)_3]^-$
5. Preparation of Potassium dioxalatocuprate(II),$[Cu(C_2O_4)_2]^{2-}$.

C. Inorganic Qualitative Analysis (6 Expts.)

1. Inorganic Qualitative analysis (5 mixtures) [1 simple water soluble mixture, 2 mixtures containing borates and 2 mixtures containing phosphates]

(*DST manual green chemistry monograph procedure must be followed strictly*) Ref.-4

2. Limit test for iron, chloride and sulphate from pharmaceutical raw materials. Ref.-2; pp - 220

OR

2. Qualitative and confirmatory tests of inorganic toxicants of any four ions (Borate, copper, hypochlorite or nitrate or nitrite, Sb or Bi, Iodate, H_2O_2). Reference-3

References:

1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

2: Indian Pharmacoepia, Vol-2; 2007

3: Basics of Analytical toxicology, World Health Organization

4: Green Chem - [PDF Document] – FDOCUMENTS; (https://fdocuments.in/document/green-chem.html)

5:https://www.studocu.com/ec/document/universidad-de-investigacion-de-tecnologia-experimental-yachay/fisica-matematica/otros/the-gravimetric-analysis-of-barium-chloride-hydrate/8364963/view

6: https://effectiveness.lahc.edu/academic_affairs/sfcs/chemistry/Shared%20Documents/Decomposing%20Baking%20Soda.pdf

7: Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horword Publishing, Chichester) 1999.

8: Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House

9: Journal of chemical education: Synthesis of cis- $Cu(gly)_2$ Trans- $Cu(gly)_2$ and cis-ni(gly)$2H_2O$ and their characterization using thermal and spectroscopic technique – a Capstone laboratory experiment.

Structure of Practical Examination [35 Marks; Time: 3 hours]

Q1. Gravimetric estimation/Inorganic preparation/Inorganic Qualitative analysis…. *30 M*

Q2. Viva-Voce ……. *05 M*

DSEC-III: CH-507: Organic Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Polynuclear and Heteronuclear Aromatic Compounds	08
2	Active Methylene Compounds	05
3	Rearrangement Reactions	12
4	Elimination reactions	11
	Total	**36**

1. Polynuclear and Heteronuclear Aromatic Compounds [08 L]

Introduction, Classification of aromatic compounds, Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine. Ref.1: Pages 759 – 779. Ref.3: Pages 952 – 962. 2.

2. Active Methylene Compounds [05 L]

Definition, Preparation of Ethylacetoacetate and Synthetic uses of ethylacetoacetate Preparation of Diethyl malonate and Synthetic uses of diethyl malonate, (preparation of non-heteromolecules having upto 6 carbon). Ref.1: Pages 864 – 875. Ref.3: Pages 859 – 874. Ref.6: Pp 206 – 213.

3. Rearrangement Reactions [12 L]

Introduction, Types of rearrangement, Types of reactive intermediate involved in different rearrangements, Rearrangement – Beckmann, Baeyer-Villiger, Favorskii, Curtius, Lossen, Schmidt and Pinacol-Pinacolone with mechanism. Electrocyclic Rearrangements- Claisen, Cope and Mc-Lafferty rearrangements with mechanism. Ref.4: Pages 618-656. Ref.7: Pages 89-94, 105-107, 112-114, 122-125, 158-161. Ref.10: Pages 130-132.

4. Elimination reactions [11 L]

Introduction; Types of eliminations-1,1; 1,2 elimination, Mechanism with evidences of E1and E2, E1cB reactions, stereochemistry of E1 and E2 elimination, Orientations and reactivity in E1 and E2 elimination- Hoffmann and Saytzeff's orientation, Factors affecting the reactivity- effect of structure, attacking base and leaving groups. Ref.1: Pages 305-326. Ref. 3: Pages 260-265. Ref.4: Pages 472-496. Ref.6: Pages 188-194.

References

1) R.T. Morrison & R.N. Boyd: Organic Chemistry, 7th edition, Prentice Hall.

2) Organic Chemistry: Clayden, Greeves, Wothers, Warren, Oxford Press.

3) Organic Chemistry: Graham Solomans

4) E. S. Gould: Mechanism and Structure in Organic Chemistry

5) Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman

6) I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.

7) S. N. Sanyal: Reactions, Rearrangements and Reagents

8) Eliel: Stereochemistry of Organic Compounds, Tata Mc Graw Hill, 1989

9) D. Nasipuri: Stereochemistry of Organic Compounds- Principles and Applications, New Age International Publishers, 3rd edition.

10) Jagdamba Singh, Jaya Singh: Photochemistry and Pericyclic reactions.3rd edition

Learning Outcomes

Chapter 1 Polynuclear and Heteronuclear Aromatic Compounds: After studying the polynuclear and heteronuclear aromatic compounds, students will able to

1. Define and classify polynuclear and hetreonuclear aromatic hydrocarbons.
2. Write the structure, synthesis of polynuclear and hetreonuclear aromatic hydrocarbons.
3. Understand the reactions and mechanisms
4. Explain the reactivity of polynuclear and hetreonuclear aromatic hydrocarbons.
5. Describe the synthesis of chemical reactions of polynuclear and hetreonuclear aromatic Hydrocarbons.

Chapter 2 Active Methylene Compounds : Students should be able to understand

1. Meaning of active methylene group
2. Reactivity of methylene group,
3. Synthetic applications ethyl acetoacetate and malonic ester
4. To predict product with panning or supply the reagent/s for these reactions

Chapter 3 Molecular Rearrangements Students will study

1. What is rearrangement reaction?
2. Different types of intermediate in rearrangement reactions?
3. To write the mechanism of some named rearrangement reactions and their applications 4. Electrocyclic rearrangement with their mechanisms Chapter

Chapter 4 Elimination Reactions: Students should be familiar with

1. 1,1 and 1,2 elimination
2. E1, E2 and E1cB mechanism with evidences of these reactions 4
3. Understand stereochemistry by using models and learn reactivity of geometrical isomers
4. Orientation and reactivity in E1 and E2 elimination
5. Hoffmann and Saytzeff's Orientation
6. Effect of factors on the rate elimination reactions

DSEC-III: CH-508: Chemistry of Biomolecules [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to molecular logic of life	03
2	Carbohydrates	07
3	Lipids	06
4	Amino acids and Proteins	08
5	Enzymes	06
6	Hormones	06
	Total	**36**

1. Introduction to molecular logic of life. (3L)

Unicellular and multicellular organisms, prokaryotes and eukaryotes. List of cell organelles and its functions. Molecules that constitute the organisation of cell and its organelles. types of bonds in biomolecules

2. Carbohydrates (7L)

Introduction, classification of carbohydrates, their structures and biological significance. Concept of anomers, epimers, reducing and non-reducing sugars, mutarotation, inversion. Reactions of glucose with acid, base, phenyl hydrazine, oxidizing agents, reducing agents and its significance, Glycosidic bonds.

3. Lipids (6L)

Introduction, classification of lipids, their structures and biological significance. Reactions of Lipids-Saponification Hydrolysis, emulsification, oxidation. Concept of saponification number, acid number, iodine number and their significance. Rancidity. Types of Lipoproteins and their significance. Blood group substances.

4. Amino acids and Proteins (8L)

Amino acids: classification of amino acids. Cocept of ampholytes, isoelectric pH, zwitter ions, titration curve of glycine. Reactions of amino acid with Ninhydrin, Sanger's, Dansyl chloride, Dabsyl chloride and Edmann's reagents and their significance. Peptide bond and its features. **Proteins:** Classification based on function, nutrition and composition. Structural organization of proteins- primary, secondary, tertiary and quaternary structures.

5. Enzymes (6L)

Classification of enzymes. Features of active site. ES complex formation, Enzyme specificity, Factors affecting enzyme activity. Basics of Enzyme kinetics. MM and LB equation and

Significance of Km. Types of Enzyme inhibitions. Concept of Conjugated enzymes- Holoenzyme, Apoenzyme, prosthetic groups. Coenzymes of vitamins. Industrial applications of enzymes.

6. Hormones (6L)

Introduction to endocrine glands and their hormones. Biochemical nature of hormones, Mechanism of action of lipophilic and hydrophilic hormones.

References

1. Lehninger's Principles of Biochemistry, by Nelson and Cox Macmillan Publisher 4th Edn.
2. Biochemistry by U. Satyanarayana
3. Harper's Illustrated Biochemistry, 26th Edition
4. Biophysical techniques by Upadhyay and Nath, 3rd revised edition.
5. Organic Chemistry, Morrison, R. T. & Boyd, R. N.
6. Organic Chemistry (Volume 1) Finar, I. L.
7. Organic Chemistry (Volume 2) Finar, I. L.

Learning Outcome:

1. **Introduction to molecular logic of life.** The student will understanding of Cell types, Difference between a bacterial cell, Plant cell and animal cell. Biological composition and organization of cell membrane, structure and function of various cell organelles of plant and animal cell. Concepts of biomolecules, Bonds that link monomeric units to form macromolecules
2. **Carbohydrates:** The student will understand the types of carbohydrates and their biochemical significance in living organisms, structure of carbohydrates and reactions of carbohydrates with Glucose as example. Properties of carbohydrates.
3. **Lipids:** The student needs to know the types of lipids with examples, structure of lipids, properties of lipids
4. **Amino acids and proteins:** The student will understand the structure and types of amino acids. Reactions of amino acids. Properties of amino acids. Peptide bond formation. Types of proteins. Structural features in proteins. Effect of pH on structure of amino acid, Determination of N and C terminus of peptide chain.
5. **Enzymes:** The student know the classes of enzymes with subclasses and examples. Enzyme specificity, Equations of enzyme kinetics Km and its significance, features of various types of enzyme inhibitions, industrial applications of enzymes.

6. **Hormones:** Basic concepts of Endocrinology. Types of Endocrine glands and their hormones. Biochemical nature of hormones. Mechanism of action of lipophilic and hydrophilic hormones.

DSEC-III: CH-509: Organic Chemistry Practical-I [Credit -2, 73 L]

Total 12 Experiments to be performed

A) Separation of Binary Mixtures and Qualitative Analysis (Any Six)

a) Solid-Solid (3 Mixtures) b) Solid-Liquid (2 Mixtures) c) Liquid-Liquid (1 Mixture) At least one mixture from each of the following should be given-Acid-Base, Acid- Phenol, AcidNeutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral- Neutral. (Solid-solid mixtures must be insoluble in water)

B) Preparations

a) Green Chemistry Preparations (Any Two)

1. Preparation of dibenzalpropanone from benzaldehyde and acetone using $LiOH.H_2O/NaOH$
2. Nitration of phenol or substituted phenols using $CaNO_3$.
3. Bromination of acetamide using ferric ammonium nitrate and KBr in aqueous medium.

b) Organic Preparations (Any Two)

1. Preparation of 1, 4- dihydropyrimidinone from ethyl acetoacetate, benzaldehyde and urea using oxalic acid as catalyst.
2. Preparation p-Iodonitrobenzene from p-Nitroaniline by Sandmeyer Reaction
3. Preparation P-chloro benzoic acid and p-chloro benzyl alcohol from p-chloro benzaldehyde.

C) Preparations of Organic Derivative (Any Two)

1. Amide derivative of Carboxylic acid
2. Glucosazone derivative of Glucose
3. Paracetamol from p-Aminophenol

Imp. Note: At the time of practical examination candidate should perform complete analysis of one binary mixture OR One preparation and one preparation of organic derivative.

• To develop skills required in chemistry such as the appropriate handling of apparatus and chemicals.

• The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.

• To expose the students to an extent of experimental techniques using modern instrumentation.

• The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes:

A) Separation of Binary Mixtures and Qualitative Analysis The students will be able to

1. Perform the quantitative chemical analysis of binary mixture, explain principles behind it.
2. Separate, purify and analyse binary water insoluble mixture.
3. Separate, purify and analyse binary water-soluble mixture.
4. Understand the techniques involving drying and recrystallization by various method.
5. Familiarize the test involving identification of special elements.
6. Learn the confirmatory test for various functional groups.

B) Preparations The students will be able to

1. Systematic working skill in laboratory will be imparted in student.
2. Learn the basic principles of green and sustainable chemistry.
3. Synthesis of various organic compounds through greener approach.
4. Do and understand stoichiometric calculations and relate them to green process metrics.
5. Learn alternative solvent media and energy sources for chemical processes.
6. Learn the preparations of derivative various functional groups aspects of electrical experiments.
7. Understand the techniques involving drying and recrystallization by various method
8. Expertise the various techniques of preparation and analysis of organic substances
9. Understand principle of Thin Layer Chromatographic techniques.
10. Understand the purification technique used in organic chemistry.

SEC-I: CH-510: Skills Enhancing Course-I [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-510 (A) : Introduction to Medicinal Chemistry

Chapter No.	Title	Number of Lectures
1	An Introduction to Drugs, their Action and Immunobiologicals	08
2	Bio-physicochemical Properties in Drug Action and Design	08
3	Drugs for Infectious Diseases	12
4	Drugs for Non -infectious Diseases	08
	Total	**36**

1. An Introduction to Drugs, their Action and Immunobiologicals (8L)

A. Introduction, Need of new drugs, Historical background of drug discovery and design, Sources of drugs, Classification of drugs, Introduction to drug action

(***Ref.1 Pages 37-53, Ref.2 Pages 4-11, Ref.4 Pages 4-9***)

B. Immunobiologicals: Vaccines: Introduction, Methods of vaccine production: Inactivated pathogens, Live/Attenuated Pathogens and Cellular Antigen from a pathogen, SARS-CoV-19

(***Ref.3 Pages 165-168, Ref.9, Ref.10***)

2. Bio-physicochemical Properties in Drug Action and Design (8L)

Introduction, Acidity/Basicity, Solubility, Ionization, Hydrophobic and hydrophilic properties, Lipinski Rule, **Terminology in Medicinal Chemistry:** Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, antimetabolites and therapeutic index. Importance of stereochemistry in drug action (Example: Ibuprofen), Concept of rational drug design: Structure activity relationship, Drug-receptor understanding

(***Ref.1 Pages 57-75, 95-96 Ref.2 Pages 189-274, 384-392, Ref.4 Pages 29-61***)

3. Drugs for Infectious Diseases (12L)

Introduction, Structures, Mode of Action and Applications**:**

A. Antimicrobial Agents: Classification on i) Type of action: Bacteriostatic and Bactericidal ii) Source (Natural, Synthetic and Semisynthetic) iii) Spectrum of activity: Narrow and Broad Spectrum iv) Chemical structure: β-lactams (Penicillin), Macrolides (Azithromycin), Sulphonamides (Sulfadiazine), and Tetracyclins (Chlortetracycline)

B. Anti-fungal and anti-viral agents: Example: Amphotericin-B, Acyclovir

(***Ref.1 Pages 131-157, Ref.2 Pages 413-472, Ref.3 Pages 258-308, Ref.4 Pages 191-228***)

4. Drugs for Non-infectious diseases (8L)

Introduction, Structures, Mode of Action, and Applications**:**

A. i) Anti-inflammatory and Analgesic Agents: Example: Aspirin, Paracetamol, and Ibuprofen, **ii) Psychoactive Agents:** Sedatives and Hypnotics: Example: Benzodiazepines,

B. Metallodrugs as Chemotherapeutic Agents: Examples: Aluminium based antacids, Salvarsan, Cis Platin, and Transition Metal Complexes

(***Ref.3 Pp 443-457, 509-515,637-647, 776-792, Ref. 5, Ref.6, Ref.7, Ref. 8 Pp.69-70,481-491***)

References:

1. Fundamentals of Medicinal Chemistry by Gareth Thomas, University of Portsmouth, UK.
2. An Introduction to Medicinal Chemistry, Patrick, G. Oxford. University Press (Vth Edition).
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical, Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale.
4. Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke, William O. Foye (VIIth Edition), Kluwer publication.

5. Medicinal chemistry, fourth edition, Ashutosh Kar (2007).
6. Metallodrugs in Medicinal Inorganic Chemistry Katja Dralle Mjos and Chris Orvig, Chem. Rev. 2014, 114, 4540-4563, http://dx.doi.org/10.1021/cr400460s
7. Metallodrugs are unique: opportunities and challenges of discovery and development, E. J. Anthony et.al. Chem. Sci., 2020, 11, 12888, http://dx.doi.org/10.1039/d0sc04082g.
8. Metallo-therapeutic Drugs And Metal-Based Diagnostic Agents by Marcel Gielen and Edward R.T. Tiekink
9. Research and Development on Therapeutic Agents and Vaccines for COVID-19 and Related Human Coronavirus Diseases, Cynthia Liu et al., ACS Cent. Sci. 2020, 6, 315−331, http://dx.doi.org/10.1021/acscentsci.0c00272
10. A comprehensive overview of vaccines developed for pandemic viral pathogens over the past two decades including those in clinical trials for the current novel SARS-CoV-2, Kannan Damodharan et al., RSC Adv., 2021, 11, 20006–20035,http://dx.doi.org/10.1039/d0ra09668g

Learning Outcomes:

Upon completion of the course the student shall be able to understand,

1. The basics of medicinal chemistry, biophysical properties, overview of basic concepts of traditional systems of medicine.
2. Over view of the overall process of drug discovery, and the role played by medicinal chemistry in this process.
3. Biological activity parameters and importance of stereochemistry of drugs and receptors.
4. Knowledge of mechanism of action of drugs belonging to the classes of infectious and non-infectious diseases.
5. Enhancement of practical skills in synthesis, purification and analysis.

Additional Study Material: NPTEL Video lecture on Medicinal Chemistry:

1. https://youtu.be/UHEXXGiegd0 ;
2. https://youtu.be/rVN_HybZ-Vk
3. https://youtu.be/-fCXLW-jF2o
4. https://youtu.be/n5C-peu54Wk
5. https://youtu.be/0wx4hep1low
6. https://youtu.be/9lWrNuUzP4A
7. https://youtu.be/84-q3SAVEQk

CH-510 (B) : Polymer Chemistry

Chapter No	Topic	Number of lectures
1	Introduction and history of polymeric materials	6
2	Polymerization Chemistry	12
3	Molecular weight of Polymers	6
4	Important Polymers	12
	Total	**36**

1. Introduction and history of polymeric materials: (6 L)

Brief history, Basic terms- monomer, polymer, polymerisation, degree of polymerisation, functionality. Different schemes of classification of polymers, polymer nomenclature, molecular forces and chemical bonding in polymers, glass transition temperature of polymer.

Ref. 1: Pages 1-20, 150

Ref. 2: Pages 1-16

Ref. 5, 7 & 8 Relevant Pages

2. Polymerization Chemistry (12 L)

Classification of polymerization processes, mechanism of- step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Polymerization techniques-bulk, solution, suspension, emulsion and interfacial condensation.

Ref. 1: Pages 20-58, 71-79

Ref. 2: Pages 25-32, 49-56, 82-86, 88-94, 126-132

Ref. 3 & 4 Relevant Pages

3. Molecular weight of Polymers (6 L)

Average molecular weight of polymer, Number average molecular weight (M_n), Weight average molecular weight (M_w), Number average molecular weight by end group analysis, Viscosity average molecular weight by viscometric method, klMolecular weight distribution and its significance, polydispersity index.

Ref. 1: Pages 86-98, 402-409

Ref. 2 & 4: Relevant Pages

4. Important Polymers: (12 L)

Brief introduction to preparation, structure, properties and application of the following polymers: polyethylene, polystyrene, polyvinyl chloride, polyvinyl alcohol, polymethyl methacrylate, polytetrafluoroethylene, polyamides, polyesters, phenol formaldehyde resins (Bakelite, Novolac), silicone polymers, polyisoprene, conducting Polymers.

Ref. 1: Pages 215-255

Ref. 3, 4 & 6 Relevant Pages

Course Outcome: The students are expected to learn the following aspects of Polymer Chemistry:

1) History of polymers.

2) Difference between simple compounds and polymer.

3) Names of polymers.

4) Various ways of nomenclature.

5) Difference between natural, synthetic, organic and inorganic polymers.

6) Terms-Monomer, Polymer, Polymerization, Degree of polymerization, Functionality, Number average, Weight average molecular weight.

7) Mechanisms of polymerization.

8) Polymerization techniques.

9) Uses & properties of polymers.

10) Role of polymer industry in the economy.

11) Advantages of polymers.

Reference Books:

1. Polymer Science by V.R. Gowarikar, N.V.Vishvanathan, JaydevShreedhar New Age International Ltd. Publisher 1996. (Reprint 2012)
2. Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication John Wiley& Sons New York 1984. (Reprint 2008)
3. Introductory Polymer Chemistry by G.S.Misra New Age International (P) Ltd. Publisher 1996.
4. Polymer Chemistry by Charles E. Carraher (Jr.), 6th Edn, (First Indian Print 2005), New York- Basel.
5. Principle of Polymer Science by P. Bahadur, N.V. Sastry, 2nd Edn, Narosa Publishing House.
6. Polymer Chemistry by Ayodhya Singh, 2008, Published by Campus Book International, New Delhi.
7. Organic Polymer Chemistry by Jagdamba Singh, R.C. Dubey, 4th Edn, 2012.
8. Principles of Polymerisation by George Odian3rd Edn. John Wiley & Sons New York.

SEC-II: CH-511: Skills Enhancing Course-II [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-511 (A) : Environmental Chemistry

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Concepts and Scope of Environmental Chemistry	06
2	Hydrosphere and Water Pollution	10
3	Analytical Techniques in water Analysis	10
4	Water pollution and treatment methods	10
	Total	**36**

1: Concepts and Scope of Environmental Chemistry (06L)

Introduction, Environmental Pollution and Classification, Units of concentration, Segments of Environment, Biogeochemical cycles of C, N, P, S and O system

Reference: 1, 2, 3

Aims and objectives: -Students should know:

i. Importance and conservation of environment.

ii. Importance of biogeochemical cycles

2: Hydrosphere and Water Pollution (10L)

Water resources, Hydrological Cycle: stages of hydrological cycle and chemical composition of water bodies, Microbially mediated aquatic reactions, Classification of water pollutants

Organic and Inorganic pollutants, Sewage and Domestic waste, Sediments, Detergents, Pesticides, Eutrophication, Sampling and monitoring water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

Reference: 1 Page no -47-62,

Aims and Objectives:- Students should know:

i. Water resources

ii. Hydrological Cycle

iii. Organic and inorganic pollutants

iv. Water quality parameters

3. Analytical Techniques in water Analysis (10 L)

Water quality parameters and standards, domestic water quality parameters, surface water, sampling, preservation, Monitoring techniques and methodology (pH, conductance, DO, ammonia, nitrate and nitrite, Cl, F, CN, Sulfide, sulphate, phosphate, total hardness, boron, metals and metalloids- As, Cd,

Cr, Cu, Fe, Pb, Mn, Hg (Exclude polarographic and AAS methods), COD, BOD, TOC, phenols, pesticides, surfactants, tannis and lignins, E. Coli, Case studies of water pollution.

Ref-1: 225-278

4. Water pollution and treatment methods (10 L)

Water pollutants, Eutrophication, Waste water treatment (domestic waste water, aerobic treatment, anaerobic treatment, upflow aerobic sludge bed, industrial waste water treatment, drinking water supplies, Trace elements in water, chemical speciation (Cu, Pb, Hg, As, Se, Cr)

Ref-1: 167-225

Reference-1: Environmental Chemistry – A. K. De, Third Edition (Wiley)

Additional References:

1. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
2. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
3. Environmental Chemistry – H. Kaur 2nd Edition 2007, Pragati Prakashan, Meerut, India
4. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
5. Basic Concepts of Analytical Chemistry: S. M. Khopkar, Wiley Eastern (1995)

CH-511 (B) : Cheminformatics

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to Cheminformatics	02
2	Representation of Molecules and Chemical Reactions	10
3	Searching Chemical Structures	06
4	Applications of Cheminformatics	18
	Total	**36**

1. Introduction to Cheminformatics [02L]

1.1. History and progression of cheminformatics

1.2. Significance of cheminformatics

1.3. Prospects of cheminformatics and Molecular Modelling

Learning Outcomes:

1. Students should understand the significance of cheminformatics in the modern practices of chemical science
2. Students should learn the necessity of cheminformatics in chemical science

Ref. 2. (Page no. 4-11 and relevant pages)

2. Representation of Molecules and Chemical Reactions: [10L]

2.1. Nomenclature

2.2. Different types of notations

2.3. Canonical representation of chemical structure, SMILES notation

2.4. 2D representation of chemical structure; Graph Theory, Connection tables and linear notations, Matrix representations

2.5. 3D chemical structure representation and molecular structure file formats; Molfiles, Sdfiles and Pdbfiles

2.6. 3D molecular structure visualization

2.7. Chemical Libraries (Pubchem, ChEMBL, DrugBank and Zinc) and online Available cheminformatics toolkits

2.8. Molecular properties calculations; electronic effects, Reaction classification

Learning Outcomes:

1. Students should learn the basic concepts about these representation methods.
2. Students should understand the significance of different representation methods for their specific applications.
3. Students should able to identify these representation methods with understanding.
4. Students should able to read these representation methods for basic examples.

Ref. 1. (Page no. 1-74, 183-201 and relevant pages)

Ref. 2. (Page no. 15-51, 92-96, 169-197 and relevant pages)

3. Searching Chemical Structures: **[06L]**

3.1. Basic ideas about the Full structure search, Sub-structure search

3.2. Basics of similarity and diversity search; Tanimoto, Dice, Cosine coefficient and Euclidean distance

3.3. Basics of three dimensional search methods

3.4. Basics of computation of physical and chemical data and structure descriptors.

Learning Outcomes:

1. Students should learn the basic concepts of referencing
2. Students should understand the significance of structural data in the process of referencing
3. Students should able to correlate the necessity of input methods and the expected outcomes for the set of chemicals
4. Students should able to understand data interpretation using these methods for basic or representative molecules.

Ref. 1. (Page no. 141-158 and relevant pages)

Ref. 2. (Page no. 291-313, 320-431 and relevant pages)

Ref. 3. (Page no. 39-50, 317-371 and relevant pages)

4: Applications of Cheminformatics: [18 L]

4.1. Prediction of Properties of Compounds: Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity

4.2. Predictive Methods for Organic Spectral Data Simulation: Spectra prediction methods and tools, open source and propriety tools, spectra viewer programs, Structure-Spectra correlations

4.3. Introduction to computer aided drug design: Computer Assisted Synthesis Design; Target Identification and Validation; Lead Finding and Optimization; Combinatorial library design, Virtual screening, Molecular docking and Molecular Dynamics simulation. Pharmacophore modeling; Ligand-Based and Structure Based virtual screening, Drug likeness properties, Protein Ligand Interaction Profile (PLIP) analysis and its application in drug discovery process

4.4. Machine Learning Methods in Cheminformatics

4.5. Introduction to Cheminformatics Softwares: Basic operational principle and applications of MarvinSketch, Discovery Studio, Gaussian, GOLD, Schrodinger, Expert protein Analysis System (Expasy) online server

Learning Outcomes:

1. Students should learn the basic idea about how to apply cheminformatics tool for variety of applications.
2. Students should understand the significance of database for the specific purpose of application.
3. Students should able to correlate the content of data with the possible applications for the set of chemicals.
4. Students should get aware with the principle and the basic operational methods of well-practiced software used in the data interpretation in cheminformatics.
5. Students should learn the basic concepts of Machine Learning and Artificial intelligence

Ref. 1. (Page no. 75-97 and relevant pages)

Ref. 2. (Page no. 487-542, 567-616 and relevant pages)

Ref. 3. (Page no. 10-15, 93-129, 133-192, 375-406 and relevant pages)

Reference Books:

1. Andrew R. Leach and Valerie, J. Gillette (2007) An introduction to Chemoinformatics. Springer: The Netherlands.
2. Gasteiger, J. and Engel, T. (2003) Chemoinformatics: A text-book. Wiley-VCH.
3. Muthukumarasamy Karthikeyan and Renu Vyas (2014) Practical Chemoinformatics, Springer

Semester-VI

DSEC-IV: CH-601 : Physical Chemistry-II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Electrochemical Cells	16
2	Crystal structure	10
3	Nuclear Chemistry	10
	Total	**36**

1. Electrochemical Cells [16 L]

Electrochemical cells, reversible and irreversible cells with examples, The e.m.f. of electrochemical cell and its measurement, The Weston standard cell, Reference electrodes: The primary reference electrode and Secondary reference electrodes, The Nernst equation for E.M.F. of a cell. Types of reversible electrodes, the sign convention for electrode potentials, Thermodynamics of reversible cells and reversible electrodes, E.M.F. and equilibrium constant of cell reaction, Electrochemical series, Types of concentration cells, liquid junction potential, salt bridge, Applications of emf measurements: 1. Determination of pH of a solution by using hydrogen electrode, quinhydrone electrode and glass electrodes 2. Potentiometric titrations: i) Acid-base titrations, (ii) Redox titrations. (iii) Precipitation titration, Batteries: Primary and Secondary batteries, applications for Secondary Batteries, Fuel Cells: Types of fuel cells, advantages, disadvantages of fuels cells, comparison of battery Vs fuel cell

Expected learning Outcomes:

After studying this chapter, the student will be able to know and understand:

1. Electrochemical cells: Explanation of Daniell cell, Conventions to represent electrochemical cells
2. Thermodynamic conditions of reversible cell, Explanations of reversible and irreversible electrochemical cell with suitable example,
3. EMF of electrochemical cell and its measurement.
4. The Weston standard cell
5. The primary reference electrode: The standard hydrogen electrode (SHE) with reference to diagram, Construction, representation, working and limitation,
6. Secondary reference electrodes: (a) The calomel electrode, (b) The glass electrode (c) The silver-silver chloride electrode. Understanding of these electrodes with reference to diagram, representation, Construction, working

7. Nernst Equation for theoretical determination of EMF
8. Types of Reversible electrodes: Metal-metal ion electrodes, Amalgam electrodes, Gas electrodes, Metal-metal insoluble salt electrodes, Oxidation-reduction electrodes with respect to examples, diagram, representation, construction, working (electrode reactions) and electrode potential.
9. Sign convention for electrode potentials and Electrochemical series
10. Standard electrode potentials,
11. Types of concentration cells: Concentration cells without and with transference Concentration cells with liquid junction potential
12. Liquid junction potential and salt bridge
13. Applications of emf measurements: 1. Determination of pH of a solution by using hydrogen electrode, quinhydrone electrode and glass electrodes 2. Potentiometric titrations: i) Acid-base titrations, (ii) Redox titrations and (iii) Precipitation
14. Primary Batteries: Dry Cells, alkaline batteries with respect to construction, diagram and working
15. Secondary Batteries: Nickel-cadmium, Lithium-ion batteries, the lead acid battery with respect to construction, diagram and working
16. Applications for Secondary Batteries
17. Fuel Cells: Types of fuel cells, advantages, disadvantages of these fuels cells, comparison of battery Vs fuel cell
18. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)., (Page No: 1154-1178)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 835-880)
3. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000, (Page No: 320-412)
4) Modern Electrochemistry Second Edition by John O'M Bockris, Molecular Green Technology College Station, Texas and Amulya K. N. Reddy, President International Energy Initiative Bangalore, India, (Page No: 1789-1888)

2. Crystal structure [10 L]

Types of Solids: Isotropy and Anisotropy, Laws of crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of crystal symmetry, Weiss indices and Miller indices, Crystal Structure: Parameters of the Unit Cells, Cubic Unit Cells: Three Types of Cubic Unit Cells, Calculation of Mass of the Unit Cell, Methods of Crystal structure analysis: The

Laue method and Braggs method: Derivation of Bragg's equation, Determination of crystal structure of NaCl by Bragg's method, X ray analysis of NaCl crystal system, Calculation of d and λ for a crystal system, Numerical.

Expected learning Outcomes:

After studying this topic students are expected to know and understand:

1. Distinguish between crystalline and amorphous solids / anisotropic and isotropic solids.
2. Explain the term crystallography and laws of crystallography.
3. Weiss and Millers Indices, determination of Miller Indices
4. Bravais lattices, space groups, seven crystal systems and fourteen Bravais lattices;
5. Cubic lattice and types of cubic lattice
6. Distance between the planes for 100, 110 and 111 for cubic lattice
7. Methods of Crystal structure analysis: The Laue method and Braggs method: Derivation of Bragg's equation,
8. Determination of crystal structure of NaCl by Bragg's method,
9. X ray analysis of NaCl crystal system and Calculation of d and λ for a crystal system,
10. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).,(Pp: 491-507, 518-528)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 1165-1180)

3. Nuclear Chemistry [10L]

Radioactivity, Types of Radiations, Properties of Radiations, Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter and Film Badges, Nuclear structure, Classification of nuclides, Types of Radioactive Decay, The Group Displacement Law, Kinetics of Radioactive Decay, Half-life, average life, Energy released in nuclear reaction, Mass Defect, Nuclear Binding Energy, Some applications of radio-isotopes as tracers: Chemical investigation – Esterification, Friedel -Craft reaction, Structural determination – Phosphorus pentachloride, Age determination – use of tritium and C^{14} dating, Problems

Expected learning Outcomes:

After studying this topic students are expected to know

1. Radioactivity
2. Types and properties of radiations: alpha, beta and gamma
3. Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter, Film Badges

4. Types of radioactive decay: α- Decay, β-Decay and γ-Decay
5. The Group Displacement Law, Radioactive Disintegration Series
6. Kinetics of Radioactive Decay, Half-life, average life and units of radioactivity
7. Energy released in nuclear reaction: Einstein's equation, Mass Defect, Nuclear Binding Energy,
8. Application of radioisotopes as a tracer: Chemical investigation- Esterification, Friedel - Craft reaction and structure determination w.r.t PCl_5, Age determination use of tritium and C^{14} dating.
9. Solve the problems based on this topic

Reference books:

1. Elements of Nuclear Chemistry by H.J. Arnikar
2. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)., (Page No: 117-145)

Additional Reference Books:

1) Physical Chemistry by G. M. Barrow, International student Edition, Mc Graw Hill.
2) University General Chemistry by C.N.R. Rao, Macmillan.
3) Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4) The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5) Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.
6) Principles of Physical Chemistry by Puri, Sharma, Pathania,
7) Chemical applications of radioisotopes by H.J.M. Brown
8) Source book of Atomic energy by S. Glasstone and D. Van .
9) Modern Electrochemistry Second Edition by John O'M Bockris

Molecular Green Technology College Station, Texas and Amulya K. N. Reddy President International Energy Initiative Bangalore, India, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow

DSEC-IV: CH-602 : Physical Chemistry-III [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Colligative properties of dilute solutions	09
2	Kinetics of Reactions in the Solid State	09
3	Electronic structure and macroscopic properties	08
4	Polymers	10
	Total	**36**

1) Colligative properties of dilute solutions (09L)

Introduction, Solution, electrolytes and nonelectrolytes, Meaning of term colligative property, relative lowering of vapour pressure of solvent in solution, elevation of B.P. of solvent in solution, Landsberger's method, freezing point depression, Beckmann's method, Osmosis and Osmotic pressure, Berkeley and Hartley method, application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight, Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property, Numerical.

Expected learning Outcomes:

After studying this topic students are expected to know

1. Meaning of the terms-Solution, electrolytes, nonelectrolytes and colligative properties,
2. Lowering of vapour pressure of solvent in solution,
3. Elevation of B.P. of solvent in solution, Landsberger's method,
4. freezing point depression, Beckmann's method Osmosis and Osmotic pressure, Berkeley and Hartley method,
5. Application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight,
6. Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property,
7. Problems.

Reference books:

3) Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 778 - 800)
4) Essential of Physical Chemistry, Bahl and Tuli (S. Chand). (Page No: 614 - 684)

2) Kinetics of Reactions in the Solid State: (09L)

Some General Considerations, Factors affecting reactions in Solids, Rate Laws for Reactions in Solids , The Parabolic Rate Law, The First-Order Rate Law, The Contracting Sphere Rate Law, The Contracting Area Rate Law, The Prout–Tompkins Equation, Rate Laws Based on Nucleation, Applying Rate Laws, Results of Some Kinetic Studies, The Deaquation-Anation of $[Co(NH_3)_5H_2O]Cl_3$, Two Reacting Solids

Expected learning Outcomes:

1. Factors affecting on solid state reactions,

2. Rate laws for reactions in solid state

3. Applying rate laws for solid state reactions

4. Results of kinetics studies

Reference books:

1) Principles of James E House, Second Edn, (Page nos: 229 to 262)

2) Principles of Physical Chemistry by Puri, Sharma, Pathania,

3)Essential of Physical Chemistry, Bahl and Tuli (S. Chand).

3) Electronic structure and macroscopic properties (08L)

Cohesive energy in ionic crystals, electronic structure of solids, conductors and insulators, Ionic crystals, semiconductors, cohesive energy in metals.

Reference books:

1. Castellan, G.W. Physical Chemistry Third edition (1993) , Addision –Wesley Publishing Co. (Page Numbers 709-719)

Expected learning Outcomes:

1. Cohesive Energy of ionic crystals based on coulomb's law and Born Haber Cycle
2. Correspondence between energy levels in the atom and energy bands in solid
3. Band structure in solids – Na , Ca and diamond
4. Conductors and insulators – Its correlation with Extent of energy in energy bands
5. phenomena of photoconductivity
6. Semiconductors – Role of impurity in transformation of insulator into semiconductor
7. Temperature dependant conductivity semiconductors
8. Cohesive Energy in metals
9. Numericals based on cohesive energy

4) Polymers (10L)

Introduction to Polymer Chemistry, Brief History, Polymer definition, Preparation, Classification, Structures, Chemical bonding & Molecular forces in Polymers. Ref. 1: Pages 1-14, Ref. 2: Pp. 1-16

Molecular weights of polymers: Average Molecular weight, Number Average & Weight Average Molecular weight, Molecular weight & degree of polymerisation, Practical significance of polymer molecular weights, b) Molecular weight determination by End Group Analysis & Viscosity method and c) Problems based on Number Average & Weight Average Molecular weight Ref. 1: Pages 86-89, 92, 96-98, 402-409

References

Polymer Science by V.R. Gowarikar, N.V. Vishvanathan, Jaydev Shreedhar New Age International Ltd. Publisher 1996.(Reprint 2012)

Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication John Wiely& Sons New York 1984. (Reprint 2008)

Expected learning Outcomes:

After studying this topic students are expected to know

1) History of polymers.
2) Classification of polymers
3) Chemical bonding & Molecular forces in Polymer
4) Molecular weight of polymers
5) Practical significance of polymer molecular weights
6) Molecular weight determination

Reference books:

1) Essential of Physical Chemistry, Bahl and Tuli (S. Chand). (Page No: 1 - 35)
2) Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 9-23)

Other Reference Books:

1. Atkins' Physical Chemistry by Peter Atkins Professor of Chemistry, University of Oxford, and Fellow of Lincoln College, Oxford Julio de Paula Professor and Dean of the College of Arts and Sciences Lewis and Clark College, Portland, Oregon
2. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).

DSEC-IV: CH-603 : Physical Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed.

1. Potentiometry (any five)

1) To determine the PKa value of given monobasic weak acid by potentiometric titration.
2) To determine the formal redox potential of Fe_2+/ Fe_3+ system potentiometrically.
3) To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
4) To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.
5) Estimate the amount of Cl-, Br- and I- in given unknown halide mixture by titrating it against standard AgNO3 solution (mixture of any two ions).
6) To prepare standard 0.2 M Na2HPO4 and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pH value of these and unknown solution.

7) To determine the composition of Zinc ferrocyanide complex potentiometrically
8) To determine the standard electrode potentials of Cu and Ag electrodes and to determine the EMF of a concentration cell.

2. pH metry (any three)

1) To determine the degree of hydrolysis of aniline hydrochloride.
2) To determine the dissociation constant of oxalic acid by pH-metric titration with strong base.
3) Determination of Pka of given weak acid by pH metry titration with strong base
4) To determine the acid and base dissociation constant of an amino acid and hence the isoelectric point of an acid.
5) pH metric titration of strong acid against strong base by pH measurement and hence determine the concentration and strength of strong acid.

3. Radioactivity (any one)

1) To determine plateau voltage of the given G M counter.
2) To determine the resolving time of GM counter.
3) To determine Emax of beta particle

4. Colligative properties (any one)

1. To determine the molecular weight of solute by depression in freezing point method
2. To study the association of Benzoic acid in benzene by Beckmann Method
3. Determine the molecular weight of given electrolyte and non-electrolyte by Landsberger's method and to study the abnormal molecular weight of electrolyte

5. Turbidometry: (any one)

1. Determination of $SO4^{2-}$ and Cl^{-} by turbidimetric method (turbidimetric titration or calibration curve method)
2. To determine the molecular weight of a given polymer by turbidometry

6. Table work

1.Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

Reference Books:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co.,

Delhi.).

4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Physical chemistry by Wien (2001)
6. Advance Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut),
7. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
8. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books
9. Vogel-qualitative-inorganic-analysis-5th-edition-1979
10. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
11. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

DSEC-V: CH-604 : Inorganic Chemistry -II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Organometallic Chemistry	08
2	Homogeneous and Heterogeneous catalysis	10
3	Bioinorganic Chemistry	08
4	Inorganic Polymers	05
5	Inorganic solids/ionic liquids of technological importance	05
	Total	**36**

1. Organometallic Chemistry [8L]

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, classification of metal carbonyls, synthesis of metal carbonyls; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis. Hepticity, Molecular and electronic structures of binary metal carbonyls, Electron count in complexes (18 electron rule). Applications of organometallic compounds in industrial catalysis (list of examples). Chemistry of ferrocene; Introduction, synthesis and physical properties of ferrocene. Reactions of ferrocene such as Friedel-Craft Acylation, Friedel-Craft Alkylation, Mannich reaction, Nitration and Halogenation.

[Further Reading: Student should also read about the interaction of different organic ligands with metals and their possible bonding.]

Aim and Objectives: Students should be able:

i. To understand M-C bond and to define organometallic compounds
ii. To define organometallic chemistry
iii. To understand the multiple bonding due to CO ligand.
iv. To know methods of synthesis of binary metal carbonyls.
v. To understand the structure and bonding using valence electron count (18 ele. rule)
vi. To understand the catalytic properties of binary metal carbonyls.
vii. To understand the uses of organometallic compounds in the homogenous catalysis.
viii. Chemistry of ferrocene

References:

1. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Lamgford – Oxoford, 5th Edn., 1994, pp 534-542,553-564.
2. Concise Inorganic Chemistry by J. D. Lee (Relevant pages)
3. General Chemistry by Raymond Chang(Relevant pages)

4. Basic Organometallic Chemistry: Concepts, Syntheses and Applications of Transition Metals (CRC), B. D. Gupta and Anil J. Elias, Universities Press; 2nd Edition, 2013.

2. Homogeneous and Heterogeneous catalysis [10L]

Introduction to Catalysis, basic principles, activity and selectivity in catalysis, Types of catalysis, homogeneous vs. heterogeneous catalysis, importance of catalysis in the synthesis of high value chemicals.

Homogeneous catalysis: catalytic cycles for following reactions: a) Hydrogenation of olefins using Wilkinson complex, b) Hydroformylation of olefins using Cobalt and Rhodium complexes, c) Carbonylation reaction: methanol to acetic acid process i.e. Monsanto processes and d) C-C coupling reactions: Heck reaction. **[References 1 to 3]**

Heterogeneous catalysis: History of the development of industrial heterogeneous catalysis, Classification of heterogeneous catalysts, supported metal catalyst, Role of support, Promoters and Poisons. Catalytic processes viz., a) Hydrogenation of olefins using Raney Nickel catalyst, b) Zeolites in catalysis: Catalytic cracking, c) Biodiesel synthesis using Heteropolyacids (HPAs) d) Automotive Exhaust catalysts: The catalytic converters. **[Reference 5 to 6]**

[Further reading: Student should also read about advanced development in the field of homogeneous and heterogeneous Catalysis.]

Aims and objectives: A student should be able to:

i. Understand the phenomenon of catalysis, its basic principles and terminologies.
ii. Define and differentiate homogeneous and heterogeneous catalysis.
iii. Give examples and brief account of homogeneous catalysts.
iv. Understand the essential properties of homogeneous catalysts-Give the catalytic reactions for Wilkinson's Catalysis, hydroformylation reaction, Monsanto acetic acid synthesis, Heck reaction
v. Understand the principle of heterogeneous catalyst and development in it.
vi. Give examples of heterogeneous catalysts.
vii. Understand the classification and essential properties of heterogeneous catalysts.
viii. Give the brief account of Hydrogenation of olefins , Zeolites in catalysis, biodiesel synthesis, Automotive Exhaust catalysts
ix. Understand the catalytic reactions used in industries around.

References:

1. Homogeneous Catalysis: The Applications and Chemistry of Catalysis by Soluble Transition Metal Complexes, G.W. Parshall and S.D. Ittel, Wiley, New York 1992.

2. Inorganic Chemistry D.F. Shriver and P.W. Atkins, 5th Edn, Oxford University Press, 2010, Chapter 26 pp690-721.
3. Homogeneous Catalysis: Mechanisms and Industrial Applications, S. Bhaduri and D. Mukesh, Wiley, New York, 2000.pp 13-23, 55-61,85-102, 161-163
4. Catalysis: Concepts and Green Applications: Gadi Rothenberg, Wiley-VCH; First edition, 2015 Relevant pages.
5. Heterogeneous catalysis in industrial practice, Chaerls N. Shatterfield, second edition, Krieger Publishing Company, Florida USA pp 1-16, 87-112, 203-205, 222-224.
6. Heterogeneous catalysis by B. Vishwanathan and D. K. Chakrabarty , New Age International Private Limited, 2007 (Relevant pages)

3. Bioinorganic Chemistry [8 L]

I. Introduction, Role of metals in bioinorganic chemistry, Classification as enzymatic and non-enzymatic metals, enzymatic redox metals such as Cu (SOD) and enzymatic non-redox metals such as Zn (Hydrolase). Role of metal ions in non-enzymatic processes-Na, K, Ca, Mg (one example of each and brief discussion). Role of metals in enzymatic processes-Transition metals-Catalase, peroxidase and nitrogenase (Redox active). II. Metalloproteins-Iron proteins-Introduction of Fe-S proteins, Electron transfer proteins (Fe-S, Fe_2S_2, Fe_3S_4, Fe_4S_4). Transport protein (transferrin) and Storage protein (ferritin) III. Bioinorganic Chemistry of Fe: Hemoglobin and myoglobin, its structure and functions and IV. Bioinorganic Chemistry of Co: Vitamin-B_{12}, its structure and function.

[Further Reading: Student should also read about the role of other metals and advanced development in the field of Bioinorganic Chemistry.]

Aims and objective- A student should:

i. Identify the biological role of inorganic ions & compounds.
ii. Know the abundance of elements in living system and earth crust.
iii. Give the classification of metals as enzymatic and non-enzymatic.
iv. Understand the role of metals in non-enzymatic processes.
v. Know the metalloproteins of iron.
vi. Explain the functions of hemoglobin and myoglobin in O_2 transport and storage.
vii. Understand the toxicity of CN- and CO binding to Hb.
viii. Draw the structure of Vit.B_{12} and give its metabolism.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th edition, Pages 353, 775, 779, 796-797.
2. Inorganic Chemistry,-D.F. Shiver & P.W. Atkins- C.H. Longford ELBS- 2nd Ed,782-806.

3. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, Panima Publishing Corporation, 1st Edn., Pages 1-13, 24, 285-290.

4. Inorganic Polymers [5L]

Introduction, Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicates, silicones, siloxanes, borazines, and phosphazenes.

Aims and objective: A student should be able to:

i. know thy types of Inorganic polymers
ii. comparison with organic polymers
iii. synthesis, structural aspects of Inorganic polymers
iv. understand the polymers of Si, B, Si and P
v. Inorganic polymers and their use.

References:

1. Inorganic polymer chemistry, Pimpalpure , jain, soni, Sahai, Pragati edition 2012, pages 1-7, 110-129, 179-186, 207-217
2. N. H. Ray, Inorganic Polymers, Academic Press (1978).
3. Inorganic Polymers, Second Edition James E. Mark Harry R. Allcock Robert West Oxford University Press, 2nd Edition, 2005.

5. Inorganic solids/ionic liquids of technological importance [5L]

Inorganic solids, Preparation of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel method and Hydro-thermal method. Introduction to Solid electrolytes, inorganic liquid crystals and their examples. Ionic liquids, synthesis and application of imidazolium and phosphonium based ionic liquids.

Further reading: student should also read about the advanced smart materials and green aspects of ionic liquids.

Aims and objective: A student should know:

i. Understand Preparation of inorganic solids by various methods,
ii. Inorganic liquid crystals
iii. Ionic liquids, their preparations, and their significance w.r.t green chemistry.
iv. Technological importance of ionic liquids,

Reference

1. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning, 2002.
2. Ionic Liquids: Industrial Applications for Green Chemistry, Robin D. Rogers, Kenneth R. Seddon, American Chemical Society, Washington, DC, USA.pp1-13, 30-41

DSEC-V: CH-605: Inorganic Chemistry -III [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Acid–Base and Donor–Acceptor Chemistry	08
2	Ionic Solids	10
3	Chemistry of Zeolites	08
4	Introduction to Nanochemistry	05
5	Chemical Toxicology	05
	Total	**36**

1. Acid–Base and Donor–Acceptor Chemistry [8 L]

Acid–Base Models as Organizing Concepts, Arrhenius Concept, Brønsted–Lowry Concept, solvent system concept, Lux Flood concept, Lewis Concept, Frontier Orbitals and Acid–Base Reactions, Hard and soft acids and bases, theory of hard and soft acids bases, Acid and base strength (proton affinity, acidity and basicity of binary hydrogen compounds, inductive effects, steric effect, strength of oxy acids, acidity of cations in aqueous solutions, non-aqueous solvents and acid and base strengths, super acids).

Aims and objectives: A student should:

1. Student will learn the concept of acid base and their theories.
2. They will also come to know different properties of acids and bases.
3. Strength of various types acids.
4. How acid and base strengths get affected in non-aqueous solvents.

Reference: Inorganic chemistry, Gary L Messler and Donald A Tar, Third Ed, Pearson publisher, pages: 67-178, 183 – 208.

2. Ionic Solids [10L]

Crystalline and amorphous solids, crystal structures simple cubic, body centered cubic and face centered cubic, Properties of ionic solids, packing arrangements of anions in an ionic solids, Voids in crystal structure- tetrahedral and octahedral, Ionic radius, Palings univalent and crystal radii, Conversion of univalent radii to crystal radii, problems based on conversion of radii, Radius ratio effect, Lattice energy, Born-Lande equation, Born Haber cycle and its applications, Schottky and Frenkel defect.

A student should:

1. Know the nature of solids.
2. Know the crystal structures of solids.

3. Draw the simple cubic, BCC and FCC structures.
4. Identify the C.N. of an ion in ionic solid.
5. Identify the type of void.
6. Know the effect of radius ratio in determining the crystal structure.
7. Be able to define Pauling's univalent radius and crystal radius.
8. Be able to solve simple problems based on Pauling's univalent radii and crystal radii.
9. Know how to draw Born-Haber cycle.
10. Be able to solve simple problems based on Born- Haber cycle.
11. Know the defects in Ionic solids.
12. Be able to differentiate between the defects.

Reference Books:

Ref. 1- Concise Inorganic Chemistry by J.D. Lee - 5th edition. Pages 32-61

Ref .2- Concept and Model of Inorganic Chemistry by Douglas–Mc Daniels - 3rd edition Pp 102-127.

Ref. 3 -New Guide to Modern Valence Theory by G.I. Brown - 3rd edition Pages 55-62

3. Chemistry of Zeolites [8L]

1. Historical Background, Natural and artificial Zeolites,

2. Zeolite Framework Types: Classification, Nomenclature, Database of Zeolite Structures, Channels, Building Units, Natural Tiles, Framework Density, Coordination Sequences

3. Zeolite Structures: Framework Composition, Extra-framework Species, Stacking Faults and Disorder

4. Synthesis of Zeolites: Introduction, Basic Zeolite Synthesis, Mineralizing Agents, Effects of water concentration, Gel preparation and crystallization, Structure Directing Agents (SDA)

5. Applications 1.Zeolites as Heterogeneous Catalysts: Critical Properties for Catalysis, Catalytic Applications, Zeolites for Fine Chemistry: Acylation and Alkylation Aromatic Hydrocarbons, 2. Zeolites for Adsorption and Separations

A student should:

1. Different Zeolite Framework Types and their classification
2. Zeolite synthesis and their structure
3. Application of zeolites

Reference:

1. Zeolites in Catalysis Properties and Applications Edited by Jiri Cejka, Russell E. Morris, Petr Nachtigall, The Royal Society of Chemistry 2017 pp 1-5, 19-25, 37-50, 73-79, 87, 412-414, 418

2. Chemistry of Zeolites and Related Porous Materials: Synthesis and Structure, Ruren Xu, Wenqin Pang, Jihong Yu, Qisheng Huo, Jiesheng Chen, John Wiley & Sons (Asia) Pvt. Ltd, 2007

4. Introduction to Nanochemistry [5L]

Synthesis and Stabilization of Nanoparticles by Chemical Reduction, Reactions in Micelles, Emulsions, and Dendrimers. Photochemical and Radiation Chemical Reduction, Cryochemical Synthesis, Physical Methods. Particles of Various Shapes and Films, Properties and Application of Nanoparticles in Science and Technology (in bief), Applications of CNTs

Reference:

1. Nanochemistry, G.B.Sergeev, Elsevier, 2006, pp 7-36, 175-83,199-201
2. The Chemistry of Nanomaterials C. N. R. Rao, A. Muller, A. K. Cheetham (Eds.) WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2004. (Relevant pages)

A student should:

1. Various methods of nanoparticle synthesis
2. Stabilization of Nanoparticles in solution
3. Properties and Application of Nanoparticles
4. Know about carbon nanotube and its application

5. Chemical Toxicology [5L]

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes. Biochemical effect of Arsenic, Cadmium, Lead and Mercury. Biological methylation.

A student should be able -

i) To know toxic chemical in the environment.

ii) To know the impact of toxic chemicals on enzyme.

iii) To know the biochemical effect of Arsenic, Cd, Pb, Hg.

iv) To explain biological methylation.

Reference:

i) Fundamental Chemistry by A. K. De (3^{rd} Ed.)

ii) Environmental chemistry by A.K.De Publisher- Wiley Eastern Limited New Age International Limited Page No. 75-100.

DSEC-V: CH-606: Inorganic Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed.

A. Volumetric Estimations (Any 3)

1. Analysis of Phosphate (PO_4^{3-}) from Fertilizer. (Ref-1)
2. Analysis of Iodine from Iodized salt.(Ref-2)

3. Strength of medicinal H_2O_2. (Ref-1)
4. Analysis of Calcium from milk powder. (Ref-1)
5. Analysis of Cu from Cu-Fungicide. (Ref-1)

B. Flame Photometry (Any 3) (Ref-1)

1. Estimation of Na by flame photometry by calibration curve method.
2. Estimation of Na by flame photometry by regression method.
3. Estimation of K by flame photometry by calibration curve method.
4. Estimation of K by flame photometry by regression method.

C. Column Chromatography (any 1) (Ref-1)

1. Purification of water using cation/anion exchange resin and analysis by qualitative analysis /conductometry.

D. Nanomaterial synthesis (Any 1) (Ref-3, 4)

1. Synthesis of Silver nanoparticles.
2. Synthesis of ZnO nanoparticles.

E. Verification of periodic trends using solubility of alkaline earth metal hydroxides $Ca(OH)_2$, $Mg(OH)_2$, $Cr(OH)_2$, $Ba(OH)_2$. (Ref-1)

F. Synthesis of amine complexes of Ni(II) and its ligand exchange reaction (bidentate ligands like acac, DMG, Glycine) by substitution method.

OR

Determination of the Metal to ligand ratio (M : L) in complexes. (Ref-5)

G. Solvent free microwave assisted one pot synthesis of pthalocynin copper (II) complex.

OR

Fenton reaction: Degradation of H_2O_2 using Fe catalyst. (Ref-6)

H. Table work: Band gap calculation for the nanomaterial TiO_2/ SnO_2/ ZnO from its electronic spectra (UV-Visible). (Ref-3, 4)

References:

1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

2: General Chemistry Experiment – Anil J Elias (University press).

3: Nanotechnology: Principles and Practices by Dr.Sulbha Kulkarni. Third Edition,Springer

4: A laboratory course in nanoscience and nanotechnology, Dr. Gerrad Eddy Jai Poinem, CRC press

5: Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horword Publishing, Chichester) 1999.

6: Environmental Chemistry Microscale Laboratory Experiments, Jorge G.Ibanez Margarita Hemandez-Esparza Carmen Doria-Serrano Arturo Fregoso-Infante, Springer

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Structure of Practical Examination [35 Marks; Time: 3 hours]

Q1. Expt. A/ B/ C/ D/ E/ F/ G/ H ……...***30 M***

Q2. Viva-Voce ……...***05 M***

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DSEC-VI: CH-607: Organic Chemistry-II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to Spectroscopy	03
2	Ultra Violet and Visible Spectroscopy	06
3	Infra-Red Spectroscopy	08
4	Nuclear Magnetic Resonance Spectroscopy (PMR)	10
5	Combined problems based on U.V., I.R. and PMR spectroscopy	05
6	Stereochemistry of Disubstituted Cyclohexane and Decalin	04
	Total	**36**

1: Introduction to Spectroscopy [03 L]

Introduction, meaning of spectroscopy, Types of spectroscopy, nature of electromagnetic radiation and regions of electromagnetic spectrum, Terms used in spectroscopy; wavelength, amplitude, frequency, wavenumber, energy and their relations and conversions Ref 2: Page Nos. 43-55 Chapter

2: Ultra Violet and Visible Spectroscopy [06 L]

Introduction, Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts, Application of visible, ultraviolet spectroscopy in organic molecules. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α, β – unsaturated compounds. Ref 1: Page Nos.367-398

3: Infra-Red Spectroscopy [08 L]

Introduction, Infrared radiation and types of molecular vibrations, functional group and fingerprint region. Infra-red spectroscopy in organic molecules, IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions). Ref 1: Page Nos 26-93

4: Nuclear Magnetic Resonance Spectroscopy (PMR) [10 L]

Introduction, Principles, Magnetic and nonmagnetic nuclei, nuclear resonance, chemical shift, shielding, & deshielding effect. Measurement of chemical shift, TMS as reference and its advantages, peak area, integration, spin-spin coupling, coupling constants, J-value , problems

based on NMR. Ref 1: Page Nos.108-175 and 225-366 Chapter 5: Combined Problems Based on U.V., I.R. and PMR Spectroscopy. [05 L] Ref 1: Page Nos. 501 to 567

5:Combined problems based on U.V., I.R. and PMR spectroscopy. [05 L]

Ref 1: Page Nos. 501 to 567

6: Stereochemistry of Disubstituted Cyclohexane and Decalin [04 L]

Recapitulation, Geometrical and optical isomerism of 1,3- dimethyl and 1,4-dimethyl cyclohexane with their stability and energy calculations. Conformations of decalin and their stability.

Ref.19: Pages 94, 213 - 216, 250. Ref.20: Pages 243 – 250, 289-292.

References:

1. Pavia D.L.; Lampman G.M. Kriz G. S.; Vyvyan J.R. Spectroscopy, First Indian Reprint 2008 : Brooks/Cole CENGAGE Learning.
2. Silverstein and Basallar: Spectroscopic Identification of Organic Compounds.
3. M. Parikh :Absorption Spectroscopy Organic Compounds (John Wiley)
4. P. S. Kalsi : Spectroscopy of organic compounds (New Age)
5. J. R. Dyer: Application of absorption spectroscopy of organic compounds.
6. V. M. Parikh:Application spectroscopy of Organic molecules. (Mehata)
7. D.W. Williams and Flemming: Spectroscopic methods of Organic compound.
8. Jackman and Stermineil: Application of NMR spectroscopy
9. J. D. Roberts:Nuclear magnetic resonance (J. Wiley)
10. Jaffe and Orchin: Theory and application of U. V.
11. K. Benjamin: Mass spectroscopy
12. Budsikiewicy et al.: Mass spectroscopy.
13. Beynon J H et al: The mass spectra of organic molecules.
14. W. Kemp: Organic spectroscopy ELBS
15. Atherben; Electron spin resonance
16. Das and Jame: Mass Spectroscopy.
17. Eliel: Stereochemistry of Organic Compounds, Tata Mc Graw Hill, 1989
18. D. Nasipuri: Stereochemistry of Organic Compounds- Principles and Applications, New Age International Publishers, 3rd edition.

Learning Outcomes

Chapter 1 to 5: Organic Spectroscopic Methods in Structure Determination. (Chapter 1-5)

Students will learn the interaction of radiations with matter. They will understand different regions of electromagnetic radiations. They will know different wave parameters.

1. Students will learn the principle of mass spectroscopy, its instrumentation and nature of mass spectrum.
2. Students will understand the principle of UV spectroscopy and the nature of UV spectrum. They will learn types of electronic excitations.
3. Students will be able to calculate maximum wavelength for any conjugated system. And from the value of λ-max they will be able to find out the extent of conjugation in the compound.
4. Students will understand the principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.
5. From the IR spectrum, they will be able to find out IR frequencies of different functional groups. And thus, they will be able to find functional groups present in the compound.
6. Students will understand the principle of NMR spectroscopy and will understand various terms used in NMR spectroscopy. They will learn measurement of chemical shift and coupling constants.
7. Students will be able to interpret the NMR data and they will be able to use it for determination of structure of organic compounds.
8. Students will be able to determine the structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values).

Chapter 6: Students should be able to learn

1. The use of models to draw different types of disubstituted cyclohexanes in chair form
2. The geometrical isomerism in disubstituted cyclohexanes
3. The stability, energy calculations and optical activity of these conformers
4. The use models and to draw different types of conformational isomers of decalin in chair form
5. To know the stability of geometrical isomers of decalin

DSEC-VI: CH-608: Organic Chemistry-III [Credit -2, 36 L]

Synthetic Organic Chemistry

Chapter No	Chapter	No of Lectures
1	Retrosynthetic Analysis and Applications	06
2	Organic Reaction Mechanism and Synthetic Applications	12
3	Reagents in Organic Synthesis	10
4	Natural Products	08

1. Retrosynthetic Analysis and Applications [06 L]

Introduction, Different terms used – Disconnection, Synthons, Synthetic equivalence, FGI, TM. One group disconnection, Retrosynthesis and Synthesis of target molecules: Acetophenone, Crotonaldehyde, Cyclohexene, Benzylbenzoate, and Benzyl diethyl malonate.

Ref 1: *Page Nos. 1-34* ***Ref. 2:*** *Page Nos. 694-722*

2. Organic Reaction Mechanism and Synthetic Applications [12 L]

1. Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes etc…);
2. Wolff rearrangement (Step up),
3. Hofmann rearrangement (Step down),
4. Simmons-Smith reaction,
5. Michael reaction,
6. Wittig reaction and McMurry reaction,
7. Diels-Alder reaction,
8. Functional group interconversions and structural problems using chemical reactions.

Ref 2 *Page Nos. 1021-1022, 1009-1018, 500, 237-238, 982-983, 877-893*

3. Reagents in Organic Synthesis [10 L]

Reagents- Preparation and Applications of following reagents.

Reducing Reagents: ***Ref 2*** *Pages Nos. 226, 828, 131-132, 26, 39, 537*

Lithium aluminium hydride $LiAlH_4$, $NaBH_4$, DIBAL-H, $Li(tBuO)_3AlH$ & Raney Nickel.

Oxidizing Reagents: ***Ref. 2*** *Page Nos. 545, 1123-1126, 919, 764*

1. DMSO either with DCC or Ac_2O, Dess Martin reagent, Osmium tetroxide, Selenium dioxide-(SeO_2), DDQ.

4. Natural Products [08 L]

Ref 2: *Page Nos. 1413-1447*

Terpenoids: Introduction, Isolation, Classification. Citral- structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis.

Alkaloids: Introduction, extraction, Purification, Some examples of alkaloids and their natural resources. Ephedrine- structure determination using chemical methods.Synthesis of Ephedrine by Nagai.

Reference:

1.Designing Organic Synthesis by Stuart Warren 1983.

2.Organic Chemistry by Clayden, Greeves, Warren and Wothers.Second edition.

3.Organic Chemistry by I. L. Finar Vol. II Edn.V.

4.Organic Chemistry by Morrison and Boyd. VI Edn.

A Guidebook to Reaction Mechanism by Peter Sykes VI Edn.

DSEC-VI: CH-609: Organic Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed

A) Interpretation of IR and NMR spectra (2 Experiments of each type)

1. Determination of functional group of organic compound from given IR spectra.
2. Determination of structure of organic compound from given NMR spectra.

(Ethyl alcohol, Cis-2-butene, Trans-2-butene, Benzoic acid, Propanaldehyde, Ethyl methyl ether, 1 Butyne, Ethyl acetate, Propyl Cyanide, Salicylic Acid, Nitro phenols, Isopropyl benzene, Propanamine, Benzamide, n-Pentane, 2-chloro butane, Acetophenone)

B) Organic Estimations (Any Three)

1. Estimation of glucose
2. Estimation of glycine
3. Saponification value of oil
4. Estimation of Alkali content in Antacid using HCl.

C) Organic Extractions (Any Three)

1. Caffeine from tea leaves
2. Eugenol from cloves
3. Lycopene from tomato peels
4. Cinnamic acid from cinnamon
5. Trimyristin from nutmeg

D) Column chromatography

1. Separation of mixture of aldehyde and carboxylic acid by column chromatography
2. Separation of mixture of O-nitrophenol and P-nitrophenol by column chromatography

Learning Outcomes:

A) Interpretations of IR and PMR Spectra The students will be able to

1. Explain “fingerprint region” of an infrared spectrum can used in the identification of an unknown compound.
2. Identify the functional group or groups present in a compound.
3. Identify the broad regions of the infrared spectrum in which occur absorptions caused by N−H, C−H, and O−H, C≡C and C≡N, C=O, C=N, and C=C.
4. Understand use NMR spectra to determine the structures of compounds.
5. Interpret integration of NMR spectra
6. Calculate coupling constants from 1 H NMR spectra.
7. Interpret elemental analysis technique

B) Organic Estimations The students will be able to

1. Practical knowledge of handling chemicals.
2. Achieve the practical skills required to estimations of glucose and glycine.
3. Achieve the practical skills required to Saponification value of oil.
4. Determine the molecular weight of given tribasic acids.

C) Organic Extractions The students will be able to

1. Apply the principles of extraction
2. Understand the equipment for extraction.
3. Gain practical hands-on experience of modern Extraction.
4. Develop basic design of extractor
5. Describe the extraction separation process.

D) Column chromatography The students will be able to

1. Defines the basic parameters in chromatography
2. Explain the processes of a chromatography analysis
3. Describes the types and materials of column.
4. Explains the types of mobile phase and elution.
5. Realize the selection of appropriate mobile phase, column and detector

SEC-III: CH-610: Skill Enhancing Course-III [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-610 (A) : Chemistry of Soil and Agrochemicals

Chapter No	Name of the Topic	Number of lectures
1	Soil Chemistry	6
2	Problematic Soil and Soil testing	6
3	Laboratory Methods of Soil Analysis	12
4	Fertilizers and Manures	6
5	Protection of Plants	6
	Total Lectures	**36**

1. Soil Chemistry (6 L)

1.1 Role of agricultural chemistry

1.2 Introduction to soil chemistry, definitions of soil, Soil components- Mineral component, organic matter or humus, soil atmosphere, soil water, soil microorganism.

1.3 Physical properties of soil- Soil texture, soil structure, soil colour, soil temperature, soil density, porosity of soil.

1.4 Surface soil and sub-soil, Functions of soil.

1.5 Chemical properties of soil - Soil reactions, importance of soil reaction, factors controlling soil reactions,

1.6 Buffer action, buffering capacity, importance of buffer reaction in agriculture, ion exchange and importance of ion exchange.

Ref 1- Pages 8-12, 92-94, 98-113, 116-146

Ref 3 - Pages 28-50

Ref 12 - Pages 211-224, 228-234

Ref 17 - Pages 49-56, 295-308, 357-370

2. Problematic Soil and Soil testing (06 L)

2.1 Introduction to problematic soils.

2.2 Acid soils- formation of acid soil, effect of soil acidity on plant, reclamation of acidic soil, application of lime in improving the acidity of soil, lime requirements.

2.3 Alkali Soil- formation of alkali soil, reclamation of alkali soil.

2.4 Classification of alkali soil- saline soil, alkali soil, saline alkali soil, non-saline alkali soil.

2.5 Soil testing - Introduction, different methods of soil fertility evaluation.

2.6 Objectives of soil testing.

Ref 1- Pages 345-370

Ref 3 - 301-312

Ref 4 – Pages 135-147, 150-159

Ref 12 - Pages 237-246, 337-353

3. Laboratory Methods of Soil Analysis (12 L)

3.1 Collection of soil Samples from field.

3.2 Soil sample preparation for analysis of various parameters.

3.3 Digestion and Extraction Procedures for soil.

3.4 Project/ Hands on training of Analysis of various parameters of soil and writing project on it.

(**Note: Students can perform minimum six experiments out of eight in the laboratory with the help of teacher and write report on it and submit to subject teacher. It is considered for internal marks of this course**).

1. Determination of pH of soil
2. Determination of EC and TDS of soil
3. Determination of soil organic matter of soil.
4. Determination of available nitrogen in soil.
5. Determination of available phosphorus from soil.

6. Determination of calcium and magnesium from soil by EDTA method.
7. Determination of sodium and potassium by flame photometry method.
8. Determination of carbonate and bicarbonates from soil.
9. Calculate the RSC, SAR, SSP, Salinity of soil. Interpretation of soil data and recommendations for soil use.

Ref 23 pages 11-160

Ref 25 pages 17-104

4. Fertilizers and Manures (06 L)

Fertilizers

4.1 Introduction, Classification of nitrogenous fertilizers, reaction of ammonium sulphate, urea as a fertilizer in soil.

4.2 Nano fertilizers- Nano-Fertilizers for Sustainable Crop Production, Nano urea- preparation, forms and application of nano urea.

4.3 Phosphatic fertilizers- Classification of phosphatic fertilizers, reactions of superphosphate as a fertilizer in soil.

4.4 Potassic fertilizers - Classification of potassic fertilizers, reactions of potash fertilizer in soil.

4.5 Complex fertilizers- Characteristics, advantages and disadvantages,

4.6 Mixed fertilizers - Characteristics, advantages and disadvantages.

4.7 Time and mode of applications of fertilizers in the solid and liquid form to plants.

4.8 Factors affecting efficiency of fertilizers.

Manures

4.9 Introduction, Definition and classification of manures.

4.10 Effect of bulky organic manures on soil.

4.11 Farm yard manures (FYM), improved methods of handling FYM- Trench method for FYM, Factors affecting the composition of FYM, losses during the handling and storage of FYM, Gober gas-compost plant - construction and advantages.

4.12 Biofertilizers - Definition, classification, role & advantages.

4.13 Vermicompost - Preparation, effect of vermicompost on soil fertility.

Ref 2- Pages 205-213,

Ref 3- Pages 90-112, 137-149

Ref 5 Pages Relevant pages

Ref 12 – Pages 263- 275, 280-290,

Ref 18 – URL: Attached in reference.

Ref 19 - URL: Attached in reference.

Ref 20 URL: Attached in reference.

5. Protection of Plants (06 L)

5.1 Classification of pesticides.

5.2 Insecticide- Definition, Classification on the basis of mode of action and chemical properties.

5.2.1 Inorganic insecticides - plants or animal origin insecticides- nicotine, pyrethrum, rotenone.

5.2.2 Synthetic organic insecticides – a) Organochlorine insecticides - DDT, BHC, Aldrin and dieldrin. b) Organophosphorus insecticides – Parathion, Malathion, c) Carbamate insecticides – Carbaryl, Baygon.

5.3 Fungicide – Definition and Classification of fungicides.

5.3.1 Inorganic fungicide- Copper fungicides a) Bordeaux mixture, b) Copper oxychloride.

5.3.2 Organic fungicides- Dithiocarbamate, Quinone fungicides, Heterocyclic fungicides.

5.3.3 Synthetic fungicides.

5.4 Herbicides- Definition, Classification on the basis of mode of action- Selective and non-selective herbicides, classification based on their effect on weeds- contact, systemic herbicides. Classification on the basis of their chemical structures.

5.5 Nano pesticides: Its Scope and Utility in Pest Management

Ref 6 - Relevant Pages

Ref 13 – Pages 80-177,

Ref 14 – Pages 73-110,

Ref 15 – Chapter 3 Pages 1-45

Ref 16 Pages 2-16,

Ref 19 URL: Attached in reference.

Ref 21 URL: Attached in reference.

Learning Objectives:

1) Know the different components and properties of soil.
2) Know classification of soil on the basis of pH.
3) Identify the problematic soil and recommend method for their reclamation.
4) Know the different plant nutrients required for plants and their functions.
5) Know the role of various fertilizers and manures required for plant growth.
6) Know the various methods and their techniques in analysis of soil.
7) Know importance of manures as compared to chemical fertilizers.

8) Know various techniques to protect the plants.
9) Have the knowledge of various pesticides, insecticides, fungicides and herbicides.

Course Outcomes:

After studying this course, student is expected to

1) Understood various components of soil and soil properties and their impact on plant growth.
2) Understood the classification of the soil.
3) Explores the problems and potentials of soil and decide the most appropriate treatment for land use.
4) Understood the Reclamation and management of soil physical and chemical constraints.
5) Useful in making decisions on nutrient dose, choice of fertilizers and method of application etc. practiced in crop production.
6) Got experience on advanced analytical and instrumentation methods in the estimation of soil.
7) Understood various Nutrient management concepts and Nutrient use efficiencies of major and micronutrients and enhancement techniques.
8) Proper understanding of chemistry of pesticides will be inculcated among the students.
9) Imparts knowledge on different pesticides, their nature and, mode of action and their fate in soil so as to monitor their effect on the environment.

Reference Books

1. A text book of soil science (Revise Edition) J. A. Daji. Revised by J. R. Kadam, N. D. Patil, Media promoters and publishers, Mumbai, 1996.
2. Text book of soil science, T. D. Biswas, S. K. Mukherjee, 2nd ed. Tata McGraw Hill Publishing company, New Delhi, 2017.
3. Introduction to Agronomy and soil, water management, V. G. Vaidya, K. R. Sahashtrabuddhe, (Continental Prakashan).
4. Principals of soil science, M. M. Rai, 4th ed. Million complex of India, Bombay, 1977.
5. Manures and fertilizers (12th ed.), K. S. Yawalkar, J. P. Agarwal and Bokde, Agri-horticulture publishing house, Nagpur, 2016.
6. Chemistry of insecticides and fungicides, U.S. Sreeramula (2nd ed.), oxford and IBH Publishing company, New Delhi.
7. Fundamentals of soil sciences, Henry D. Foth, 8th ed. John Wiley and Sons, 1990. Book Soft copy URL: https://1lib.in/book/634160/343570

8. Soil, Plant, Water and fertilizer analysis, P. K. Gupta, 2nd ed. Agrobios Publication, Jodhpur, India. Book Soft copy URL: https://content.kopykitab.com/ebooks/2016/06/7111/sample/sample_7111.pdf
9. Handbook of Biofertilizers and biopesticides, A. M. Deshmukh, R. M. Khobragade and P. D. Dixit, Oxford Book Company, Jaipur, India 2007. Book Soft copy URL: https://1lib.in/book/961124/8ecdcd
10. Essential Plant Nutrients uptake use efficiency and Management, M. Naeem, Abid A. Ansari, Sarvajeet Singh Gill Editor, Springer International Publishing AG, 2017. Book Soft copy URL: https://1lib.in/book/3376008/16ba17
11. The Use of Nutrients in crop plants, N.K. Fageria, CRC Press, Taylor and Francis Group, LLC, 2009. Book Soft copy URL: https://1lib.in/book/550595/3a2232
12. Agronomic Handbook – Management of crops, soils and their fertility, J. Benton Jones, Jr. CRC Press LLC, Washington D.C. 2003. Book Soft copy URL: https://1lib.in/book/946311/37a879
13. The chemistry of Organophosphorus Pesticide, Christa Fest, Karl-Julius Schmidt, 2nd revised ed., Springer, Verlag Berlin Heidelberg, New York, 1982. Book Soft copy URL: https://1lib.in/book/2137868/423f0a
14. Chemical Pesticide - Mode of action and Toxicology, Jorgen Stenersen, CRC Press, 2004. Book Soft copy URL: https://1lib.in/book/550607/97f6b8
15. Agrochemical and Pesticide safety Handbook, Michel F. Waxman, CRC Press, 1998. Book Soft Copy URL: https://1lib.in/book/2061906/6282cc
16. Basic Guide to Pesticides: Their Characteristics and Hazards, Shirley A. Briggs, Rachel Carson Council, First Edition, CRC Press, Taylor and Francis Group, 2017. Book Soft copy URL: https://1lib.in/book/3580723/94db6c
17. Principles of Soil Chemistry, Kim H. tan, 4th ed. revised and expanded, Marcel Dekker AG, New York, 1998. Book Soft copy URL: https://1lib.in/book/2572952/f500e1
18. Nano fertilizers, Nano Urea- URL: https://www.iffco.in/
19. Nano fertilizers & Nano Pesticides, URL: https://www.sciencedirect.com/science/article/pii/S0570178320300440 , https://www.sciencedirect.com/science/article/pii/B9780128200926000124
20. Biofertilizers, URL: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biofertilizers , https://agritech.tnau.ac.in/ta/org_farm/orgfarm_biofertilizers.html, https://en.wikipedia.org/wiki/Biofertilizer
21. Nano Pesticides, URL: https://link.springer.com/article/10.1007/s10311-016-0600-4

22. A Practical Course in Agricultural Chemistry, D. W. Gilchrist Shirlaw and J. E. Nichols, First ed. Pergamon Press Ltd. Headington Hill Hall Oxford4 & 5 Fitzroy Square, London. 1967. Book Soft copy URL: https://1lib.in/book/2275633/04aec0
23. Laboratory Guide for Conducting Soil Tests and Plant Analysis, J. Benton Jones Jr. CRC Press, 2001. Book Soft copy URL: https://1lib.in/book/665386/63e6f0
24. Agricultural Chemistry, First Edition, R. P. Dhok, Amazon Digital Services, LLP-KDP E Book, US. 2021. Book Soft copy URL: https://drive.google.com/file/d/1gnvIAzdN0aaZtKbX6TY9UZ2PC7M3ANN9/view?usp=sharing
25. Methods in Agricultural Chemical Analysis: A Practical Handbook: N.T. Faithfull, CABI Publishing, 2002, Book Soft copy URL: https://1lib.in/book/917802/0b4a71

CH-610 (B) Introduction to Forensic Chemistry

Chapter No	Name of the Topic	Number of lectures
1	History of Development of Forensic Science in India	10
2	Introduction to Narcotics Drugs and Psychotropic Substances	10
3	Analysis of Narcotics Drugs and Psychotropic Substances	16
	Total Lectures	**36**

1. History of Development of Forensic Science in India [10 L]

Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science. Frye case and Daubert standard. Work nature of forensic science. Qualifications of forensic scientists. Duties & Code of conduct for forensic scientists.

Learning Objectives: After studying this paper the students will know –

a. The significance of forensic science to human society.

b. The fundamental principles and functions of forensic science.

c. The work nature in a forensic science laboratory.

d. Encourage academic students towards the noble career

Suggested Readings

1. B.B. Nanda and R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty First Century*, Select Publishers, New Delhi (2001).

2. M.K. Bhasin and S. Nath, *Role of Forensic Science in the New Millennium*, University of Delhi, Delhi (2002).

3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005). Page No : 1-13, 243-260, 667-678

4. W.G. Eckert and R.K. Wright in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997). Page No: 11-78

5. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).Page No 5-29

6. W.J. Tilstone, M.L. Hastrup and C. Hald, *Fisher's Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013) Page No : 26-149

7. Directorate of Forensic Science services (DFSS) http://dfs.nic.in/index.html

2. Introduction to Narcotics Drugs and Psychotropic Substances [10 L]

Definition of narcotics drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics drugs and psychotropic substances. Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances. Introduction to NDPS Act-1985 and awareness about Punishment for Offences.

3. Analysis of Narcotics Drugs and Psychotropic Substances [16 L]

Crime scene search for narcotic drugs and psychotropic substances – searching a suspect, searching a dwelling, searching a vehicle. Clandestine drug laboratories. Collection and preservation of drug evidence. Testing of narcotics drugs and psychotropic substances. Isolation techniques for purifying narcotics drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography. Presumptive and screening tests for narcotics drugs and psychotropic substances. Microcrystalline testing of Drug Abuse and Illicit Trafficking. Analysis of narcotics drugs and psychotropic substances in urine, and antemortem blood & in postmortem blood. Dope tests.

Learning Objectives: After studying this paper the students will know –

a. The forensic identification of illicit liquors.

b. The classification and characteristics of the narcotics, drugs and psychotropic substances.

c. The menace of designer drugs.

d. The methods of identifying of narcotics, drugs and psychotropic substance

Suggested Readings

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004). Page No 10-26

2. S.B. Karch, *The Pathology of Drug Abuse*, CRC Press, Boca Raton (1996). Page No: 429-638

3. A. Poklis, Forensic toxicology in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).Page No : 116-141

4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013). Page No 323-337

5. THE NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES, ACT, 1985 https://legislative.gov.in/sites/default/files/A1985-61.pdf

6. THE NARCOTIC DRUGS SUBSTANCES AND PSYCHOTROPIC RULES, 1985 https://dor.gov.in/sites/default/files/Narcotic-Drugs-and-Psychotropic-Substances-Rules-1985_0.pdf

6. National Policy on NDPS Govt. of India https://dor.gov.in/narcoticdrugspsychotropic/national-policy-ndps

7.National Policy on NDPS & Punishment for Offences https://dor.gov.in/narcoticdrugspsychotropic/punishment-offences

8. J.W. Robinson, *Undergraduate Instrumental Analysis*, 5th Edition, Marcel Dekker, Inc., New York (1995). Page No : 721-797

9. Analytical Techniques in Forensic Science Rosalind Wolstenholme, Sue Jickells, Shari Forbes, edition first edition 2021 John Wiley & Sons Ltd Page No; 51-68

10. FORENSIC ANALYTICAL TECHNIQUES Barbara Stuart University of Technology, Sydney, Australia, first edition 2013 John Wiley & Sons, Ltd. 143-166

SEC-IV: CH-610: Skill Enhancing Course-IV [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-611(A): Analytical Chemistry-II

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Solvent extraction	08
2	Instrumental Methods of Chromatographic Analysis	04
3	High Performance Liquid Chromatography	06
4	Gas Chromatography	06
5	Atomic Absorption Spectroscopy	08
6	Flame Emission Spectroscopy	04
	Total	**36**

1. Solvent extraction (8 L)

Introduction to solvent extraction, organic phase, Partition the theory of extraction (distribution coefficient, Distribution ratio, solute remaining unextracted, Separation coefficient), Factors favoring solvent extraction, Quantitative treatment to solvent extraction equilibrium, Ion association complexes, synergic extraction, some extraction reagent specifically used for inorganic ions (Acetylacetone, 8-Hydroxyquinoline, Diphenylthiocarbazone, Sodium diethyldithiocarbamate, Ammonium pyrrolidine dithiocarbamate), some practical aspects, Applications: determination of copper as the diethyldithiocarbamate complex, Determination of Fe(III) with 8-hydroxyquinoline, determination of nickel by synergistic extraction. Solid phase extraction (Ref-3) Numericals; **Key Reference-2**: 242- 253, [Supplementary Ref-3: 579-593]

2. Instrumental Methods of Chromatographic Analysis (4 L)

Principles of Chromatographic Separations, classification, Theory of Column Efficiency in Chromatography, (theoretical plate, rate theory of chromatography - the Van Deemter equation, efficiency and particle size in HPLC, retention factor efficiency and resolution,

Key Reference -4: 603-617, Supplementary reference-3: 547-556.

3. High Performance Liquid Chromatography (6 L)

Introduction, Types of liquid chromatography (liquid-solid, liquid-liquid, bonded phases), Choice of mode of separation, Equipment for HPLC: mobile phase, sample injection and column design (mobile phase, optimization of mobile phase, gradient elution, solvent delivery and sample injection, sample injection system, the column (effect of column length and column diameter), Choosing the Detector, Ultraviolet detector, Luminescence detector, RI detector, electrochemical detector, Column efficiency, HPLC chromatogram and its characteristics (retention time, peak height, peak area), method of quantitative analysis by HPLC, Example: determination of aspirin, phenacetin and caffeine in a mixture, numerical, **Key Reference -2:** 289-315, [Supplementary reference - Ref-3: 649 – 724, Ref-6: 1-325 -relevant part

4. Gas Chromatography (6 L)

Introduction, Apparatus: A supply of carrier gas from a high-pressure cylinder, Sample injection system and derivatization, the column (Packed columns, Open tubular columns), the detector (properties, hot wire detector or TCD, FID, ECD), Quantitative analysis by GC (Area normalization method and internal standard addition method), Elemental analysis, numerical

Key Reference-2: 317- 337, [Supplementary reference - 7: 1-209 (relevant part)]

5. Atomic Absorption Spectroscopy (8 L)

Introduction, Elementary theory, Instrumentation, flames, the nebulizer-burner system, non-flame techniques, (graphite furnace, cold vapour technique), resonance line sources, monochromator, detectors, interferences, chemical interferences, background correction

methods, Atomic absorption spectrophotometers, Experimental preliminaries (calibration curve methods, standard addition method) Preparation of sample (wet ashing, fusion, Dry ashing, microwave dissolution, concentration procedures), Detection limits, Estimation of Ca and Mg in water.

Key Ref-2: 612 – 643

6. Flame Emission Spectroscopy (4 L)

Introduction, emission spectra, flame emission spectroscopy, flame photometers. Evaluation methods, calibration curve procedure, the standard addition technique, Applications: determination of alkali metals by flame photometry, determination of trace elements in contaminated soil by AAS. Numerical,

Key Reference-2: 645-649, 655-656

References:

Ref-1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

Ref-2: Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6th Ed, Pearson education

Ref-3: Analytical Chemistry by G. D. Christian, et al , Wiley, 6th Ed.

Ref-4: Principles of Instrumental Analysis: Holler, Skoog, Crouch 6th Ed. Thomson Publication

Ref-5: Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education

Ref-6: High performance Liquid Chromatography, (Analytical Chemistry through open learning series) Second Ed, Sandie Lindsay, Wiley

Ref-7: Gas Chromatography, (Analytical Chemistry through open learning series) 2nd Ed, Ian A. Fowlis, Wiley

Course outcome: After completion of the course student should able to

1. Define basic terms in solvent extraction, basics of chromatography, HPLC, GC, and AAS and AES. Some important terms are: solvent extraction, aqueous and organic phase, distribution ratio and coefficient, solute remain unextracted, percent extraction, ion association complex, theoretical plate, HETP, retention time, selectivity, resolution, stationary phase, normal and reverse phase, ion exchange, column efficiency, carrier gas, split and spitless injection, packed column, tubular column, atomic absorption and emission spectroscopy, electronic excitation in atoms, nebulization, atomization, reduction of metal ions in flame, absorbance by atoms in flame, flame atomizers, furnace atomizers, interference in AES and FES, HCL, hydride generator, etc.

2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration for particular analysis, reagent for particular analysis, reaction condition to convert analyte into measurable form, wavelength selection in HPLC with spectrophotometric and fluorometric detector, solvent or carrier gas in HPLC and GC, choice method for the sample preparation in atomic spectroscopic methods, choice of filter and HCL in atomic spectroscopic methods, etc.

3. Explain different principles involved in the analyses using solvent extraction, basics of instrumental chromatography, HPLC, GC, and atomic spectroscopic techniques.

4. Perform quantitative calculations depending upon equations students has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.

5. Discuss / Describe procedure for different types analyses included in the syllabus.

6. Select particular method of analysis if analyte sample is given to him.

7. Differentiate / distinguish / compare among the different analytical terms, process and analytical methods.

8. Demonstrate / explain theoretical principles with help of practical.

9. Design analytical procedure for given sample.

10. Apply whatever theoretical principles he has studied in theory during practical in laboratory.

CH-611 (B): Chemistry of Cosmetics and Perfumes

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Chemical composition, preparation and uses of some cosmetics	12
2	Chemistry of Perfumes and fragrances	12
3	Rules and regulations for cosmetic industry	12
	Total	**36**

1. Chemical composition, preparation and uses of some cosmetics [12 L]

A general study including chemical composition, preparation and uses of the following:

Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), Eye make-up (Mascara, Eyeshadow, Eyeliner, Eyebrow pencil), Antiperspirants,***(Ref. 1** – all relevant pages, Ref. 2 Pp. 149 - 177, 187 to 199, 233 to 255, 263, 291 to 310, 323 to 346, 406 to 422, 437 to 452, 457 to 490, 519 to 522**)***

2. Chemistry of Perfumes and fragrances [12 L]

History of perfume, classification sources of fragrance, Development and role of natural products in cosmetics, Extraction of Essential oils and their importance and uses in cosmetic industries with reference to Chemistry of - Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-

phenyl ethyl alcohol, Jasmone, Civetone, Muscone. **(*Ref. 3 Pages 3 to 67 and relevant pages from 68 to 360*)**

3. Rules and regulations for cosmetic industry [12 L]

Understanding of regulations of Central Drugs Standard Control Organization, India Cosmetic Regulation, Steps for process of cosmetic registration in India **(*Ref. 4, 5, 6*)**

4. Projects: (students can choose any one of the following projects and submit a project report at the end of semester for evaluation)

1. Preparation of talcum powder. **(*Ref.2 Pages 263*)**
2. Preparation of shampoo. **(*Ref.2 Pages 323 to 346*)**
3. Preparation of enamels. **(*Ref.2 Pages 495 to 522)***
4. Preparation of hair remover. **(*Ref.2 Pages 425 to 434*)**
5. Preparation of face cream. **(*Ref.2 Pages 149 to 177*)**
6. Preparation of nail polish and nail polish remover. **(*Ref.2 Pages 505 to 522*)**
7. Preparation of Emulsified and solid fragrances. **(*Ref.2 Pages 575 to 583*)**
8. Isolation of Simple Floral fragrances and Alcoholic fragrances solution. **(*Ref.2 Pp 569 to 573*)**

Reference Books:

1. Cosmetic Formulation: Principles and Practice - Heather A.E. Benson, Michael S. Roberts, Vania Rodrigues Leite-Silva, Kenneth Walters
2. COSMETICS Formulation, Manufacturing & Quality Control, Fourth Edition - P. P. Sharma, M pharm
3. Perfumes, Cosmetics and soaps, ninth edition, – W. A. Poucher.
4. **https://cdsco.gov.in/opencms/opencms/en/Cosmetics/cosmetics**
5. **https://cosmetic.chemlinked.com/cosmepedia/india-cosmetic-regulation**
6. **https://morulaa.com/cdsco/process-cosmetics-registration-india**

Additional References :

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).
3. Indian medical plants: by Kirtikar & Basu
4. Naturals and Cosmetics – by Dr. Satish Sakharwade
5. Manufacture of Perfumes, Cosmetics & Detergents – Giriraj Prasad
6. Perfumes: History & Chemistry Vol-I- Dr. D. D. Wasule
7. Cosmetics: Science & Technology – Sagarin.
8. Essential oils Vol. I by Gunther.
9. Perfume flowers & essential oil industries by S.B. Srivastva.

Savitribai Phule Pune University, Pune

Revised Syllabus 2020-21

Course Design

CBCS: 2020-2021 T. Y. B. Sc. **Environmental Science**

Course Structure

Course	Course Code	Name of the Course	Course Code	Name of the Course	Credit
Semester V			Semester VI		
DSEC	EVS-351	Terrestrial Ecosystem and Management	EVS-361	Aquatic Ecosystem and Management	2+2
DSEC	EVS-352	Wildlife biology and Management	EVS-362	Nature Conservation	2+2
DSEC	EVS-353	Water and Soil quality	EVS-363	Air and Noise quality	2+2
DSEC	EVS-354	Atmoshpheric and Global Climate change	EVS-364	Issues in Environmental Science	2+2
DSEC	EVS-355	Environmental legislation and policy	EVS-365	Environmental governance: EMS, EIA & ISO14000	2+2
DSEC	EVS-356	Environmental Biotechnology-I	EVS-366	Environmental Biotechnology-II	2+2
DSEC	EVS-357	Practical-I	EVS-367	Practical-I	2+2
DSEC	EVS-358	Practical-II	EVS-368	Practical-II	2+2
DSEC	EVS-359	Practical-III	EVS-369	Project	2+2
SEC	EVS3511	Remote sensing, GIS and modeling	EVS3613	Solid Waste Management	2+2
SEC	EVS3512	Soil Health Management	EVS3614	Urban Ecosystem	2+2

References:
1. Groom. B. & Jenkins. M. 2000. *Global Biodiversity: Earth's Living Resources in the 21st Century.* World Conservation Press, Cambridge, UK, Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2002.
2. *The Ecology of Plants*. Sinauer Associates Incorporated. Loreau, M. & Inchausti, P. 2002.
3. *Biodiversity and Ecosystem Functioning: Synthesis and Perspectives.* Oxford University Press, Oxford, UK, Odum, E. P. 1971.
4. *Fundamentals of Ecology*. W. B. Sounders, Pandit, M. K., White, S. M. & Pocock, M. J. O., 2014. The Contrasting Effects of Genome Size, Chromosome Number and Ploidy Level on Plant Invasiveness: A Global Analysis.
5. *New Phytologist* 203: 697-703. Pimentel, D. (Ed.). 2011.
6. *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal and Microbe Species*. CRC Press. Singh, J. S., Singh, S. P. & Gupta, S. R. 2006.
7. *Ecology, Environment And Resource Conservation.* Anamaya Publications.
8. Wilson, E. O. 1985. The Biological Diversity Crisis. *Bioscience* 35: 700-706.

Semester – V, Paper –II Credit -2

EVS –352 Wildlife Biology and Management **Total Lectures- 30**

Sr.No.	Name of Unit	Content	Lecture
1	**Introduction to Wildlife Biology**	● Introduction to wildlife Biology ● Definition of Wildlife Biology ● Study of Different characteristics of wildlife Habitat in Biosphere: 1. Aquatic Habitat: Marine, Fresh water, and Estuaries. 2. Terrestrial Habitat: Forest, Grassland, Desert, Landscape.	5
2	**Groups of wildlife species**	● Plant Classification: Algae, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms (Monocot and Dicot) ● Animal Classification: 1.Arthropods (Insect, Arachnids, Crustaceans, Millipedes, Centipedes), 2.Vertebrates (Mammals, Birds, Fish, Reptiles, Amphibians)	5
3	**Threats to wildlife**	Habitat Destruction, Developmental projects, Urbanization, Agriculture expansion, Poaching, Human Wildlife conflict, Deforestation, Ecploitation of animals and plants	5
4	**Habitat Analysis and Population Assessment Techniques**	● Standard Evaluation processes for habitat: HEP & HIS. ● Population Assessment technique (wildlife sensus) 1. Direct count : Block count, Transect methods, Point count, Visual encounter survey, Waterhole survey 2. Indirect count: Pugmark,camera trap, DNA finger printing, Call count, track and sign, pellet count 3. Marking wildlife : Ringing, Tagging, Clipping, Colouring.	5
5	**Modern Wildlife management Techniques**	● Bio- telemetry; ● Management practices :Monitoring Wildlife Populations, Habitat Improvement, Hunting Regulations,Artificial Stocking, Controlling or Preventing Disease and Its Spread, Management Funds/Programs, captive breeding and propagation.	5
6	**Sustainable Wildlife management**	● Eco tourism / wild life tourism in forests; ● Reasons for Biodiversity formation, contribution to adaptive evolution, Landraces of crop plants, conservation of genetic resources,	5

	• Soil types and their formation • Soil Horizons, Texture, Soil structure , fertility • Factors influencing soil –Soil aeration, Soil temperature etc	**05**
5	• Soil Reactions –Acid base reactions, Ion exchange, Micro and Macro nutrients , Nitrogen pathways , NPK in soil • Soil Analysis –pH, Lime ,Silica ,phosphorous , Total nitrogen, Total Sulphur, Manganese, Soluble salts, Pesticides and Environmental friendly technologies	**05**
6	Soil Pollution and Management • Soil sickness & Soil Toxicology • Soil as waste disposal • Remediation of Contaminated site • GIS & Remote sensing application in soil resource management Soil Conservation techniques	**05**

References

1. Principles of Environmental Science-Cunningham & Cunningham
2. Ecology ,Environment and Resource Conservation (2006) : Singh JS, Singh SP, Gupta SR, AnamayaPubl, New Delhi
3. Fundamentals of Ecology (1971) :EP Odum ,WB Saunders Company
4. RS Ramalho ,1983 Introduction to Waste water Treatment Process, Academic press, New York
5. Quanag, EAR ,Principles of Waste waster Treatment Vol I, Biological process,National Science Development Board ,Manila,Phillipines
6. Water pollution by Dr. AnuradhaSalpekar
7. Environmental pollution Analysis by S.M. Khopkar
8. Textbook of Practical Chemistry by Vogel, A.I Tatchell and Furnis
9. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J., &Jones, A., (2011), Practical skills in Chemistry, 2nd Ed., Prentice Hall, Harlow
10. Hydrology – Principles, analysis and Design – H. M Ragunath, New age International Publications.(1996)
11. Standard Methods for the examination of water and waste water – APHA (American Public Health Association), AWWA (American Water Works Association), WEF (Water Environmental Federation)
12. Low cost waste water treatment technologies – R. K. Trivedy and SiddharthKaul
13. Pollution and Bioremediation- P. C. Trivedi
14. An Introduction to Environmental pollution- B. K. Sharma and H. Kaur
15. Environmental Chemistry – A. K. De
16. Microbiology – Micheal J. Pelczar, E. C. S. Chan, Noel R. Krieg.
17. Textbook of Microbiology – R. Ananthanarayan and C. K. JayaramPaniker
18. Soils and soil fertility, Troch, F.R. And Thompson, L.M. Oxford Press.
19. Fundamentals of soil science, foth, H.D. Wiley Books. 3. Soil Science and Management, Plaster, Edward J., Delmar Publishers.
20. Principles of Soil Chemistry (2Wed.) Marcel Dekker Inc., New York. 5. Handbook of Agricultural Sciences, S.S.Singh, P.Gupta, A.k.Gupta, Kalyani Publication.

Semester – V, Paper – IV, Credit- 2

Semester – V, Paper –V Credit-2

EVS –355 Environmental Legislation and policy **Total Lectures- 30**

Unit No	Course Content	Number of Lectures
1	**Introduction to Law and Policy:** Concept of law and policy, environmental governance. Importance and elements of environmental governance.	4
2	**Environmental Legislation:** Legal definitions:Environmental pollution, natural resource, biodiversity, forest, sustainable development. Article 48A:The protection and improvement of environment and safeguarding offorests and wildlife. Fundamental rights and duties as per the Constitution of India Environmental Ethics: Introduction, Concept, Development of environmental ethics.	4
3	**Government Institutions** Role of Ministry of Environment, Forests & Climate Change Role of Central Pollution Control Board (CPCB) Role of State Pollution Control Boards Role ofNational Green Tribunal (NGT)	4
4	**International Laws and Policy** Stockholm Conference 1972, United Nations Conference on Environment and Development 1992, Montreal Protocol 1987; Rio de Janeiro (Rio Declaration, Agenda 21), Kyoto Protocol 1997, Copenhagen and Paris summits, Ramsar convention.	4
5	**Environmental Acts** • The Environment (Protection) Act, 1986, • The Forests (Conservation) Act 1980 • The Wildlife (Protection) Act 1972 • The Water (Prevention and Controlof Pollution) Act 1974 • The Air (Prevention and Control ofPollution) Act 1981 • Motor Vehicle Act 1988 • The Public Liability Insurance Act 1991 • Noise Pollution (Regulation and Control) Rules 2000	14

		• Growth condtions, • Nutritional types, • Types of microbes. • Xenobiotic components.	
			30

References;

1.Erickson, LE and DY Fung. 1988. Handbook on Anaerobic fermentations. Marcel and Dekker Inc. New York.

2.. Holland, KT, JS Knapp and JG Shoesmith. 1990. Anaerobic bacteria. Blackie Publications. New York.

3. Ramasamy, K., G. Kalaichelvan and B. Nagamani. 1992. Working with anaerobes: Methanogens. Fermentation Laboratory, TNAU, Coimbatore.

4. Gerhardt, P., RGE Murray, WA Wood and NR Krieg. 1994. Methods for General and Molecular Bacteriology. ASM Publications, Washington.

5. Jogdand, SN 1995. Environmental Biotechnology. Himalaya Publishing House, Mumbai.

6.. Erickson, LE and DY Fung. 1988. Handbook on Anaerobic fermentations. Marcel and Dekker Inc. New York.

7. Ramasamy, K, G Kalaichelvan and B Nagamani. 1992. Working with anaerobes: Methanogens. Fermentation Laboratory, TNAU, Coimbatore.

8. Crawford, RL and DLCrawford. 1996. Bioremediation - Principles and Applications. Cambridge University Press, London

semester – V, Paper –IX EVS –359 **Practicals based on ENV- 355 and 356**

Unit No	Course Content	Number of Lectures
1	Determining the factors influencing the composting process, nutrients, moisture, temperature and air, microbial populations	1
2	Study of micro organisms by Standard Plate Count (SPC) method	1
3	Microbial analysis of flocs in activated sludge system	1
4	Biological de-colorization using microbial columns	1
5	Isolation of bacteria from soil and decaying matter	1
6	Survey of plants in and around air polluted sites	1
7	Determination of hydrogen sulfide (H2S) from sewage sample	1
8	Analysis of residual pesticides in agricultural land and crops	1
9	Study of Eutrophication parameters & its effects on water bodies	1
10	Study of instrumentation and safety standards in microbial laboratory	1
11	Isolation and characterization of soil microgarinsm from polluted sites	1
12	Analysis of residual pesticides in agricultural land and crops	1
13	Study of Eutrophication parameters & its effects on water bodies	1
14	Survey of plants in and around air polluted sites	1

Semester – V, Paper – IV,

SEC–3511 Remote sensing, GIS and modeling **Total Lectures- 30**

Unit No	Course Content	Number of Lectures
1	Remote Sensing: definitions and principles; electromagnetic (EME) spectrum; interaction of EMR with Earth's surface; spectral signature; satellites and sensors Types of platform; Geostationary orbit and Sun-synchronous Polar orbit; Multi spectral scanning	4
2.	Interaction of EMR with the earth's surface and atmosphere, Energy response mechanism: Reflection, Absorption, Transmission, Scattering,	4

	● Methods of Pest Management-Biological, Cultural, Legislative, Physical & Chemical, (Chlorinated Hydrocarbons, Organophosphates & Carbamates), ● Pesticide use & Environment, Organic Crop Production , Agroforestry, Integrated Pest Management (IPM) & Bio-pesticides. ● Concept of Ecological Pest & Disease Management-Energy Crops,	
4	● Fertilizers, Classification of Fertilizers Effects due to use of excess fertilizer & Their Management . ● Concept & importance of Bio-fertilizers, Types and Use. ● Calculation of Recommended dose of fertilizer	6
5	● Schemes for water conservation ● Scheme for fertilizer, seed, and other material purchase ● Soil Health card	4

References:

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2.Clark, A., ed. *Managing Cover Crops Profitably*. 3rd ed. Handbook Series No. 9. Beltsville, MD: Sustainable Agriculture Network, 2007.

3. Coleman, D. C., D. A. Crossley Jr., and P. F. Hendrix. *Fundamentals of Soil Ecology*. 2nd ed. Burlington, MA: Elsevier Academic Press, 2004.

4.Gugino, B. K., O. J. Idowu, R. R. Schindelbeck, H. M. van Es, B. N. Moebius-Clune, D. W. Wolfe, J. E. Thies, and G. S. Abawi. *Cornell Soil Health Assessment Training Manual*. Edition 2.0. Ithaca: Cornell University, 2009.

5. Hall, M., and G. Roth, eds. *The Penn State Agronomy Guide* .

6. Hooper, D., et al. “Interactions between aboveground and belowground biodiversity in terrestrial ecosystems: Patterns, mechanisms, and feedbacks." *BioScience* 50 (20): 1049–61.

7. Magdoff, F., and H. van Es. *Building Soils for Better Crops: Sustainable Soil Management*. 3rd ed. Handbook Series No. 10. Beltsville, MD: Sustainable Agriculture Network, 2009.

8 Tisdall, J. M., and J. M. Oades. “Organic matter and water-stable aggregates in soils." *Journal of Soil Science* 33 (1982): 141–63.

9 Tugel, A., A. Lewandowski, D. HappevonArb, eds. *Soil Biology Primer*. Rev. ed. Ankeny, Iowa: Soil and Water Conservation Society, 2000.

10 Zehnder, G. Farmscaping: *Making Use of Nature's Pest Management Services*

	• Methods of aquatic sampling and data analysis: sampling approaches, species association. • Case studies	
6	**Exploitation and Consequences of wetlands,** • Sustainable management • Role of Local Government and people in conservation, • Impact of Tourism, Eco-tourism • Conservation and Sustainable use of India's aquatic resources	5

References:
1. Groom. B. & Jenkins. M. 2000. *Global Biodiversity: Earth's Living Resources in the 21st Century.* World Conservation Press, Cambridge, UK, Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2002.
2. *The Ecology of Plants*. Sinauer Associates Incorporated. Loreau, M. & Inchausti, P. 2002.
3. *Biodiversity and Ecosystem Functioning: Synthesis and Perspectives.* Oxford University Press, Oxford, UK, Odum, E. P. 1971.
4. *Fundamentals of Ecology*. W. B. Sounders, Pandit, M. K., White, S. M. & Pocock, M. J. O., 2014. The Contrasting Effects of Genome Size, Chromosome Number and Ploidy Level on Plant Invasiveness: A Global Analysis.
5. *New Phytologist* 203: 697-703. Pimentel, D. (Ed.). 2011.
6. *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal and Microbe Species*. CRC Press. Singh, J. S., Singh, S. P. & Gupta, S. R. 2006.
7. *Ecology, Environment And Resource Conservation.* Anamaya Publications.
8. Wilson, E. O. 1985. The Biological Diversity Crisis. *Bioscience* 35: 700-706.

Semester – VI, Paper –II Credit-2

EVS –362 **Nature Conservation** **Total Lectures- 30**

Sr.No.	Name of Unit	Content	Lecture
1	**Introduction to Nature Conservation**	● Introduction, ● Concept of nature conservation ● Objectives ● Challenges	5
2	**In-situ Conservation**	● Concept and principle of Insitu Conservation. ● Types : Biosphere reserve, National Parks, Wildlife sanctuaries, Biodiversity Hotspots, Gene Sanctuary, Community reserves, Sacred groves ● Challenges, merits and Demerits	5
3	**Ex-situ conservation**	● Concept and principle ● Types : Cryopreservation, Seed banks, Field gene banking, Cultivation Collections ● Challenges, merits and Demerits	5
4	**International and National Efforts for conservation**	● Role if IUCN, WWF for naure conservation. ● Introduction to Protocol and Conventions for Nature conservation. ● National Efforts: BNHS, Tiger, Crocodile, Reindeer, Whaling mission. ● Administrative Setup: MoEFCC, SPCB, CPCB, etc ● Role of NGO	10

	Matter,	**05**
4	Air Pollution control Air Pollution control- at source-equipment for control of air pollution-For particulate matter-Settling chambers-Fabric filters-Scrubbers-Cyclones Electrostatic precipitators, For Gaseous pollutants-control by absorption-adsorption scrubbers-	**05**
5	Noise pollution Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; causes of noise, outdoor and indoor noise propagation; psycho-acoustics and noise criteria	**05**
6	Effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices	**05**

References

- Rao and Rao: Air Pollution Control Engineering.
- Environmental Pollution Control Engineering-CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
- C.S. Rao, Air pollution and control
- Environmental Noise Pollution-PE Cunniff, McGraw Hill, New York, 1987

Semester – VI, Paper – IV, Credit-2

EVS –364 Environmental Issues **Total Lectures- 30**

Unit No	**Course Content**	**Number of Lectures**
1	Global Environmental issues - ozone depletion, global warming and climatic change., Energy crisis and conservation, Biodiversity conservation, Hotspots , Bio-resources and their impact on local economy.	4
2	The green revolution, food crisis and population explosion, Pastoralism.Rehabilitating degraded lands, The Gender and environment debate	6
3	Ecological conflicts and the environmental movements in India: Narmada Bachao Andolan, Appiko Movement, Chipko movement, Silent Valley Movement, Tehri Dam conflicts, Almatti dam, Bhopal gas tragedy, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil	4
4.	Waste lands and their reclamation. Desertification and its control. Vehicular pollution and urban air quality. Depletion of Nature resources	6
5	Waste disposal, recycling and power generation. Fly ash utilization. Water Crises-Conservation of water. Environmental Hazards. Eutrophication and restoration of Indian lakes. Rain water harvesting. Wet lands conservation. Epidemiological issues (e.g. Corona pandemic Goitre, Fluorosis, Arsenic)	6
6.	International trade and economic reforms on the environment, industrial growth, environmental and ecology in India, major issues in sustaining growth and development	4

5	Case studies based on Developmental Project	Assessment of impact on development activities on • vegetation and wildlife, • deforesrtration and mining	4

References

- EIA notification published by Ministry of Environment, Forests and Climate Change, Government of India
- Environmental Impact Assessment, Canter R.L., McGraw Hill International Edition.
- Environmental Impact Assessment: Practical Guide for Professional Practices by Rathi AKA, Publisher: Gujarat Akar Unlimited, 2016
- Preventive Environmental Management: An Indian Perspective by Dr. Shyam R. Asolekar& Dr. R. Gopichandran

Semester – V , Paper –VI Credit-2

EVS –366 Environmental Biotechnology-II **Total Lectures- 30**

Unit No	Name of Unit	Content	Lectures
	Bioremediation	Principles of bioremediation; Types of Bioremediation; Concept of bioaugmentation and biostimulation. (A) Microbial Remediation: - Factors affecting bioremediation process: microbial metabolism, environmental conditions and nature of pollutant. (B) Phytoremediation: - Concept and types of phytoremediation, factors affecting on phytoremediation, plants useful for phytoremediation, removal of metals and organic pollutants; phyto-extraction, phyto-stabilization, Rizo-filtration, Phyto-transformation, phyto-volatilization. Current developments in the process of bioremediation.	6
	Biotechnology for the control of pollutants	Air and water pollution & its control through biotechnology; methods of biofiltration; Xenotiotics in environment; oxic and anoxic degradation of xenobiotics; Biotechnological approach to address environmental problems; Wastewater treatment using aquatic plants; Biotechnology of solid waste disposal; Use of immobilized enzymes and microbes for pollution abatement; improvement of microbial strains by conventional and molecular biological techniques.	6
	Biodegradation	History, advantages and disadvantages of Bioleaching, microbes used for bioleaching; Biochemical extraction from mixture types of bioleaching, methods of bioleaching and	4

Semester – VI, Paper –VII

EVS –367 **Practicals based on ENV- 361 and 362**

Sr. No.	Title	No. of practical
1	Identification and Classification of phytoplankton and zooplankton from water sample	1
2	Quantitative analysis of phytoplankton by Lackey's Drop count method	1
3	Study of Wetland ecosystem	1
4	Study of swamp (Mangrove) ecosystem	1
5	Study of Aquatic Weeds, Insects, Birds	1
6	Study of Benthic fauna	1
7	Study of Macrophytes and microorganisms as Bioindicator of pollution	1
8	Determination of pH, EC and temperature of waste water	1
9	Estimation of Dissolved oxygen and CO2 of water sample	1
10	Determination of BOD of waste water sample	1
11	Determination of COD of waste water sample	1
12	Testing the bacteriological quality of drinking water	1
13	Jar test for Coagulation and Flocculation	1
14	Determination of Sludge Volume Index	1
15	Study of various disinfection methods for water	1

Semester – VI, Paper –VIII

EVS –368 **Practicals based on ENV- 363 and 364**

Sr No	Name of Practical	No. of Practical
1	Principle and functioning of high volume air sampler	1
2	Sampling of waste water from different polluted sites	1
3	Estimation of SPM from atmosphere	1
4	Determination of SOx	1
5	Determination of NOx	1
6	Visit to pollution control laboratories	1
7	Determination of MPN from drinking water resource for potability	1
8	Study of phytoremediation techniques to remove pollutants	1
9	Study of Safety instructions	1
10	Testing the bacteriological quality of drinking water	1
11	Examination of sewage water for microbial pathogens	1
12	Methods of disinfection in waste waters	1
13	Use of macrophytes as bio-indicators for water/soil pollution monitoring	1
14	Use of microorganisms as bio-indicators for water/soil pollution monitoring	1

2. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons.
3. Blackman, W.C. 2001. Basic Hazardous Waste Management. CRC Press.
4. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons.
5. US EPA. 1999. Guide for Industrial Waste Management. Washington D.C.
6. White, P.R., Franke, M. &Hindle P. 1995. Integrated Solid waste Management: A Lifecycle Inventory. Blackie Academic & Professionals.
7. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. Improving Municipal Solid waste Management in India. The World Bank, Washington D.C..

Semester – V, Paper – IV, Credit-2

SEC–3614 Urban Ecosystem **Total Lectures- 30**

Unit No	Course Content	Number of Lectures
1	Introduction to urbanization; urban sprawl and associated environmental issues.	3
2.	**Environment in an urban setting:**Man as the driver of urban ecosystem; commodification of nature; metros, cities and towns as sources and sinks of resources; resource consumption and its social, cultural, economic and ecological perspectives; urban transformation; increasing challenges posed by modernity for the environment; urban pollution (air, water, soil).	4
3.	**Urban dwelling** :Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure.	6
4	**Urban interface with the environment**: Management of urban environment; alternative resources; policy and management decisions; urban settings as loci of sustainability; challenges associated with sustainability and urban future.	6
5	**Natural spaces in a city** :Concept of 'controlled nature'; scope, importance and threats to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; urban natural forest ecosystem as green lungs.	4
6	**Planning and environmental management**: Urban planning and its environmental aspects from historical and contemporary perspectives; benefits of environmental management; introduction to green buildings; urban governance; political complexity of applying ecological science to urban policy and planning, smart cities.	6

References

1.D'Monte, Darryl. 1985. Industry versus Environment Temples or Tombs. Three Controversies, Delhi, CSE.

2. Ernstson, H. 2011. Re-translating nature in post-apartheid Cape Town: The material semiotics of people and plants at Bottom Road. In: Heeks, R., (Ed.) Conference on "Understanding Development through Actor-Network Theory", London School of Economics, 30 June, London.

3. Gaston, K.J. 2010. Urban Ecology. Cambridge University Press, New York.

4. Grimm, N. B., Faeth, S. H., et al. 2008. Global Change and the Ecology of Cities. Science 319: 756-760.

5. Hinchliffe, S. & Whatmore, S. 2006. Living cities: Towards a politics of conviviality. Science as Culture 15: 123–138.

University of Pune

Two Year M. Sc. Degree Course in Chemistry

M. Sc. Chemistry

(Credit and Semester based Syllabus to be implemented from Academic Year 2013-14)

1) Title of the Course: M.Sc. Chemistry

2) Preamble of the Syllabus:

Master of Science (M.Sc.) in Chemistry is a post graduation course of University of Pune. The credit system to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

The students pursuing this course would have to develop in depth understanding of various aspects of the subject. The conceptual understanding, development of experimental skills, designing and implementation of novel synthetic methods, developing the aptitude for academic and professional skills, acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological processes and rationale towards computer assisted drug designing are among such important aspects.

3) Introduction:

Salient Features of the Credit System:

1. Master's degree course in Chemistry would be of 100 credits, where one credit course of theory will be of one clock hour per week running for 15 weeks and one credit for practical course will consist of 15 of laboratory exercise including the revision and setting up the practical. Thus, each credit will be equivalent to 15 hours.
2. Student will have to take admission in Chemistry Department and complete 75 credits incorporated in the syllabus structure of Chemistry. The remaining 25 credits shall be chosen from courses offered by the Chemistry Department or other Departments of the University/College with credit system structure.
3. Except practical credits wherever applicable, students may be allowed to complete less courses per semester on the condition they complete the degree in maximum of four years. This facility will be available subject to the availability of concerned courses in a given semester and with a maximum variation of 25 credits (in case of fresh credits) per semester.
4. Every student shall complete 100 credits in a minimum of four semesters. All Semesters will have average 25 credits each.
5. The student will be declared as failed if s/he does not pass in all credits within a total period of four years. After that such students will have to seek fresh admission as per admission rules prevailing at that time.
6. Academic calendar showing dates of commencement and end of teaching, internal assessment tests and term end examination will be prepared and duly notified before commencement of each semester every year.
7. Project course should not be greater than 5% of the total credits of the degree course. Project course is equivalent to 4 credits.

Instructions for the Students

The students seeking admission to M.Sc. Chemistry course is hereby informed that they are supposed to adhere to the following rules:

1. A minimum of 75 % attendance for lectures / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visits / training course as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be given to the student absent for the test/s.
3. The students opting for dissertation course shall follow the rules framed for the same.
4. Industrial / Institute - Visit and or Industrial Workshops / Laboratory Workshops / Training Programme is a compulsory component of the syllabus. The students are supposed to attend all the Industrial Workshops / Laboratory Workshops / Training Programme organized by the department. The students shall attend these programs at their own cost.

4) Eligibility:

The candidate should have a B.Sc. degree with Chemistry as principal subject **OR** B.Sc. (General) degree with Chemistry (Electronics) as one of the subsidiary subjects.

Admission: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune.
Reservation and relaxation will be as per the government rules.

5) Examination

[A] Pattern of Examination

Evaluation of Students:

1) The In-semester and End-Semester examinations will be of 50 marks each.
2) Student has to obtain 40% marks in the combined examination of In-Semester and End-Semester assessment with minimum passing of 30% passing in both assessments separately.
3) A student cannot register for third semester if s/he fails to complete the 50% credits of the total expected within two semesters.
4) Internal marks will not change. Student cannot repeat internal assessment. If student misses internal assessment examination, s/he will have second chance with the permission of the concerned teacher. But it will not be right of the student. It will be the discretion of the concerned teacher and internal departmental assessment committee. In case s/he wants to repeat Internal, s/he can do so only by registering for the said courses during $5^{th}/6^{th}$semester whichever is applicable.
5) There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.
6) Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

i. **In-semester Examination**: Internal assessment for each course would be continuous and dates for each tutorials/practical tests will be pre-notified in the time table for teaching or placed separately as a part of time table. Department / College Internal Assessment Committee will coordinate this activity

a) **Theory Courses**: Conducting written tests should not be encouraged. More focus should be on non-written tests. Students should be encouraged to conduct various academic activities. A teacher must select a variety of the procedures for internal assessment suggested as follows.

a) Mid-term test
b) On-line test
c) Computer based examination
d) Open book test (concerned teacher will decide the allowed books)
e) Tutorial
f) Surprise test
g) Oral
h) Assignments
i) Review of research paper
j) Seminar presentation
k) Journal/Lecture/Library notes

Student has to preserve the documentation of the internal assessment except midterm test answer script. It is the responsibility of the student to preserve the documents.

b) **Practical Courses**: It is a continuous evaluation process. Practical courses will be evaluated on the basis of the following

1. Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
2. Test on practical may be conducted before the end-semester examination.
3. Assessment of each experiment shall be done for each practical weekly.
4. Assessment of the Activity will be based on any one of the following per practical course.
   i. Experimental and analytical skills
   ii. Synthesis of compounds
   iii. Evaluation of physical constants, purity of compounds
   iv. Fundamental understanding of instrumental techniques
   v. Recording and analysis of spectral data
   vi. Economic utilization of chemicals
   vii. Basic understanding of the experiment

The student strength of practical batch should be eight. Note that one practical session of 4 hour duration of one practical batch.

Project Course: Project will be evaluated by In-Charge of project batch in concern with project guide. Assessment will be done weekly in the respective batch. Evaluation will be on the basis of weekly progress of project work, progress report, referencing, oral, results and documentation.

ii. **End-Semester Examination**: End-Semester examination for 50 marks per course would be held about two weeks after completion of teaching for the semester. Paper setting and assessment for a particular course would be the responsibility of the course In-charge, and these activities would be coordinated by the Department Examination Committee. The Department Examination committee would undertake preparation of the result-sheets for the student

[B] Standard of Passing

Student has to obtain 40% marks in the combined examination of In-Semester and End-Semester assessment with minimum passing of 30% passing in both assessments separately.

[C] ATKT Rules

A student cannot register for third semester if s/he fails to complete the 50% credits of the total credits expected to be ordinarily completed within two semesters.

[D] Award of Class

Grades will be awarded from grade point average (GPA) of the credits.

GPA Rules:

1. The formula for GPA will be based on Weighted Average. The final GPA will not be printed unless a student passes courses equivalent to minimum 100 credit hours (Science). Total credits hours means the sum of credit hours of the courses which a student has passed.
2. A seven point grade system [guided by the Government of Maharashtra Resolution No. NGO – 1298 / [4619] / UNI 4 dt. December 11, 1999 and University regulations] will be followed. The corresponding grade table is attached herewith.
3. If the GPA is higher than the indicated upper limit in the third decimal digit then the student be awarded higher final grade (e.g. a student getting GPA of 4.492 may be awarded 'A')
4. For Semester I, II, III examinations, only the grade points will be awarded for each subject. Final GPA along with final grade will be awarded only at the end of IV semester. There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course.
5. After the declaration of result, for the improvement of Grade, the student can reappear for the examination of 30 credits worth theory courses.
6. Grade improvement programme will be implemented at the end of the academic year. A student can opt for grade improvement programme only after the declaration of final semester examination i.e. at the end of next academic year after passing M.Sc. (Chemistry) examination and within two years of completion of M.Sc. (Chemistry). A student can appear for grade improvement programme only once.

Grade and Grade Point Average		
Marks	**Obtained Grade**	**Grade Points**
100 – 75	**'O'** Outstanding	06
74 – 65	**'A'** Very Good	05
64 – 55	**'B'** Good	04
54 – 50	**'C'** Average	03
49 – 45	**'D'** Satisfactory	02
44 – 40	**'E'** Pass	01
39 and less	**'F'** Fail	00

Final Grade Points	
Grade Points	**Final Grade**
5.00 – 6.00	**O**
4.50 – 4.99	**A**
3.50 – 4.49	**B**
2.50 – 3.49	**C**
1.50 – 2.49	**D**
0.50 – 1.49	**E**
0.00 – 0.49	**F**

Common Formula for Grade Point Average (GPA):

$$GPA = \frac{\text{Total of Grade Points earned} \times \text{Credit hours for each course}}{\text{Total Credit hours}}$$

B Grade is equivalent to at least 55% of the marks

[E] External Students: There shall be no external students.

[F] Setting of Question Paper / Pattern of Question Paper

For core (compulsory) theory courses, end semester question papers set by the University of Pune and centralized assessment for theory papers done as per the University instructions. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

Theory examination will be of 2 hours duration for each theory course of 5 credits. There will be **two sections** for each paper. Each section will be of **25 marks** and the pattern of question paper shall be:

Question 1 (10 Marks)	5 compulsory sub-questions, each of 2 marks; answerable in 2-3 lines
Question 2 (10 Marks)	2 out of 4 – short answer type questions of 5 marks each; answerable in 8 – 10 lines
Question 3 (5 Marks)	1 out of 2 – numerical problem type question; note, spectral analysis, functioning of instrumental technique with components

[G] Verification / Revaluation

There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course. There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

6) Structure of Course

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two year integrated course leading to M.Sc. (Chemistry) in the colleges affiliated to Pune University.

a) Compulsory Papers

Theory: CHP-110, CHP-210, CHI-130, CHI-230, CHO-150, CHO-250, CHA-290

Practical: CHP-107, CHI-147, CHO-247

M. Sc. Chemistry - Course structure & Credits Distribution

Semester	Course Code	Course Title	No. of Units	No. of credits
Sem-I	CHP-110	Fundamentals of Physical Chemistry-I	04	04
	CHI-130	Molecular Symmetry & Chemistry of p-block elements	04	04
	CHO-150	Basic organic chemistry	04	04
	CHA-190	Safety in Chemical Laboratory and Good Laboratory Practices	04	04
	CHP-107	Practical Course (Physical Chemistry)	24 Practical Sessions	06
	CHI-147	Practical Course (Inorganic Chemistry)	24 Practical Sessions	06
Sem-II	CHP-210	Fundamentals of Physical Chemistry-II	04	04
	CHI-230	Coordination and Bioinorganic Chemistry	04	04
	CHO-250	Synthetic organic chemistry and spectroscopy	04	04
	CHA-290	General Chemistry	04	04
	CHO-247	Practical Course (Organic Chemistry)	24 Practical Sessions	06

b) Question Papers and papers etc.:

Theory

In-Semester Examination:	50 Marks
End-Semester Examination:	50 Marks

Practical

In-Semester Examination:	50 Marks
End-Semester Examination:	50 Marks

c) Medium of Instructions: English.

7) Equivalence of Previous Syllabus:

New Course (5 credit pattern; 20013-14 Pattern)	New Course (4 Credit pattern; 2014 - 15 Pattern)
CH-110	CHP-110
CH-130	CHI-130
CH-150	CHO-150
-	CHA-190
CH-107	CHP-107
CH-127	CHI-127
CH-210	CHP-210
CH-230	CHI-230
CH-250	CHO-250
CH-290	CHA-290
CH-247	CHO-247

8) University Terms:

Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only for duly admitted students. The term shall be granted only on minimum 75 percent attendance at theory and practical course and satisfactory performance during the term.

9) Qualification of Teacher:

i. M.Sc. (Chemistry) degree with NET/SET qualification.
ii. Recognition of Pune University as a post graduate teacher, by papers.

iii. Other criteria as per the guidelines of UGC and University of Pune.

M. Sc. Chemistry Part-I

Physical Chemistry

Semester - I

CHP-110: Fundamentals of Physical Chemistry-I (4 Credits)

SECTION-I (2 Credits, 24 L, 6 T)

Thermodynamics

1. Recapitulation:- Heat, work & Conservation of energy – The basic concepts, the first law, infinitesimal changes, mechanical work, work of compression & expansion, free expansion, expansion against constant pressure, reversible expansion. Heat:- heat capacity, enthalpy. State functions & differentials – State functions, exact & inexact differential, changes in internal energy, temperature dependence of the internal energy, temperature dependence of the enthalpy. Work of adiabatic expansion – Irreversible adiabatic expansion, reversible adiabatic expansion. (02 L)
2. The second law of Thermodynamics: Measuring the dispersal the entropy. The second law, the definition of entropy, the entropy changes in the system, natural events. Entropy changes in the universe – The enthalpy change when a system is heated. Entropy changes in surroundings. The entropy of phase transition. The entropy of irreversible changes. Concentrating on the system – The Helmholtz & Gibbs function, some remarks on the Helmholtz function. Maximum work, some remarks on Gibbs function. Evaluating the entropy & Gibbs function. The third law of Thermodynamics, Third law entropies standard molar Gibbs function. (05 L)
3. Combining First & Second law – One way of developing the fundamental equations properties of Gibbs function. The temperature dependence of the Gibbs functions. The pressure dependence of the Gibbs functions. The chemical potential of a perfect gas. The open system & changes of composition. (03 L)

4. Changes of State: Physical Transformation of pure materials. The stabilities of phases, Phase equilibrium & phase diagrams. The solid – liquid boundary. The liquid - vapor boundary. The solid-liquid-vapor boundary. (03 L)

5 Changes of State: Physical transformation of simple mixtures, partial molar quantities – Partial molar volume, Partial molar Gibbs function. The thermodynamics of mixing – the Gibbs function of mixing after thermodynamics mixing functions. The chemical potential of liquid-liquid mixture. Colligative properties – The common features, the elevation of boiling point. The depression of freezing point, solubility, osmosis. Mixtures of volatile liquid-vapor pressure diagram. (04 L)

6. Quantum Chemistry (07 L)

Historical development of quantum theory, failure of classical mechanics, black body radiation, photo electric effect, specific heats of solids, Atomic spectra, wave particle duality, uncertainty principles, Schrodinger equation, free particle, particle in one dimensional box, hydrogen like atoms (No derivation), atomic orbital's.

SECTION-II (2 Credits, 24 L, 6 T)

Chemical kinetics and reaction dynamics

1. Recapitulation: The rates of reaction, reaction rate, rate laws & rate constants, the determination of the rate law, first order, second order reactions, half lives, fractional order reactions. (02 L)

2. Accounting for rate laws, simple reactions, the temperature dependence of reaction rates, reactions approaching equilibrium, consecutive reactions, the steady state approximations, pre equilibria, unimolecular reactions. (05 L)

3. The kinetics of complex reactions: chain reaction- explosion, photochemical reactions-quantum efficiency, fast reactions-flash photolysis, flow techniques, relaxation methods.

(02 L)

4. Molecular reaction dynamics- collision theory-the basic calculations, the steric requirements, Diffusion control reactions- classes of reactions, diffusion and reactions, the details of diffusion, Activated complex theory- the reaction coordinate and the transition state, the formation and decay of the activated complex, how to use the Eyring equation, thermodynamics aspects, reactions between ions. (05 L)

5. Enzyme catalysts: Michaelis-Menten mechanism, limiting rate, Lineweaver Burk and Eadie plots enzyme inhibition, competitive and non-competitive inhibition. (04 L)

6. Molecular Thermodynamics: Molecular energy levels, Boltzmann distribution law, partition functions and ensembles, translational, rotational and vibrational partition functions of diatomic molecules, Obtaining energy, heat capacity, entropy free energy, equilibrium constants from partition functions, equipartition of energy, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics. (06 L)

References

1. Physical Chemistry- P.W.Atkin and De Paule 8th edition (2010)
2. Physical Chemistry-T. Engel and P. Reid, Pearson Education (2006)
3. Physical Chemistry and molecular approach- D. Mcquarie and J. Simon (University Science) (2000)
4. Physical Chemistry for Bilogical Sciences by Raymond Change (Universal books) (2000)
5. Physical Chemistry – Marron and Prouton
6. Physical Chemistry- G.M. Barrow, Tata McGrow Hill 1988
7. Quantum Chemistry- I. Levine 5^{th} edition, Prentice Hall, 1999.

Inorganic Chemistry

Semester - I

CHI-130: Molecular Symmetry & Chemistry of p-block elements (4 credits)

SECTION-I: Molecular Symmetry and its Applications

(2 Credits, 24 L, 6 T)

(a) Definitions and Theorems of Group Theory: Defining properties of a group, group multiplication table, some examples of group, subgroups, classes

(b) Molecular Symmetry and Symmetry Groups: Symmetry elements and operations, Symmetry planes and reflections, the inversion centre, proper axes and proper rotations, improper axes and improper rotation, products of symmetry operations, equivalent symmetry elements and equivalent atoms, general relations symmetry elements and symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classes of symmetry operations, classification of molecular point groups.

(c) Representations of Groups: Matrix representation and matrix notation for geometric transformation, The Great Orthogonality Theorem and its consequence, character tables (No mathematical part)

(d) Group theory and quantum mechanics: Wave function as basis for irreducible representations

(e) Symmetry Adapted Linear Combinations: Projection operators and their use of construct SALC (Construction of SALC for sigma bonding for molecules belonging point groups: $D_{2h,}$ D_{3h} D_{4h}, C_{4v}, Td, Oh, normalization of SALC.

(f) Molecular Orbital Theory: Transformation properties of atomic orbital, MO's for Sigma bonding ABn molecules, tetrahedral AB_4 and Oh AB_6 cases.

References:

1) Chemical Applications of Group Theory, 3rd Edn., Author - F. A. Cotton (Wiley, New York)

2) Symmetry and spectroscopy of molecules, 2nd Ed. 2009; K. Veera Reddy, (New Age International Publication)
3) Group Theory and its Chemical Applications, P.K. Bhattarchrya

Section-II: Chemistry of Main group elements

(2 Credits, 24 L, 6 T)

1. Hydrogen and its compounds: Hydrides: Classification, electron deficient, electron precise and electron rich hydrides. PH_3 , SbH_3 , AsH_3 , Selenides, Tellurides **(2 L)**
2. Alkali and alkaline earth metals: Solutions in non-aqueous Media, Application of crown ethers in extraction of alkali and alkaline earth metals **(2 L)**
3. Organometallic Compounds of Li, Mg, Be,: Classification, Synthesis, Properties, Uses and Structure **(3 L)**
4. Boron Group: Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOMO, interconversion of lower and higher boranes, Metalloboranes, Carboranes, Reactions of Organoboranes **(4 L)**
5. Carbon Group: Allotropes of Carbon, C_{60} and compounds (fullerenes), Intercalation compounds of Graphite, Carbon nanotubes, synthesis, properties, structure-single walled, multi walled, applications **(2 L)**
6. Organometallic compounds of Si, Sn, Pb, Ga, As, Sb, Bi. Structures, synthesis, **(3 L)** Reactions
7. Nitrogen Group: Nitrogen activation, Boron nitride, Oxidation states of nitrogen and their interconversion, PN and SN Compounds, NOx and their redox chemistry **(3 L)**
8. Oxygen Group: Metal Selenides and Tellurides, oxyacids, and oxoanions of sulphur & nitrogen. Ring, Cage and Cluster compounds of p-block elements. Silicates, including Zeolites **(3 L)**
9. Halogen Group: Interhalogens, pseudo-halogen, Synthesis, Properties and Applications, Structure, Oxyacids and Oxoanions of Halogens, Bonding **(2 L)**

References:

1) Inorganic Chemistry : Shriver & Atkins (4th edition 2003, Oxford)
2) Concise Inorganic Chemistry, J. D. Lee, Fourth Edn.(Chapman and Hall)

3) Inorganic chemistry: principle of structures and reactivity, Huheey, Keiter, Keiter, Medhi, Pearson Education, 4th Edn. (2007).
4) Inorganic Chemistry: Catherine Housecroft
5) Inorganic Chemistry: Messler & Tarr, Pearson Publishers 3rd Edition
6) Organometallic Chemistry-A Unified Approach: R. C. Mehrotra & A. Singh

Organic Chemistry

Semester - I

CHO-150: Basic organic chemistry (4 Credits)

Section-I (2 credits, 24 L, 6 T)

1. **Structure and reactivity:** **(10 L)**
   a) Chemical bonding and basis of reactivity- Chemical bond, delocalization, conjugation, resonance, hyperconjugation, tautomerism, inductive effects.
   b) Acidity and basicity: various structural effects, hard and soft acid and base concept.
   c) Aromaticity: Benzenoid and non-benzenoid compounds, Huckels rule, antiaromaticity, Application to carbocyclic and heterocyclic systems, annulenes, azulenes, current concepts of aromaticity.
   d) Structure and stability of reactive intermediates, carbenes, nitrenes, carbocations, carbanions and free radicals.
2. **Stereochemistry**: **(14 L)**
   a) Sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S, E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship, stereospecific and stereoselective reactions, optical activity in biphenyls, spiranes, allenes.
   b) Conformational analysis of cyclic and acyclic compounds.

Section-II

1. **Organic reactions:** **(2 credits, 24 L, 6 T)**
   a) **Substitution reaction**: **(10 L)**
   Aliphatic nucleophilic substitution-S_N1, S_N2 mechanism, NGP by pi and sigma bonds, classical and non-classical carbocations, phenonium ions, norbornyl system, carbocation rearrangement in NGP, SNi mechanism, nucleophilic substitution in allylic,trigonal and vinylic carbon.

Effect of structure, nucleophile, leaving group and solvent on rate of S_N1 and S_N2 reactions, ambident nucleophile and regioselectivity.

b) Aromatic Electrophilic substitution (4 L)

Arenium ion mechanism, orientation and reactivity, energy profile diagram, ortho, para, ipso attack, orientation in other ring systems, six and five membered heterocycles with one hetero atom.

Important reactions like Friedel crafts alkylation and acylation, Nitration, halogenation, formylation, chloromethylation, sulphonation, diazonium coupling.

Aromatic nucleophilic substitution (2 L)

S_NAr, S_N1, Benzyne and S_NR1 reactions, reactivity: effect of substrate structure, leaving group and attacking nucleophile.

c) Addition reactions (4 L)

Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition reaction involving electrophile, nucleophile and free radicals, Regio and chemo selectivity, orientation and reactivity, conjugate addition.

d) Elimination reactions (4 L)

E1, E2, E1cb mechanisms, orientation and stereochemistry in elimination reaction, reactivity effect of structure, attacking and leaving group, competition between elimination and substitution, syn eliminations.

References:

1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)
2. Advanced Organic Chemistry –by J. March 6^{th} Edition
3. Advanced Organic Chemistry (part A) –by A. Carey and R.J. Sundberg
4. Stereochemistry of carbon compound-by E.L. Eliel
5. Stereochemistry of organic compound-by Nasipuri
6. Guide book to Reaction Mechanism –Peter Sykes

General Chemistry

Semester – I

CHA-190 **(4 Credits, 48 L, 12 T)**

Safety in Chemical Laboratory and Good Laboratory Practices

1 History and importance of safety and health in Laboratory **(1 L)**

- Moral, legal and financial reasons.

2 Different types of Hazards at workplace handling chemicals **(3 L)**

- Physical, chemical, biological, allergens
- Effect of hazards on health
- Where to find Hazard information-Reading Labels,

Ref. 1; Page 1 – 8.

3 Personal Protective and other safety equipments and their uses **(6 L)**

Various safety goggles, types of gloves, apron, masks, different filters for masks, face shield, full body suit, safety shoes, helmet, breathing apparatus suit, safety belt, earmuffs along with inspection methods. Emergency exit, its location and approach path, fire extinguishers, and their periodic inspection, first aid kit, its contents and need for monitoring. Eye wash fountains and safety showers, fire drill, and chemical accident drills, accident free days and incentives to follow safety rules, accident recording and investigation for future controls

Ref. 2; relevant pages

Dos and Don't: Safe clothing, hair, dangling jewellery responsible attitude, good House Keeping, use proper PPE, No food in Labs. **(2 L)**

6 First Aid **(1 L)**

For contact of different chemicals on skin, eyes, and inhalation and ingestion

7 Types of fire extinguishers, method of use. **(1 L)**

8 Material Safety Data Sheets, Globally Harmonised System (GHS) Signs (hhtp://www.calstatela.ed/univ/ehs/msds.php) **(3 L)**

Importance and use of current 16 point format, Labels and pictograms and some of their discrepancies, Globally Harmonized System for SDS, label changes (2014)

9. Inventory Management, Storage and Disposal **(10 L)**

Inventory Management, Storage, Waste Classification, Hazardous Waste, Non-Hazardous Waste, mixed waste, Waste Disposal

10. What to do when things go wrong **(2 L)**

Spills, mercury spills, Injuries, Fires, building Evacuations, Emergencies

11. OSHA laboratory Standards **(2 L)**

Case studies: Reason for fire or accident, affixing responsibility and proposing action for prevention or minimizing possibility or severity **(6 L)**

Losses in an accident, Financial and non-financial, Importance of system based solutions over manual action, Economical solutions, Compromise between accident costs and prevention costs.

12. Good Laboratory Practices (GLP) **(12 L)**

Introduction and principles of GLP, performance of Lab studies and calibration using Standard Operating Procedures (SOPs), Instrument validation, reagent certification, Lab notebook maintenance to contemporary standards, maintenance of lab records based on instrument and reagent certification. Introduction to ISO and NABL accreditation.

Books:

1. Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management, Lisa Moran and Tina Masciangioli, Editors, THE NATIONAL ACADEMIES PRESS Washington, DCwww.nap.edu
2. Saftey in Academic Chemical Laboratory, Vol. II, ACS Publication, 7th Edition (2003).
3. OECD Series on Principles of Good Laboratory Practices and Compliance Monitoring, 1997.
4. Handbook of Good Laboratory Practices, TDR, WHO, UNICEF, UNDP (2009).
5. A Primer for Good Laboratory Practices and Good Manufacturing Practices, L. Huber, Agilent Technologies, 2002.
6. What went wrong By Trevor Kletz, Gulf professional Pubisher

Physical Chemistry

Semester – II

CHP-210: Fundamentals of Physical Chemistry-II (4 Credits)

SECTION-I (2 Credits, 24 L, 6 T)

Molecular Spectroscopy

1) Recapitulation:-Width and intensity of spectral transitions, Fourier transform, microwave spectroscopy, rotation spectra of di and ply atomic molecules, Stark effect (04 L)
2) Infra red spectroscopy : Harmonic and an harmonic oscillator, vibrational spectra of di – and poly- atomic molecules, coarse and fine structure, Nuclear spin effect, application, (05 L)
3) Raman Spectroscopy: Introduction, Rotational Raman- spectra, Vibrational Raman , Spectra, polarization of light and Raman effect, structure elucidation from combined Raman and IR spectroscopy, applications in structure elucidation. (05 L)
4) Electronic spectroscopy of molecules: Born – Oppenheimer approximation, electronic spectra of diatomic molecules, vibration, al coarse structure, rotational fine structure dissociation energy and dissociation products, electronic structure of diatomic molecules, molecular photoelectron spectroscopy, and application. (06 L)
5) ESR and Mossbauer spectroscopy applications. (02 L)
6) Principles of NMR – Chemical applications of PMR in structure elucidation. (02 L)

Reference:

Fundamentals of molecular spectroscopy: C.N. Banewell and E.Mc. Cash (Fourth edition).

SECTION-II (2 Credits, 24 L, 6 T)

Nuclear and Radiation Chemistry

1) Radio Chemistry : recapitulation – type of radioactive decay, Decay Kinetics, Detection & measurement of radiation (G.M. & Scintillation counter) (03 L)

2) Elements of radiation chemistry – Radiation chemistry, interaction of radiation with miller, passage of nucleolus through matter, interaction of radiation with matter, Units. for measuring radiation absorption, Radiation dosimetry, Radiolysis of water, free radiation in water Radiolysis, Radiolysis of some aqueous solution. (06 L)

3) Nuclear Reactor: - The fission energy, The Natural uranium reactor, the four factor formula- The reproduction factor K, the classification of reactor. Reactor power, Critical size of thermal reactor, excess reactivity & control, the Breeder reactor, The Indians nuclear energy programme, Reprocessing of spent fuel, Recovery of Uranium & Plutonium, Nuclear waste management, Natural nuclear reactor. (06 L)

4) Isotopes for nuclear reactors. Isotope separation, separation of selected isotopes, Plutonium. (03 L)

5) Applications of radioactivity: Typical reaction involved in preparation of radio isotopes: ^{3}H, ^{14}C, ^{22}Na ^{32}P ^{35}S, and I^{127} General principles of using radioisotopes. Physical constants – Diffusion coefficients, surface area, solubility. Analytical applications-neutron activation analysis, dilution analysis, radiometric titration. Industrial applications – radiation guaging, friction and wear out, gamma radiography. (06 L)

Reference Books

1. Elements of Nuclear chemistry – H.J. Arnikar, fourth edition wiley Estern Ltd.
2. Source book of atomic energy – S. Glasstanc, D. Van Norton Company
3. Chemical applications of radioisotopes – H.J. M. Brown Buffer & Jammer Ltd.

Inorganic Chemistry

Semester – II

CHI-230: Coordination and Bioinorganic Chemistry (4 Credits)

SECTION-I: Coordination Chemistry (2 Credits, 24 lectures, 6 T)

1. Concept & Scope of Ligand Fields, Free ion Configuration, Terms and States, Energy levels of transition metal ions, free ion terms, term wave functions, spin-orbits coupling. **(4 L)**

2. Ligand Field Theory of Coordination Complexes **(7 L)**
   Effect of ligand field on energy levels of transition metal ions, weak cubic ligand field effect on Russell- Saunders terms, strong field effect, correlation diagrams, Tanabe- Sugano Diagrams, Spin-Pairing energies.
3. Electronic spectra of Transition Metal Complexes **(7 L)**
   Introduction, Band intensities, band energies, band width & shapes, spectra of 1^{st}, 2^{nd} & 3rd row ions and rare earth ion complexes, spectrochemical & nephlauxetic series, charge transfer & luminescence, spectra, calculations of Dq, B, β parameters.
4. Magnetic Properties of Coordination Complexes **(6 L)**
   Origin magnetism, types of magnetism, Curie law, Curie-Weiss Law, Magnetic properties of complexes-paramagnetism 1st & 2nd Ordered Zeeman effect, quenching of orbital angular momentum by Ligand fields, Magnetic properties of A, E & T ground terms in complexes, spin free spin paired equilibria.

References:

1. Ligand field theory & its applications: B.N. Figgis & M.A. Hitachman (2000) Wiely VCH Publ.
2. Symmetry and spectroscopy of molecules, Second Ed^{n}, by K. Veera Reddy, New Age International Publication, 2009.
3. Elements of magnetochemistry, R. L. Datta and Syamal, Second Ed^{n}, Afiliated East West Press Pvt. Ltd. 2007.

Section-II: Bioinorganic Chemistry (2 Credits, 24 Lectures, 6 T)

1. Overviews of Bioniorganic Chemistry **(1 L)**
2. Principles of Coordination Chemistry related to Bioinorganic Research and Protein, Nucleic acids and other metal binding biomolecules. **(7 L)**
3. Biochemistry of Na, K and Ca w.r.t. Na/K pumps, Calmodulin and blood coagulation. **(8 L)**
4. Biochemistry of following elements:
   (a) Iron: Ferritin, Transferrin, Fe-S clusters, Porphyrin based systems **(6 L)**
   (b) Manganese: Photosynthesis **(2 L)**

Reference Books:

1. Principle of Bioinorganic Chemistry: S.J. Lippard and J,M. Berg
2. Bioinorganic Chemistry: Inroganic Elements in Chemistry of Life: W.Kaim and B. Schwederski
3. Bioinorganic Chemistry: Bertini, Gray, Lippard and Valentine
4. Bioinorganic Chemistry: R.J.P. Willams
5. Bioinorganic Chemistry: Robert Hay
6. Bioinorganic Chemistry: M.N. Hughes

Organic Chemistry

Semester – II

CHO-250: Synthetic organic chemistry and spectroscopy (4 Credits)

SECTION – I: Synthetic Organic Chemistry (2 Credits, 24 L, 6 T)

1. **Oxidation reactions:** **(6 L)**

   CrO_3, PDC, PCC, $KMnO_4$, MnO_2, Swern, SeO_2, $Pb(OAc)_4$, Pd-C, OsO_4, m-CPBA, O_3, $NaIO_4$, HIO_4

2. **Reduction reactions**: **(4 L)**

   Boranes and hydroboration reactions,

   MPV reduction and reduction with H_2/Pd-C, Willkinsons catalyst, DIBAL and Wolff Kishner reduction.

3. **Rearrangements:** **(6 L)**

   Beckmann, Hofmann,, Curtius, Smith, Wolff, Lossen, Bayer-villiger,

   Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid, Fries.

4. **Ylides:** **(4 L)**

   Phosphorus, Nitrogen and Sulphur ylides

5. **Addition to carbonyl group:** **(4 L)**

   Grignard, organo zinc, organo copper, organo lithium, reagents to carbonyl and unsaturated carbonyl compounds.

SECTION-II: Spectroscopy (2 Credits 24 Lectures, 6T)

a) UV: Factors affecting UV absorption and interpretation of UV spectra **(2 L)**

b) IR: Basic ideas about IR frequencies, interpretation of IR spectra **(4 L)**

c) PMR: Fundamentals of PMR, factors affecting chemical shift, integration coupling (1^{st} order analysis) **(8 L)**

d) Introduction to CMR and mass spectrometry **(4 L)**

e) Problems on UV, IR and PMR **(6 L)**

References:

1. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)
2. Modern Synthetic reactions- H.O. House
3. Organic Synthesis – M.B. Smith
4. Advanced Organic Chemistry (part A & B)– A. Carey and R.J. Sundberg
5. Stereochemistry conformations and mechanism by P.S. Kalsi
6. Organic chemistry –by Cram, Hammond, Pine and Handrickson
7. Introduction to spectroscopy – D.l. Pavia, G.M. Lampman, G.S. Kriz, 3rd Edition
8. Spectroscopic methods in organic melecules – D.H. William & I Flemming Mc Graw Hill
9. Mechanism and Structure in Organic Chemistry - E.S. Gould

General Chemistry

Semester – II

CHA-290: General Chemistry – II

(Any two parts except B) (4 Credits)

PART-A: Modern Separation Methods and Hyphenated Techniques (2 Credits, 24 L, 6 T)

1. Mass Spectrometry (8 L)

Principle, Instrumentation, Ionization methods- Electron bombardment ionization, Arc and spark ionization, Photo-ionization, Thermal ionization, Chemical ionization, Mass analyzers- Magnetic, Double focusing, Time of flight, Quadrupolar, Ion cyclotron resonance analyzer, Correlation of mass spectra with molecular structure and molecular weight, Isotopic Abundances, Fragmentation patterns, Quantitative analysis, Applications and Problems. Fourier transform mass spectrometry, Tandem mass spectrometry, inductively coupled Plasma-mass spectrometry,

Ref. 1, Pages 647-696; Ref. 2, Pages 465-506

2. Gas Chromatography (8 L)

Theory and Instrumentation of GC, Sample injection- Split and splitless injection, Column types, Solid/Liquid Stationary phases, Column switching techniques, Basic and specialized detectors, elemental detection, chiral separations, , Gas chromatographs and chemical analysis, Interfacing of gas chromatography with mass spectrometry, Applications of GLC, Use of GC-MS ,High Speed gas chromatography, Gas- solid chromatography and problems,

Ref. 2, Pages 540-569; Ref. 3, Pages 125-143; Ref. 4, Pages 947-970.

3. High Performance Liquid Chromatography (HPLC) (8 L)

Theory and instrumentation of HPLC, Optimization of column performance, Gradient elution and related procedures, Derivatization, Mobile phase delivery system, sample injection, separation column, detectors, Interfacing HPLC with mass spectrometry, Structure types of

column packing, adsorption chromatography, Bonded phase chromatography, reverse phase chromatography, ion–pair chromatography, ion exchange chromatography, size exclusion chromatography, GC-MS and LC-MS, Applications and Problems.

Ref. 2: Pages 580-650, Ref. 4: Pages 974-992.

References:

1. Introduction to Instrumental Analysis, R. D. Braun, Mc Graw-Hill. Inc.1987.
2. Instrumental Methods of Chemical analysis, H. H. Willard, L. L. Merritt Jr., J. A. Dean & F. A. Settle Jr., 6th Edition, Wadsworth Publishing Company, USA,1986
3. Handbook of Instrumental Techniques for Analytical Chemistry, F. A. Settle editor, Prentice Hall Inc. A Simon and Schuster Company, New Jersey, 1997.
4. Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, 7th Edition, Thomson Asia Pte. Ltd, Singapore,2004

PART-B: (Compulsory for Drug Chemistry Students and Students from other disciplines also can opt for it)

Basic Biochemistry (4 Credits, 48 L, 12 T)

1. Introduction to Biochemistry: Scope of the subject in pharmaceutical sciences, Biochemical reactions, Highlights of prokaryotic and Eukaryotic cell metabolism.
2. Biochemical Morphology: Prokaryotes and Eukaryotes, Cell structure, sub-cellular components: Nucleus, plasma membranes, endoplasmic reticulum, Lysosome, Peroxisomes, Golgi apparatus, and Mitochondria.
3. Biomembrane: Structure, functions and composition, Model proposed , Function and properties of membrane, Transport hypothesis, Active and passive facilitated transport, Na+, K+, H+, pumps, glucose transport, Excitable membrane, drug transport.
4. Biomolecules:

   Proteins*:* Introduction, functional, classification of amino acids, classification, physicochemical properties, Optical activity, Reaction with ninhydrin, Formaldehyde,Aminoacids, Essential and non essential amino acids, efficacy, structure, peptide bond, end group analysis, Helix, B-sheet structure, tertiary, quaternary structure, globular protein, fibrous protein, amino acid therapy, Protein engineering

Carbohydrates: complex carbohydrate, structure of Chitin, Starch, Glycogen + Metabolism

Lipids: definition, classification, functions, types of fatty acids, and its biological role and metabolism.

5. Enzymes: Introduction, classification according to the reaction catalysis and source) structure of enzyme, co factures, active sites, Binding sites, Km, Vmax, Enzyme kinetics, Double reciprocal plot, effect of substrate, pH ionic strength, Concentration, Temperature on the rate of enzyme reactions, Enzyme inhibition(competitive, uncompetitive, non competitive and irreversible), Enzyme biotechnology. Manufacturing of medicinal compounds by enzymatic reactions, Penicillin acylase for the production 6-APA, Therapeutical uses of enzymes.

References:

1. Principals of biochemistry, Albert Lehninger (CBS Publisher and Distributers Pvt. Delhi.
2. Biochemistry Lubert Stryer, W. H. (Freeman and company New York)
3. Harper's Biochemistry by R.K. Murray, D. I. Granner, P. A. Mayes, (Prentice Hall International Inc.)
4. Practical Clinical Biochemistry, Harold Varley, (CBS Publisher and Distributers Pvt. Delhi.
5. Molecular Biology, J.D. Watson (The Benjamin/ Cumming Company, Inc.)

PART- C: Concept of Analytical Chemistry (2 Credits, 24 L, 6 T)

1. Data Handing and Spreadsheets in Analytical Chemistry (6 L)

Accuracy and Precision, classification of errors, Significant figures, rounding off, ways of expressing accuracy, Mean Deviation, Average Deviation, RMD, Standard Deviation Propagation of errors, Confidence limits, Tests of Significance, Rejection of results and Problems.

Ref. 2: Pages 65-99.

2. Sampling, Standardization and Calibration (8 L)

Analytical Samples and Methods of Sampling, Sample Handling, Gross sample, Preparation of Laboratory samples, Automated Sample Handling, Comparisons with standard and Numerical Problems.

Ref. 1: Pages 175-200.

3. Introduction to analytical separations (8 L)

Separation by precipitation, separation of species by distillation, separation by extraction, separation by ion exchange chromatography and problems.

Ref. 1: Pages 906-946

References:

1. Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, 5th Edition, Thomson Asia Pte. Ltd, Singapore, 2004.
2. Analytical Chemistry, G.D. Christian, 6 th Edition.

PART- D: Industrial Methods of Analysis (2 Credits, 24 L, 6 T)

1. Chemometrics: (10 L)

Concentration of solution based on volume and mass unit, calculations of ppm , ppb and dilution of the solutions , Concept of mmole, Stoichiometry of chemical reactions, Concept of gmole, Limiting reactants, theoretical and practical yield, solubility and solubility equilibria. Concept of formation constant, Stability and instability constants, stepwise formation constants and Numerical problems.

2. Quality in Analytical Chemistry (6 L)

Quality systems in chemical laboratories, cost and benefits of quality system, types of quality standards for laboratories, total quality management, quality audits, and qualities reviews , responsibility of laboratory staff for quality and problems.

3. Process Instruments and Automated Analysis (8 L)

Introduction, industrial process analyzer, methods based on bulk properties, continuous online process control, automatic chemical analyzers, automatic elemental analyzers, Numerical problems.

Ref 3: Pages: 786-828.

References:

1. Vogel's Text book of Quantitative Analysis.
2. Analytical Chemistry, G.D. Christian, 6 th Edition.
3. Instrumental Methods of Chemical analysis, H. H. Willard, L. L. Merritt Jr., J. A. Dean & F. A. Settle Jr., 6th Edition, Wadsworth Publishing Company, USA,1986

PART- E: Organometallic and Inorganic Reaction Mechanism (2 Credits, 24 L, 6 T)

(Recommended for M. Sc. other than Inorganic specialization)

1) Organometallic Chemistry (8 L)

Organic ligands and nomenclature, 18 electron rule: counting electrons, ligands having extended pi system, bonding between Metal Atoms and organic pi systems: linear pi system, cyclic pi system, spectral analysis and characterization of organometallic complexes: IR and NMR, examples.

2) Organometallic Reactions and Catalysis (8 L)

Reactions involving gain and loss of ligands: ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophelic displacement, reactions involving modification of ligands: insertion, carbonyl insertion, 1-2 insertion, hydride elimination, abstraction, organometallic catalysis: Hydroformylation, Monsanto acetic acid process, Wacker Process, Hydrognation by Willkinsons catalyst, Olefin metathesis, heterogeneous catalysis: Ziegler Natta Polymerization, Water gas reduction.

3) Coordination Compounds: Reactions and Mechanism (8L)

History and principles, Substitution reactions: Inert and labile complexes, mechanism of substitution, Kinetics Consequences of reaction pathway: dissociation, interchange, association, Experimental evidences in Octahedral Substitution: dissociation, linear free energy relationship, associative mechanism, the conjugate base mechanism, the kinetic chelate effect, Stereochemistry of reactions: substitution in trans complexes, substitution in cis complexes, isomerisation of chelate rings, substitution reactions in Sq. Pl. Complexes.

Reference Book:

Inorganic Chemistry: Gary Miessler and Donald A. Tarr, Third Ed., Pearson (Chapter-12, 13 and 14 pages: 422 to 561)

Part F: Mathematics for Chemists (2 Credit; 24 L, 6 T)

(Recommended for M. Sc. other than Physical Chemistry specialization)

1. Functions: Differential and integral calculus, limits, derivatives, physical significance, basic rules of differentiation, maxima and minima, application is chemistry, exact and inexact differentiation, Taylor & McLaurin Theorem, curve sketching, partial differentiation, rules of integration, separation of variable, substitution, partial function method to solve to indefinite integrals in chemistry. **(14 L)**
2. Differential Equations: Separation of variables, homogeneous, exact, linear equations of second order, series solution method. **(6 L)**
3. Vectors Matrices, and Determinants: **(4 L)**

   Vectors, dot, Corss and triple products, introduction to matrix algebra, addition and multiplication of matrices, inverse, adjoins and transport of matrices, unit and diagonal matrices.

References:

1) Chemical Maths Book, E. Steiner, Oxford University Press (1996).
2) Mats For Chemists Vol 1 and 2, Martin MCR Cockett and G. Doggett, Cambridge (2003).
3) Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill (1972)

Part G: Pericyclic reactions, Photochemistry and Free radicals (2 Credit; 24 L, 6 T)

(Recommended for M. Sc. other than Organic Chemistry specialization)

1. **Pericyclic reactions** **(10 L)**

   Electrocyclisation, cycloaddition, sigmatropic and Alder-ene reactions. Analysis of pericyclic reactions by construction of correlation diagrams and by FMO approach.
2. **Free radicals** **(6 L)**

   Generation, stability and general reactions like displacement, addition and rearrangements.

3. **Photochemistry** **(8 L)**

   Basic concepts in Photochemistry, Jablonski diagram, quenching, triplet excitation, photosensitization, quantum yield, photochemistry of carbonyl compounds (photoreduction, photoenolization, Norrish type I and II) and benzene derivatives.

References:

1. Conversation of orbital symmetry – Woodward and Hoffmann
2. Organic Chemistry – Morrison and Boyd
3. Organic Chemistry – Warren, Clayden, Greeves and Wothers
4. Advanced Organic Chemistry – Carey, Sandburg Vol. A.
5. Organic reactions and Orbital Symmetry - T. L. Gilchrist and R. C. Storr
6. Excited states in Organic Chemistry – J. D. Coyle and J. A. Barltrop
7. Orbital Symmetry – A problem solving approach. R. F. Lehr and A. P. Marchand
8. Principles of Organic Synthesis – Norman, Coxon

M.Sc.-I: Practical

CHP-107: Physical Chemistry Practicals (6 Credits)

A) Conductometry: (Any four)

1. Study the Hydrolysis of NH_4Cl or CH_3COONa or aniline hydrochloride.

2. Determination of equivalent conductance at infinite dilution and dissociation constant of acetic acid.

3. Study the second order velocity constant of the hydrolysis of ethyl acetate by sodium hydroxide.

4. Determination of ΔG, ΔH, and ΔS of silver benzoate by conductometry.

5. Determination of critical micellar concentration (CMC) and ΔG of micellization of sodium dodecyl sulphate (SDS).

6. Determination of concentrations of strong acid and weak acid present in the mixture by titration with strong base.

B) Potentiomerty: (Any four)

1. Determination of stability Constant of a complex ion.

2. Determination of Solubility and solubility product of a sparingly soluble salt.

3. Estimation of amount of halides present in the mixture.

4. Determination of concentrations of strong acid and weak acid present in the mixture by titrating with strong base.

5. Determination of concentrations of reductant or oxidant by redox titration.

C) pH metry: (Any two)

1. Determination of the acid and base dissociation constant of an amino acid and hence the isoelectric point of the acid.

2. Determination of dissociation constants of tribasic acid (phosphoric acid)

3. Determination of Hammett constant of o-, m-, p- amino/nitro benzoic acid.

D) Polarography:

1. Determination of half wave potential ($E_{1/2}$) and unknown concentration of an ion.

2. Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.

E) Colorimetry/Spectrophotometry: (Any two)

1. Simultaneous determination of cations from the mixture.

2. Determination of amount of copper by photometric titration with EDTA.

3. Study the kinetics of iodination of acetone spectrophtometrically.

F) Radioactivity: (Any two)

1. Estimation of Manganese in tea leaves by Neutron Activation Analysis.

2. Determination of half-life of a radioactive nuclide and counting errors.

3. Determination of E_{max} of β radiation and absorption coefficients in Al.

G) Chemical Kinetics: (Any three)

1. Study of Kinetic decomposition of diacetone alcohol by dilatometry.

2. Determination of individual orders of iodide and persulphate ions and overall order of oxidation reaction of iodide ion by persulphate ion.

3. Investigation of influence of ionic strength on rate constant (Brönsted primary salt effect).

4. Determination of temperature coefficient and energy of activation of acid catalyzed ester hydrolysis reaction.

H) Non-Instrumental: (Any five)

1) Determination of surface excess of amyl alcohol or TX-100 surfactant by Capillary rise method.

2) Statistical treatment of experimental data.

3) Determination of molecular weight by steam distillation.

4) Determination of glycerol radius by viscosity.

5) Determination of partial Molar Volume (Polynometry) and the densities of a series of solutions and to calculate the molar volumes of the components.

6) Analysis of crystal structure from single crystal X-ray pattern.

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)

2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)

3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.).

4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.

5. Physical chemistry by Wien (2001)

6. Practical physical chemistry, B. Vishwanathan and P.S. Raghavan, 2nd edition, (2012)

7. Experimental Physical chemistry, V.D. Athawale, Parul Mathur, New age International publishers.

CHI-107: Inorganic Chemistry Practical (6 Credits)

Part-I: Ore analysis (Any Two) (Ref. -1)

a. Analysis of Pyrolusite ore.
   Determination of (i) Silica and (ii) Manganese

b. Analysis of Chalcopyrite ore.
   Determination of (i) Copper and (ii) Iron

c. Analysis of hematite ore.
   Determination of (i) Silica and (ii) Iron

Part-II: Alloy Analysis (Any Two) (Ref. -1)

a. Determination of tin and lead from solder.

b. Determination of iron and chromium from mild steel.

c. Determination of copper and nickel from cupronickel.

Part-III: Inorganic Synthesis and Purity (Any five) **(Ref. – 2)**

Part A: Five preparations

Part B; Purity determination of above preparations

a. $Mn(acac)_3$

b. Chloro penta-ammine cobalt (III) chloride

c. Nitro penta-amminecobalt (III) chloride

d. Nitrito penta-amine cobalt (III) Chloride.

e. Potassium tri-oxalato aluminate

f. Tris(ethylene di ammine) Ni(II) thiosulphate.

e. Bis[TrisCu(I)thiourea]

Part-IV: Ion – exchange chromatography (Any one experiment) **(Ref. -1 and 3)**

a) Separation of mixture of Zn(II) and Cd(II) using Amberlite IRA 400 anion exchanger and quantitative estimation of separated ions Zn(II) and Cd(II)

b) Separation of mixture of Zn(II) and Mg(II) using Amberlite IRA 400 anion exchanger and quantitative estimation of separated ions Zn(II) and Mg(II)

Part-V: Spectrophotometry (all two experiments)

a. Estimation of phosphate from waste water by calibration curve method **(Ref. -4)**

b. Determination of equilibrium constant of M – L systems Fe (III) – Salicylic acid or Fe(III)–Sulphosalicylic acid or Fe(III)–β–resorcilic acid by Job's continuous variation method. (Ref.-3)

c. Determination of iron by solvent extraction techniques in a mixture of Fe(III) +AL(III) or Fe(III) + Ni(III) using 8–hydroxyquinoline reagent.
(Ref. -1)

or

c) Determination of Cu(II) by solvent extraction as Dithiocarbamate/8-Hydroxyquinoline complex (Ref-1,3)

Part-VI: Inorganic characterization techniques (any one of the following)

a. Solution state preparation of $[Ni(en)_3]S_2O_3$, $[Ni(H_2O)_6]Cl_2$, $[Ni(NH_3)_6]Cl_2$. Record absorption spectra in solution of all three complexes and analyse it. Arrange three ligands according to their increasing strength depending on your observations. (Ref. -5)

b. Determination of magnetic susptibility (χ_g and χ_m) of mercury tetracyanato cobalt or $Fe(acac)_3$ or Ferrous ammonium sulfate by Faraday or Gouy method. **(Ref. -3)**

Part-VII: Synthesis of Nanomaterials (any one of the following)

a) Synthesis of nano size ZnO, its characterization by UV-Visible spectroscopy and removal of dye by ZnO-photocatalysis **(Ref-2)**

b) Synthesis of nano size α-Fe_2O_3 and study of adsorption of phosphate on it **(Ref-2)**

Part-VIII: Conductometry (any one of the following).

a) Verification of Debye Huckle theory of ionic conductance for strong electrolytes KCl,$BaCl_2$ K_2SO_4, $K_3[Fe(CN)_6]$ (Ref. -3)

b) Structural determination of metal complexes by conductometric measurement. **(Ref-3)**

c) To study complex formation between Fe(III) with sulfosalicylic acid by conductometry (Ref-3).

Part-IX: (any one of the following)

a) Synthesis and photochemistry of $K_3[Fe(C_2O_4)_3]$ $3H_2O$. **(Ref-4)**

b) Kinetics of substitution reaction of $[Fe(Phen)_3]^{2+}$ **(Ref-3)**

Part-X: Table work

a) Data analysis, error analysis, least squares method. **(Ref-3)**

Reference Books:

1) Text book of Quantitative Analysis, A.I. Vogel 4^{th} Edn. (1992).
2) Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horwood publishing, Chichester) 1999.
3) Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
4) General Chemistry Experiments, Anil. J Elias, University press (2002)
5) Ligand Field Theory, B. N. Figgis.

CHO-247: Organic Chemistry Practical (6 Credits)

Use of chemistry software like MOPAC, ISIS draw, Chem office (Minimum 3 experiments)

Purification techniques (any 5)

Purification of solvents and reagents using techniques like crystallization, distillation, steam distillation, vacuum distillation, drying and storage of solvents, sublimation etc.

a) Chromatography: TLC, Column.

b) Solvent extraction using soxhlet extractor

1. **Three component mixture separation and analysis using ether**.

   (8 mixtures minimum including amino acid)

2. **Single stage preparations (minimum 8 preparations)**

   a) 2-Methoxy naphthalene to 1-formyl-2- methoxy naphthalene

   b) Toluene to 4-methyl acetophenone

   c) Anthranilic acid to 2-iodo /2-choro benzoic acid

   d) Cyclohexanol to cyclohexanone

   e) Benzophenone to diphenyl methane

   f) Benzyl cyanide to phenyl acetic acid

   g) Benzaldehyde to chalcone

   h) Gycine to Benzoylglycine

   i) Nitrobenzene to m-di-nitrobenzene

   j) m-di-nitrobenzene to m-nitroaniline

   k) Benzoic acid to ethylbenzoate

   l) Diel's Alder reaction of anthracene and maleic anhydride

   m) Chlorobenzene to 2,4-dintro chlorobenzene

Reference books

n) 1. Textbook of practical organic chemistry – A.I. Vogel

M.Sc. Drug Chemistry

Practical

CHD-128: INORGANIC AND ANALYTICAL CHEMISTRY PRACTICALS

(6 Credits)

1. Inorganic synthesis and characterization by physical or chemical methods:
   a) Cis-trans potassium diaquo dioxalate chromate (III)
   b) Chloropentammino cobalt (III) chloride.
2. Colorimetry;
   Keg of M-L systems such as:
   i) Fe (III) Salicylic acid
   ii) Fe (III) Sulphosalicylic acid
   iii) Fe (III) resorcilic acid by Job's method and Mole ratio method
3. Photometric titration of systems such as:
   a) Cu^{2+} - EDTA
   b) Fe^{2+} - Sulphosalicylic acid
   c) Co^{2+} - R-nitroso salt.
4. Potentiometry:
   a) Complexometric determination using disodium EDTA of
   i) Co^{2+}
   jj) Al^{3+}
   iii) Cu^{2+}
5. Solvent extraction of Al / Mo usmg 8-hydroxy quinoline complex and determination by spectrophotometry
6. Solvent extraction of ferric thiocyanate complex and determination by colorimetry.
7. Separation and estimation of Fe and Al on a cation exchanger.
8. Separation and estimation of copper and cobalt on cellulose column.
9. Analysis of Vitamin C in juices and squashes.
10. Analysis of Vitamin A in food products.
11. Simultaneous determination by titanium and vanadium Pt and Pd using hydrogen peroxide by spectrophotometry.

12, Estimation of Na, K and Ca in binary mixture by flame photometry using Li as Internal standard and using standard addition method.

13. Determination of the strength of the following by fiourimetmy, beryllium, aluminium, vitamin B1, vitamin B2.

14. Determination of the strength of commercial phosphoric acid/vinegar by conductometric titration.

15. Analysis of malathion by colorimetry or polarography.

16. Estimation of nitrile, fluoride, dissolved chlorine, chloride, iron, chromium, manganese colorimetrically.

17. Estimation of Hg, Pb, Cd spectrophotometrically/complexometrically.

18. Estimation of sulphadizine.

19. Estimation of mixtures of benzoic acid and salicylic acid in pharmaceutical preparations

20. Determination of iron, calcium and phosphorous in milk powder.

21. Partition coefficient.

References:

1) A textbook of Qualitative Inorganic Analysis3rd Edn., A. I Vogel, ELBS.

2) A Textbook of Practical Organic Chemistry, 4th Edn., A. I. Vogel, ELBS.

3) Standard Methods of Chemical Analysis, 6th Edn.; A series of volumes edited by F. J. Weicher, Robert E. Krieger Publishing co.

4) Pharmacoepoeia of India.

CHD-108: Practical Course in Separation, Purification & Analytical techniques in Drug Chemistry **(5 Credits)**

1. Purification of solvents and reagents

2. Mixture separation Two and Three components.

3. Isolation of Natural products from Clove, Cinnamom by steam distillation. Also use Soxhlet apparatus for one natural product.

4. Chromatographic techniques as TLC, Coloumn chromatography

5. Biomolecule separation and identification using Gel Electrophoresis, Paper chromatography Immunoelectrophoresis.

6. Separation and Identification of active drug ingredients from commercial pharmaceutical preparations.
7. Try to use spectral data whenever possible.
8. Any current techniques as per need and demand.

CHD-248: ORGANIC CHEMISTRY PRACTICALS **(5 Credits)**

1. Techniques: Crystallization, fractional crystallisation, fractional distillation, vacuum distillation, sublimation, steam distillation.
2. Single stage preparation involving different type of reactions (minimum 8 preparations).
3. Two-stage preparations (mininim 2 preparation).
4. Three-stage preparations (minimum 2 preparations).
5. Derivatives of functional groups such as acetyl, benzoyl, 2, 4-DNP, oxime, anilide, amide and aryloxy acetic acid (minimum one of each type)

Typical preparations from which the single and two stage preparations can be chosen are:

1. Toluene — p-nitrotoluene — p-nitrobenzoic acid — p-amino benzoic acid
2. Benzene — Acetopheneone — Acetophenone oxime — Acetanilide
3. Benzaldehyde — Benzoin — Benzil — Benzillic acid
4. Nitrobenzene — m-dinitrobenzene — m-nitroaniline — m-nitrophenol
5. Phthalic acid — phthalic anhydride – phthalimide — Anthranilic acid
6. Anthranilic acid — pheylglycine — orthocarboxylic acid — indigo
7. Acetophenone — Benzalacetophenone — epoxide
8. Cyclohexanone —Cyclohexanone oxime—caprolactam
9. Phthalic anhydride—o-benzolylbenzoic acid—anthraquinone.
10. O-Cholobenzoinc acid —N-phenylanthranilic acid —acridone.
11. Cholrobenzene—2,4-dinitrochlorobenzene —2,4-dinitrophenol
12. Bromobenzene—triphenylcarbinol-tritylchloride
13 Resorcinol—resacetophenone — 4-ethyl resorcinol
14. Phenol—allylphenyl ether—o-allylphenol
15. Phenol —salicylaldehyde—coumarin

Savitribai Phule Pune University

(Formerly University of Pune)

Two Year Degree Program in Chemistry

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. (Chemistry) Part-I

(for Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: M.Sc. (Chemistry)

Structure of the Course:

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two year integrated course leading to M.Sc. (Chemistry) in the colleges affiliated to Savitribai Phule Pune University.

Semester-I			
S. N.	**Paper No**	**Subject**	**Credits**
1	**CCTP-1** CHP-110	Physical Chemistry-I (Fundamentals of Physical Chemistry)	4 credit (48 L + 12T)
2	**CCTP-2** CHI-130	Inorganic Chemistry-I (Molecular Symmetry and Chemistry of Main Group Elements)	4 credit (48 L + 12T)
3	**CCTP-3** CHO-150	Organic Chemistry-I (Basic Organic Chemistry)	4 credit (48 L + 12T)
4	**CBOP-1** CHG-190	**Section-I: General Chemistry-I, Theory Course (Any one option)** **Elective Option-A**: Introduction to Solid State of Matter **Elective Option-B**: Mathematics for Chemists **Elective Option-C**: Introduction to Chemical Biology-I	2 credit (24 L + 6T)
		Section-II: General Chemistry Practical (Any one) **Elective Option-A** :Inorganic Chemistry-Material Analysis, Synthesis and Applications **Elective Option-B** : Chemical Biology Practical-I	2 credit (48 L + 12T)
5	**CCPP-1** CHP-107	Basic Practical Chemistry-I	4 credit (96 L + 24T)
Semester- II			
6	**CCTP-4** CHP-210	Physical Chemistry - II (Molecular Spectroscopy and Nuclear Chemistry)	4 credit (48 L + 12T)
7	**CCTP-5** CHI-230	Inorganic Chemistry -II (Coordination and Bioinorganic Chemistry)	4 credit (48 L + 12T)
8	**CCTP-6** CHO-250	Organic Chemistry-II (Photochemistry, Pericyclic and Organic spectroscopy)	4 credit (48 L + 12T)
9	**CBOP-2** CHG-290	**Section-I: General Chemistry-II, Theory (Any one option)** **Elective Option-A** : Material Characterization Technique **Elective Option-B** : Organometallic and Inorganic Reaction Mechanism **Elective Option-C**: Introduction to Chemical Biology-II	2 credit (24 L + 6T)
		Section-II: General Chemistry, Practical (Any one option) **Elective Option-A**: Electroanalytical Techniques of Analysis **Elective Option-B**: Chemical Biology Practical-II	2 credit (48 L + 12T)
10	**CCPP-2** CHP-227	Basic Practical Chemistry-II	4 credit (96 L + 24T)
Total Credits for First Year			**40**

CCTP- Core Compulsory Theory Paper; **CBOP**-Choice Based Optional Paper; **CCPP**- Core Compulsory Practical Paper

2) Equivalence to 2014 pattern

Course in 2014 pattern	Course in 2019 pattern
CHP-110	**CCTP-1,** CHP-110
CHI-130	**CCTP-2,** CHI-130
CHO-150	**CCTP-3,** CHO-150
CHG-190	**No equivalence**
CHP-107	**No equivalence**
CHP-127	**No equivalence**
CHP-210	**CCTP-4,** CHP-210
CHI-230	**CCTP-5,** CHI-230
CHO-250	**CCTP-6,** CHO-250
CHG-290	**No equivalence**
CHP-247	**No equivalence**

Detailed Syllabus:

Semester-I

CCTP-1: CHP-110, Physical Chemistry-I, Semester - I

(Fundamentals of Physical Chemistry) (4 Credits)

SECTION - I (2 Credits, 24 L, 6T)

1.**Thermodynamics** **(05 L)**

State function, path function, exact differential and inexact differential, internal energy and enthalpy, temperature dependent internal energy and enthalpy, reversible and irreversible adiabatic expansion. The entropy of irreversible changes, the Helmholtz and Gibbs function, Entropy and entropy change in an ideal gas with temperature and pressure, Clausius inequality, chemical potential, chemical potential of a substance in a mixture.

2. **Change of State** **(04 L)**

Partial molar quantities, methods for determination of molar quantities, ideal solutions, Raoult's and Henery's law, Thermodynamics of Gibbs function of mixing, colligative properties: Elevation in boiling point, depression in freezing point and osmosis.

3. **Quantum Chemistry** **(08 L)**

Applications of quantum chemistry- blackbody radiation, photoelectric effect, de Broglie hypothesis and uncertainty principle and its experimental evidence. Schrödinger wave equation, particle in one dimensional box, Normalization and orthogonality of wave function, particle in three dimensional box, hydrogen like atoms (no derivation).Operators: algebra of operators, commutative property, linear operators, commutator operator, the operator ∇ and ∇^2.

4. **Chemical Bonding** **(07 L)**

Valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital theory for di and tri atomic molecule, linear variation method, approximations underlying Huckel theory, applications to simple π-systems.

SECTION – II (2 Credits, 24 L, 6 T)

Chemical Kinetics and Reaction Dynamics

1.**Rate Laws** **(06 L)**

Recapitulations of basic concept, the temperature dependent reaction rates, reaction moving towards equilibrium, consecutive reaction, parallel reactions, pre-equilibria, unimolecular reactions. 2.

2. **Kinetics of Complex Reactions** **(03 L)**

Fast reactions: flash photolysis, flow technique, stopped flow technique, relaxation method, the steady state approximation, chain reactions - free radical polymerization reaction between H_2 and Br_2, explosive reaction.

3. **Molecular Reaction Dynamics** **(05 L)**

Collision theory of bimolecular gas phase reactions, diffusion controlled and activation controlled reaction in solution, activated complex theory of reaction rate, Eyrings equation.

4. **Enzyme Catalysis** **(04 L)**

Michaelis mechanism, effect of pH and temperature on enzyme catalyzed reactions, limiting rate, Lineweaverburk and Eadie equation and plots, inhibition of enzyme action, competitive inhibition and non- competitive inhibition.

5. **Molecular Thermodynamics** **(06 L)**

Molecular energy levels, Boltzmann distribution law, partition functions and ensembles, translational, rotational and vibrational partition function of diatomic molecule, obtaining energy, heat capacity, entropy and equilibrium constants from partition functions, Maxwell- Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

References:

1. Physical Chemistry by P.W.Atkin and De Paul
2. Physical Chemistry by T.Engel and P. Reid
3. Physical Chemistry and molecular approach by D. Mequarie and J. Siman
4. Physical Chemistry for biological sciences by Raymond Chang (Universal books, 2000)
5. Physical Chemistry by Merron and C.F. Prouton
6. Physical Chemistry by G.M. Barrow
7. Quantum Chemistry by I. Levine 8. Quantum Chemistry by R.K. Prasad

Semester-II

CCTP-4: CHP-210, Physical Chemistry-II, Semester - II

(Molecular Spectroscopy and Nuclear Chemistry) (4 Credits)

SECTION - I (2 Credits, 24 L, 6T)

Molecular Spectroscopy

1) **Microwave Spectroscopy** **(03 L)**

Types of molecule on the basis of moment of inertia and rotational spectra of di- and poly-atomic molecules.

2) **Infra-red Spectroscopy** **(05 L)**

The vibrating diatomic molecule, harmonic and Anharmonic oscillator, The diatomic vibrating rotator, breakdown of the Born-Oppenheimer approximation, The vibrations of polyatomic molecule, Fourier transform spectroscopy and its advantages, The carbon dioxide laser, Applications.

3) **Raman Spectroscopy** **(05 L)**

Quantum and classical theory of Raman effect, pure rotational Raman spectra, vibrational Raman spectra, polarization of light and Raman effect, structure determination from Raman and Infra-red spectroscopy, applications.

4) **Electronic Spectroscopy of molecules** **(07 L)**

Electronic spectra of diatomic molecules - The Born- Oppenheimer approximation, Vibrational coarse structure, Frank- Condon principle, dissociation energy and dissociation product, Rotational fine structure of electronic-vibration transition, The fortrat diagram, Pre-dissociation, molecular photoelectron spectroscopy.

5) **Mossbauer Spectroscopy** **(04 L)**

Principle, Instrumentation and Applications of Mossbauer Spectroscopy.

SECTION – II (2 Credits, 24 L, 6T)

Nuclear and Radiation Chemistry

1) **Radioactivity** **(04 L)**

Types of radioactive decay, general characteristics of radioactive decay, decay kinetics, general expression for the activity of a daughter nuclide, Geiger- Nuttalis law, α-decay: A problem in classical physics, Internal conversion and the Auger effect.

2) **Elements of Radiation** **(06 L)**

Chemistry: Interaction of radiation with matter, interaction of γ radiation with matter, units for measuring radiation absorption, Radiation dosimetry, Radiolysis of water, free radicals in water radiolysis, Radiolysis of some aqueous solutions.

3) **Nuclear Fission**: **(06 L)**

The discovery of nuclear fission, the process of nuclear fission, fission fragments and their mass distribution, charge distribution, Ionic charge of fission fragments, fission energy,

fission cross-section and threshold, fission neutrons, theory of nuclear fission, Neutron evaporation and spallation.

4) **Applications of Radioactivity** **(08 L)**

Typical reaction involved in the preparation of radioisotopes, The Szillard- Chalmers reaction, Radiochemical principles in the use of tracers, Isotopes in elucidating reaction mechanism and structure determination, physic-chemical research - The solubility of a sparingly soluble substances, surface area of a powder or precipitate rates of diffusion, Analytical applications- Isotope dilution analysis, Neutron activation analysis, Radiometric titrations, Medical applications-Thyroiditis, Assessing the volume of blood in a patient, Industrial applications thickness measurements and control, friction and wear out, gamma radiography.

References:

1) Elements of Nuclear Chemistry by H.J.Arnikar
2) Source book of Atomic energy by S. Glasstone and D. Van
3) Chemical applications of radioisotopes by H.J.M. Brown
4)Fundamentals of molecular spectroscopy by C.N.Banwell and E.M.McCash

Semester-I

CCTP-2: CHI-130, Inorganic Chemistry-I, Semester - I

(Molecular Symmetry and Chemistry of Main Group Elements) (4 credits)

SECTION-I (2Credits, 24 L, 6 T)

Molecular Symmetry and its Applications

1) Molecular Symmetry and Symmetry Groups (10L)

Symmetry elements and operations, Symmetry planes and reflections, the inversion centre, proper axes and proper rotations, improper axes and improper rotation, products of symmetry operations, equivalent symmetry elements and equivalent atoms, general relations among symmetry elements and symmetry operations, classes of symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classification of molecular point groups. Defining properties of a group, group multiplication table, some examples of group, subgroups andclasses.

2) Representations of Groups (06 L)

Matrix representation and matrix notation for geometric transformation, The Great Orthogonality Theorem and its consequence, character tables (No mathematical part),wave function as basis for irreducible representations.

3)Symmetry Adapted Linear Combinations (04L)

Projection operators and their use of construct SALC (Construction of SALC for sigma bonding for molecules belonging point groups: $D_{2h,}$ D_{3h} D_{4h}, C_{4v}, Td., Oh., normalization of SALC, transformation properties of atomic orbital, MO's for sigma bonding,ABn molecules, tetrahedral AB_4 and Oh AB_6 cases.

4) Application of Group theory to Infrared Spectroscopy (04L)

Introduction, selection rules, polyatomic molecules, possible vibrations in a linear molecule, bending modes, symmetry of vibrations and their IR activity, Group vibration concept and its limitations, IR spectra related to symmetry of some compounds, IR spectra of complex compounds.

References:

1) Chemical Applications of Group Theoryby F. A. Cotton
2) Symmetry and spectroscopy of molecules by K. VeeraReddy
3) Group Theory and its Chemical Application, P.K. Bhattarchrya
4) Inorganic Chemistry by Shriver and Atkins
5) Concise Inorganic Chemistry by J. D. Lee
6) Inorganic chemistry: principle of structures and reactivity by Huheey, Keiter, Medhi

Learning outcomes:

1. Student should visualize/ imagine molecules in 3 dimensions.
2. To understand the concept of symmetry and able to pass various symmetry elements through the molecule.
3. Understand the concept and point group and apply it to molecules.
4. To understand product of symmetry operations.
5. To apply the concept of point group for determining optical activity and dipole moment.

6. Student should understand the importance of Orthogonality Theorem.
7. They should able to learn the rules for constructing character table.
8. Using reduction formulae should be able to find out the possible type of hybridization.
9. Student should know the concept of SALC.
10. Student able to find out character for reducible representation.
11. To know about projection operator.
12. Apply projection operator to find out the normalized wave function for atomic orbital.
13. Student should correlate the application of symmetry to spectroscopy.
14. Students able to find out the possible modes of vibration.
15. From the previous knowledge of symmetry student must able to find out which mode are IR active.

Section-II (2 Credits, 24 L, 6 T)
Chemistry of Main Group Elements

1. Hydrogen and its compounds: (02L)
Classification of Hydrides, electron deficient, electron precise and electron rich hydrides.; PH_3, SbH_3 , AsH_3 , Selenides, Tellurides.

2. Alkali and Alkaline Earth Metals (02L)
Solutions innon - aqueous media, application of crown ether in extraction of alkali and alkaline earth metal

3. Boron Group (04L)
Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOMO, interconversion of lower and higher boranes, metalloboranes, carboranes, reactions of organoboranes, STYX rules and structure of higher boranes.

4. Carbon Group (03L)
Allotropes of carbon, Diamond, Graphite, Graphene, fullerenes ,carbon nanotube with synthesis, properties , Structure- single walled and multi walled and its application ,Intercalation compounds of graphite, Silicates, including Zeolites.

5. Nitrogen Group
(03L) Nitrogen activation, Boron nitride, Oxidation states of nitrogen and their interconversion, PN and SN Compounds, Applications of PN and SN compounds**.**

6. Oxygen Group (03L)
Metal Selenides and Tellurides, oxyacid's, and oxoanions of Sulphurand nitrogen. Ring, Cage and Cluster compounds of p-block elements.

7. Halogen Group: (02L)
Interhalogens, pseudohalagen, Synthesis, Properties and Applications, Structure, Oxyacid's andOxyanions of Halogens.

8.Noble gases: (02L)
Occurrence**,** Compounds ofXenon-with fluorine andOxygen and its uses

9.Organometallic Compounds (03L)

Organometallic Compounds of Li, Mg, Si, Pb, As, with Classification, Nomenclature, Synthesis, Structure Properties and Usesof Li, Mg, Si, Pb, As, with Classification, Synthesis, Structure Properties and Uses

References:

1) Inorganic Chemistry by Shriver and Atkins
2) Concise Inorganic Chemistry by J. D. Lee
3) Inorganic chemistry byPrinciple of Structures and Reactivity by Huheey, Keiter, Medhi
4) Inorganic Chemistry by Catherine Housecraft
5) Inorganic Chemistry by MeisslerandTarr
6) Organometallics by Christoph Elschenbroich
7) Organometallics by A Concise Introduction by Christoph Elschenbroich and Albrecht Salzer
8) Basic Organometallic Chemistry by B. D. Gupta and A. J. Elias

Learning outcomes:

1.Student should understand the detail chemistry of S and P block elements w.r.t. their compounds, their reactions and applications.
2. To learn the advance chemistry of boranes, fullerene, zeolites, polymers etc.
3. Organometallic chemistry of some important elements from the main groups and their applications

Semester-II

CCTP-5: CHI-230,Inorganic Chemistry, Semester – II
(Coordination and Bioinorganic Chemistry) (4 Credits)

SECTION-I **(2 Credits, 24 L, 6T)**

Coordination Chemistry

1)Concept and Scope of Ligand Fields: (05 L)
Quantum numbers, Free ion Configuration, Terms and States, Energy levels of transition metal ions, free ion terms, microstates, term wave functions, spin-orbits coupling.

2)Ligand Field Theory of Coordination Complexes (07L)
Effect of ligand field on energy levels of transition metal ions, weak cubic ligand field effect on Russell- Saunders terms, Orgel diagrams, strong field effect, correlation diagrams, Tanabe-Sugano Diagrams, Spin-Pairing energies.

3)Electronic spectra of Transition Metal Complexes (06 L)
Introduction, band intensities, band energies, band width and shapes, transition metalspectra of 1^{st}, $2^{nd}$and 3^{rd} row ions and complexes, electronic spectra of Lanthanide and Actinide, spectrochemical andnephelauxetic series, charge transfer and luminescence spectra, calculations of Dq, B, β parameters, percentage of covalent character for metal complexes.

4)Magnetic Properties of Coordination Complexes (06 L)
Origin magnetism, types of magnetism, Curie law, Curie-Weiss Law, Magnetic properties of complexes-Para magnetism, $1^{st}$and 2^{nd} Ordered Zeeman effect ,quenching of orbital angular momentum by Ligand fields, Magnetic properties of A, E and T ground terms in complexes, spin freeand spin paired equilibria, temperature dependence of magnetism.

References:

1. Ligand field theory and its applications by B.N. Figgis and M.A. Hitachman
2. Symmetry and spectroscopy of moleculesby K. Veera Reddy
3. Elements of Magnetochemistry by R. L. Datta and A. Syamal

Learning outcomes:

1. Student should able to find out the no of microstates and meaningful term symbols, construction of microstate table for various configuration
2. Hund's rules for arranging the terms according to energy.
3. Student should understand interelectronic repulsion.
4. Student should know the concept of weak and strong ligand field.
5. Student able to find out splitting of the free ion terms in weak ligand field and strong ligand field.
6. To draw correlations diagram for various configurations in Td an Oh ligand field.
7. Student should know basic instrumentation and selection rules and relaxation in rules.
8. Student should know basic d-d transition, d-p mixing, charge transfer spectra.
9. Interpretation of electronic spectra for spin allowed oh and td complexes using Orgel diagram.
10. Understand the concept of spectro chemical series and Nephelauxetic series.

11. Should able to solve numerical based on crystal field parameters.
12. Understand the various terms involved in magnetochemistry.
13. Various phenomenons of magnetism and their temperature dependence.
14. Various experimental methods to find out magnetic moment.
15. Understand the various Quenching of orbital angular momentum.

Section-II: (2Credits, 24 L, 6 T)
Bioinorganic Chemistry

1) Overview of Bioinorganic Chemistry (04 L)
Historical Background and current relevance, role of Cu, Fe, Mn and Mo in metalloprotein, and metalloenzymes.

2) Concepts of Inorganic Chemistry in Bioinorganic Chemistry (08L)
Thermodynamic aspects - HSAB concept, chelate effect and Irving-William series, pK_a values of coordinated ligands, Tuning of redox potential, Biopolymer effects. Kinetic aspects- Electron transfer reaction, Electronic substitution reaction. reactions of coordinated ligands and Template effect, concept of spontaneous self-assembly model compounds.

3) Functions and Transport of Alkali and Alkaline Earth Metal Ions (04L)
Importance of alkali and alkaline earth metals, Distribution of cationic and anionic electrolytes in blood plasma and intracellular fluid, Ionophores: Natural and Synthetic, Application of ionophores, Different mechanism involved in exchange of ions across cell wall,Na+/K+-ATPase ion pump for active transport of Na^+ and K^+.

4) Biochemistry of following Elements: **(08L)**
(a) Ca in Blood coagulation.
(b) Magnesium in Photosystem I
(c) Manganese in Photosystem II
(d) Iron in Ferritin, Transferrin, Fe-S clusters, Porphyrin based system.

References:
1. Principle of Bioinorganic Chemistry by S.J. Lippard and J. M. Berg
2.Bioinorganic Chemistry: Inorganic Elements in Chemistry of Life by W.Kaim and B. Schwederski

Learning outcomes:
1) Importance of bioinorganic chemistry.
2) Role of metals in Metalloprotein and metalloenzymes.
3) Similarities in coordination theory for metal complexes and metal ions complexed with biological ligands.
4) Importance and transport of metal ions.
5) Passive transport metal ions by ionophores and gramicidin.
6) Mechanism for active transport of $Na^+$and K^+
7) Nerve impulse generation in rod cell of retina.
8) Importance and function of Ca, Fe and Mg in metalloprotein
9) Catalytic role of Mn in photosynthesis.

Semester-I

CCTP-3:CHO-150, Organic Chemistry-I, Semester – I (4 Credits)

SECTION-I (2 Credits, 24 L, 6T)

Basic Organic Chemistry

1. Structure and Reactivity: (04 L)

Aromaticity: Benzenoid and non-benzenoid compounds, Huckel's rule, antiaromaticity, Application to carbocyclic and heterocyclic systems, annulenes, azulenes, current concepts of aromaticity.

2. Heterocyclic Chemistry (08 L)

Five and six membered heterocycles with one and two hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocyclic compounds, Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, Pyrimidine

3. Stereochemistry: (12 L)

a) Sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S, E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship, stereospecific andstereoselective reactions, optical activity in biphenyls, spiranes, allenes, Topicity.

b) Conformational analysis of di, tri, tetra-substituted 5 -6 membered rings and decalins.

SECTION-II (2 Credits, 24 L, 6T)

1. Structure, Stability and Reactions of Reactive Intermediates (06 L)

a) Carbocation, Carbanion, Free Radical, Carbenes and nitrenes

b) NGP : Neighbouring group participation

2. Rearrangements: (06 L)

Beckmann, Hofmann, Curtius, Schmidt, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid, Fries, Tiffeneau Demjanov.

3. Ylides: (04 L)

Phosphorus, Nitrogen and Sulphur ylides

4. Oxidation and Reduction Reactions: (08 L)

Oxidisingagents: CrO_3, PDC, PCC, $KMnO_4$, MnO_2, Swern, SeO_2, $Pb(OAc)_4$, Pd-C, RuO_4, OsO_4, m-CPBA, O_3,$NaIO_4$, HIO_4, TEMPO, IBX, CAN, Dess-Martin, DDQ, Ag_2O

Reducing agents: Boranes and hydroboration reactions,MPV reduction and reduction with H_2/Pd-C, Raney-Ni, $NaBH_3CN$, Willkinsons catalyst, DIBAL and Wolff-Kishner reduction, Birch, Clemenson, Dissolving metal

References:

1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)
2. Advanced Organic Chemistry –by J. March 6th Edition
3. Advanced Organic Chemistry (Part A) –by A. Carey and R.J. Sundberg
4. A guidebook to mechanism in organic chemistry – Peter Sykes 6th Ed.
5. Stereochemistry of carbon compound-by E.L. Eliel
6. Stereochemistry of organic compound-by Nasipuri
7. Stereochemistry conformations and mechanism by P.S. Kalsi

8. Modern Synthetic reactions- H.O. House
9. Organic Synthesis – M.B. Smith
10. Organic chemistry –by Cram, Hammond, Pine and Handrickson
11. Mechanism and structure in Organic Chemistry – E. S. Gould
12. Heterocyclic Chemistry -T. Gilchrist
13. An introduction to the chemistry of heterocyclic compounds-R M Acheso
14. Heterocyclic Chemistry- J A Joule and K Mills
15. Principles of modern heterocyclic chemistry- A Paquette
16. Handbook of Heterocyclic Chemistry- A R Katritzky, A F Pozharskii
17. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt

Learning outcomes

At the end of the course the students will know and recall the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism.

1. They will understand the **c**riteria for aromaticity in nonbenzenoid molecules and other advanced polycyclic aromatics
2. Understand the chemistry of monocyclic heterocycles, nomenclature and reactions
3. Learn the concept stereochemistry and its importance; their rules and the concept of chirality
4. Understand the role of various reaction intermediates like carbocation, carbanion, carbenes, radicals, and nitrenes in organic reactions; concept of NGP
5. Able to describe mechanism of different rearrangement reactions. Appreciates the various steps involved in the molecular rearrangements.
6. Understand the chemistry of Ylides
7. Use synthetic reagent of oxidation and reduction for solving the problems

Course outcomes

1. To understand some fundamental aspects of organic chemistry, to learn the concept aromaticity, to understand the various types of aromaticity

2. To study heterocyclic compound containing one and two hetero atoms with their structure, synthesis and reactions.

3. To know stereochemistry of organic compounds; able to do interconversion of Fischer to Newmann, Newmann to Sawhorse and vice versa, Able to assign R and S to given molecules; understand stereoselective and stereospecific reactions; acquire knowledge on topicity.

4. To study structure, formation, stability and related name reaction of intermediates like Carbocation, Carbanion, Free Radical, Carbenes and nitrenes; Recognize neighboring group participation

5. To study rearrangement reaction with specific mechanism and migratory aptitude of different groups.

6. To study Ylides and their reaction.

7. To understands the basis of redox reaction; acquire knowledge about the reagents which causes selective oxidation / reduction in various compounds; learn the basic mechanism of oxidation / reduction in organic compounds.

Semester-II

CCTP-6:CHO – 250, Organic Chemistry-II, Semester–II

(4 Credits)

SECTION-I (2 Credits, 24 L, 6T)

Photochemistry and Pericyclic Reactions

1) Photochemistry **[12 L]**

Principles of Photochemistry, photochemistry of carbonyl compounds, alkenes,dienes, and aromatic compounds, photo rearrangements, Barton reaction

2) **Pericyclic Reactions** **[12 L]**

Cycloaddition reactions, Analysis by correlation diagrams, FMO approach, Electrocyclic, sigmatropic and ene reactions, 1,3-dipolar additions,

References:

1. Advanced Organic Chemistry, Part A by F. A. Carey and R. J. Sundberg
2. Excited states in Organic Chemistry by J.A. Barltrop and J.D.Coyle
3. Organic photochemistry: A visual approach by Jan Kopecky
4. Conservation of orbital symmetry by R. B. Woodward and R. Hoffmann
5. Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P. Marchand
6. Pericyclic Reactions By A. P. Marchand, Roland E. Lehr
7. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr
8. Molecular Orbitals and Organic Chemical Reactions by Ian Fleming
9. Pericyclic Reactions by Ian Fleming
10. Pericyclic Reactions by A Mechanistic and Problem-Solving Approach by Sunil Kumar Vinod Kumar S.P. Singh
11. Essentials of Pericyclic and Photochemical Reactions by Dinda and Biswanath
12. Pericyclic Reactions - A Textbook: Reactions, Applications and Theory by S. Sankararaman, Roald Hoffmann (Foreword by)

SECTION-II (2 Credits, 24 L, 6T)

Spectroscopic Methods in Structure Determination of Organic Compounds

1. UV and IR Spectroscopy **[04L]**

UV: Recapitulation of UV spectroscopy, calculations of □max of aromatic compounds IR spectra of important functional groups 1. With and without conjugation, 2. Ring size effect 3. Effect of H-bonding, 4. Resonance effect,5. Inductive effect.

2. ^{1}H-NMR **[12L]**

Understanding of basic principle, chemical and magnetic nonequivalence, Homotopism, Enantiotopism, diastereotopism, chemical shifts and factors influencing chemical shift: electronegativity, NMR solvent polarity, temperature, anisotropic effect, chemical shifts of acidic protons, D_2O exchange, Multiplicity patterns and Coupling Constants: Pascal's triangle, understanding of tree diagram, complex splitting patterns in aromatic, vinylic, saturated monocyclic compounds, bicyclic compounds (fused and bridged rings), Integration: NMR of racemic mixture, relationship between integration and ee% in diasterotomers.

Problems: complex problems based on multiple coupling constants should be discussed and drawing of expected ^{1}H-NMR spectrum along with complex multiplicity patterns and coupling constants. Drawing of multiplicity patterns and determination of coupling constants of complex multiplets should be discussed.

3. ^{13}C-NMR **[04L]**

Basic of ^{13}C-NMR: Chemical shift and factors affecting chemical shifts in ^{13}C NMR, off resoanance and proton decoupled spectra. Simpleproblems on ^{13}C-NMR.

4. Mass spectrometry (MS) **[04L]**

Basic principle of MS, significance of M^+ (m/z) in determination of molecular formula, Rule of 13. Genesis of m/z fragments: alkanes (cyclic and acyclic), alcohols, amines

Problems: Based on 2-3 fragments of above mentioned functional groups should be discussed.

Combined problems: Problems based on UV, IR, MS, ^{1}H-NMR, ^{13}C-NMR should be solved.

References:

1. Introduction to Spectroscopy by Donald L. Pavia and Gary M. Lampman
2. UV-VIS Spectroscopy and Its Applications by Perkampus, Heinz-Helmut
3. Infrared Spectroscopy: Fundamentals and Applications by Barbara H. Stuart
4. Infrared Spectroscopy by James M. Thompson
5. Spectrometric Identification of Organic Compounds by Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce
6. Introduction to Spectroscopy by Donald L. Pavia
7. Understanding NMR Spectroscopy by James Keeler
8. Spin Dynamics: Basics of Nuclear Magnetic Resonance by Malcolm H. Levitt
9. Guide to Spectroscopic Identification of Organic Compounds by Karen Feinstein
10. Principles of Nuclear Magnetic Resonance in One and Two Dimensions by Richard R. Ernst, Geoffrey Bodenhausen, Alexander Wokaun
11. NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry by Harald Günther
12. Basic One- and Two-Dimensional NMR Spectroscopy by Horst Friebolin
13. Principles of Nuclear Magnetism by A. Abragam
14. Principles of Magnetic Resonance by Charles P. Slichter
15. Nuclear Magnetic Resonance by Peter Hore
16. Applications of NMR Spectroscopy by Atta-ur-Rahman, M. Iqbal Choudhar
17. Solving Problems with NMR Spectroscopy by Atta-ur-Rahman Muhammad Choudhary Atia-tul- Wahab

Learning outcomes:

1. Students should able to understand free radicals' formation, stability and reactivity and should also be able to use the basic understanding in writing probable reaction mechanisms.
2. Students should able to write MO diagram for various olefinic compounds and should able to predict the products, the stereochemistry as well as should able to understand the preferred reaction pathways.
3. Students should able to calculate λmax of organic compounds containing more than one and less than four conjugated systems. Students should able to correlate IR bands with functional groups using numerical data as well as spectral data.
4. Students should able to solve 1H-NMR problems and should also able to draw the 1H-NMR spectrum for simple organic compounds mentioning multiplicity pattern and coupling constant with the help of "Tree Diagram" Should able to predict and analyze the multiplicity patterns with more than one coupling constants.

5. Students should able to use ^{13}C-NMR data to interpret the structure NMR problems and should also able to draw the ^{1}H-NMR spectrum for simple organic compounds mentioning multiplicity pattern and coupling constant with the help of "Tree Diagram" Should be able to predict and analyze the multiplicity patterns with more than one coupling constants.
6. Students should know various key factors responsible for the spectroscopic data acquisition and should able to solve Problems based on UV, IR, MS, ^{1}H-NMR,^{13}C-NMR.

Course outcomes:

Students will be able to understand -

1. MOT and will be able to extend this in predicting reaction mechanism and stereochemistry of electrocyclic reactions.
2. The concepts in free radical reactions, mechanism and the stereo chemical outcomes.
3. The basic principle of spectroscopic methods and their applications in structure elucidation of organic compounds using given spectroscopic data or spectra.

Semester-I

CBOP-1: CHG – 190, General Chemistry-I, Semester-I (4 Credits)

SECTION-I: Theory Course (2 Credits, 24 L, 6T)
(Any one option is to be selected by candidate)

Elective Option-A : Introduction to Solid State of Matter

1. **Bonding in Solids and Electronic Properties** (Ref-1, 4) **(05 L)**

Recollect the concepts: Crystalline solids, unit cell, and types of unit cells

Introduction, Bondingin Solids—Free Electron Theory, Electronic Conductivity, Bonding In Solids—Molecular Orbital Theory, Simple Metals, Semiconductors—Si And Ge, Photoconductivity, The *P-N* Junction—Field-Effect Transistors, Bands In Compounds—Gallium Arsenide, Bands In D-Block Compounds—Transition Metal Monoxides.

2. **Defects and Non-Stoichiometry** (Ref-1, 4) **(07 L)**

Introduction, point defects—an introduction, defects and their concentration, intrinsic defects, extrinsic defects the concentration of defects, ionic conductivity in solids, solid electrolytes, fast-ion conductors: oxygen ion conductors, fast-ion conductors: sodium ion conductors, Applications: 1) fuel cells, 2) sensors, 3) electrochromic devices, non-stoichiometric compounds, introduction, non-stoichiometry in wustite, the titanium monoxide structure.

3. **Superconductivity** (Ref-1, 4) **(04 L)**

Introduction, Discovery, The Magnetic Properties Of Superconductors, Josephson Effects, The Bcs Theory Of Superconductivity, High Temperature Superconductors, Theory Of High Tc Superconductors, Uses Of High Temperature Superconductors

4. **Synthesis of Solids** (Ref-2 and 3) **(08L)**

Introduction, Common Reactions Employed in Synthesis, Soft-Chemistry Routes, Ceramic Methods, Decomposition of Precursor Compounds, Combustion Synthesis, Mechano-chemical and Sono-chemical methods, Soft Chemistry Routes(Ion Exchange Reactions, Use of Fluxes, Sol–Gel Synthesis, Electrochemical Methods, Hydrothermal, Solvothermal and Ionothermal Synthesis), Chemical Vapour Deposition and Atomic Layer Deposition, Procedures of synthesis of some nano-materials- Gold and Silver nanoparticles, CdS nanoparticles, ZnO, TiO2 and Fe_2O_3 nanoparticles and Porous Silica

References

Ref.-1: Elaine A. Moore, Lesley E. Smart - Solid State Chemistry - an Introduction. Third Ed. / Fourth Ed. CRC Press (2012)

Ref-2: C. N. R. Rao, Kanishka Biswas, Essentials of inorganic materials synthesis, Wiley, 2015

Ref-3: Nanotechnology: Principles and Practices, S. K. Kulkarni, Third Ed. Springer

Ref-4: Anthony R. West, Solid State Chemistry and its Applications Second Edition (Student Edition), Wiley.

Learning outcomes

At the end of course student will understand

1. Bonding in solids – band theory
2. Electronic conductivity
3. Semiconductors, photoconductivity
4. Non-stoichiometry, defects and types of defects in solids
5. Ionic conductivity and their applications
6. Superconductivity and theory of superconductivity

7. Method of synthesis of solids

Elective Option-B: Chemical Mathematics

1. Functions **(14 L)**

Differential and integral calculus, limits, derivatives, physical significance, basic rules of differentiation, maxima and minima, application is chemistry, exact and inexact differentiation, Taylor and McLaurin Theorem, curve sketching, partial differentiation, rules of integration, separation of variable, substitution, partial function method to solve to indefinite integrals in chemistry

2. Differential Equations **(06 L)**

Separation of variables, homogeneous, exact, linear equations of second order, series solution method.

3. Vectors Matrices, and Determinants **(04 L)**

Vectors, dot, Corss and triple products, introduction to matrix algebra, addition and multiplication of matrices, inverse, adjoins and transport of matrices, unit and diagonal matrices.

References:

1) Chemical Maths Book, E. Steiner, Oxford University Press (1996).
2) Maths For Chemists Vol. 1 and 2, Martin MCR Cockett and G. Doggett, Cambridge (2003).
3) Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill (1972)

Elective Option-C: Introduction to Chemical Biology-I

1. **Overview of Biochemical Concepts** **(03 L)**

Central dogma of cell biology, prokaryotes- eukaryotes and subcellular components, Overview of cell metabolism, Interdisciplinary approach, Biomolecules as potential drug targets

2. **Chemistry of Biomembranes** **(06 L)**

Structure, Functions and Composition, Fluid Mosaic Model by Singer and Nicholson, Properties of membrane, Transport of Ions (Na^+, K^+, H^+, Ca^{2+}, Cl^-) and Molecules (Glucose, Amino acids, Proteins), transport across the membrane, Uniport, Symport, Antiport, Active and Passive facilitated transport, Exocytosis and Endocytosis (Pinocytosis, phagocytosis, receptor mediated endocytosis), Drug transport, Amphipathic nature and Significance of liposomes

3. **Carbohydrates** **(04 L)**

Classification, Structure and Properties, Derived sugars and their significance, Glycoproteins, glycolipids

4. Lipids **(04 L)**

Classification, Structure and Properties of lipids, Saponification number, Iodine number, Acid number, Rancidity of lipids, Lipoproteins

5. Amino Acids and Proteins **(07 L)**

Introduction, Classification of amino acids, Physico chemical properties, Optical properties, Peptide bond, Primary, Secondary, Tertiary and Quaternary structure of proteins, Protein -Ligand interactions, Denaturation of proteins, Oligopeptide synthesis, Concept of proteomics

References:

1. Principals of biochemistry, Albert Lehninger (CBS Publisher and Distributers Pvt. Delhi.
2. Harper's Biochemistry by R.K. Murray, D. I. Granner, P. A. Mayes, (Prentice Hall International Inc.)

3. Biochemistry by U. Satynarayana
4. Biochemistry by J. L. Jain
5. Biophysical Techniques by Upadhyaya Nath

Course Outcomes:
The goal of this course is to introduce students to fundamental concepts in Chemical Biology and methods of chemistry used to solve problems in molecular and cell biology. After completion of this course, successful students will:

1) Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
2) Students will be able to function as a member of an interdisciplinary problem solving team.
3) To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
4) Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
5) Develop skills to critically read the literature and effectively communicate research in a peer setting.

SECTION-II: Practical Course (2 Credits,48 L 12T)
(Any one option to be selected by candidate)

Elective Option-A: Inorganic Material Analysis, Synthesis and Applications

Time allotted: One practical session of 4 hours per week for one semester

Part-I: Analysis (at least two of the following) (Ref. -1)
1. Determination of Silica and Manganese from pyrolusite ore.
2. Determination of Aluminum and Silica from Bauxite ore.
3. Determination of silica and iron from hematite ore.
4. Determination of copper and iron from Chalcopyrite ore.

Part-II: Alloy Analysis (at least two of the following) (Ref. -1)
5. Determination of tin and lead from solder alloy.
6. Determination of iron and chromium from stainless steel alloy.
7. Determination of copper and nickel from cupranickel alloy.

Part-III: Synthesis of solid state materials / nano-materials **(any three) (Ref- 2 and 3)**
8. Synthesis of ZnO from zinc oxalate - precursor method and determine band gap by absorption spectroscopy
9. Synthesis of TiO_2 $TiCl_4$ or Ti-Isopropoxide by Sol-gel method and determine band gap by absorption spectroscopy
10. Synthesis of Colloidal silver nanoparticles and determine band gap by absorption spectroscopy
11. Synthesis of Fe_2O_3 nanoparticles sol-gel/coprecipitation/hydrothermal (any one method)
12. ZnO, TiO_2, Fe_2O_3 nanoparticles powder XRD, SEM, TEM (at least one spectral analysis should be done)

Part-IV: Applications of Solid State Materials

12. Removal and kinetics of photocatalytic dyes, degradation (methylene blue) by ZnO TiO_2 photocatalysis (Ref-2)
13. Study of adsorption of phosphate ion on alfa-Fe_2O_3 (Ref-2)

References:

1. Text book of Quantitative Analysis by A.I. Vogel 3^{ed}ed^{n} (1963).
2. Experimental Inorganic Chemistry by Mounir A. Malati, Horwood
3. Nanotechnology by S. K. Kulkarni

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **50% students will be assigned experiment on part-I or II while remaining – (analysis of any one component) 50% students will assigned experiment on part-III and IV.**
3. **Use of only university supplied procedure will be allowed at the time of examination.**

Elective Option - B: Chemical Biology-I Practical

Time allotted: One practical Session of 4 hours per week for one semester

1. Statistical treatment of experimental data (calculation of mean and standard deviation for given data and least square method for calibration curve method) - Compulsory

Perform at least 10 Practical from the following

1. Preparation of biological buffers.
2. Qualitative analysis of carbohydrates
3. Qualitative analysis of Lipids
4. Qualitative analysis of amino acids
5. Paper chromatographic / TLC separation of mixture of amino acids and their detection
6. Paper chromatographic separation of mixture carbohydrates and their detection
7. Quantitative estimation of Glucose by dinitro salicylic acid by using calorimetric method
8. Quantitative estimation of proteins by Loawry's method
9. Kjeldahl method of Protein Determination
10. Saponification number of fats
11. Iodine value of oil
12. Isolation Quantitative estimation of DNA by Diphenyl amine method
13. Determination of Inorganic Phosphate in Biological Samples

References:

1. A reference book of biochemistry practicals by Sadashivam
2. Practical approach to biochemistry by Plummer
3. Martin Holtzhauer, Basic Methods for the Biochemical Lab, First Edition, Springer

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**

Semester-II

CBOP-2: CHG – 290, General Chemistry -II, (4 Credits)

SECTION-I: Theory Course (2 Credits, 24 L, 6T)

(Any one option is to be selected by candidate)

Elective Option-A: Material Characterization Technique

1. X-Ray Diffraction Methods (Ref-1) (6 L)

Miller and Weiss indices, X-Ray Radiation, Generation of X-Rays, X-Ray Absorption, Theoretical Background of Diffraction, Diffraction Geometry, Bragg's Law, Reciprocal Lattice, Diffraction Intensity, Structure Extinction, X-Ray Diffractometry, Instrumentation, System Aberrations, Samples and Data Acquisition, Sample Preparation, Acquisition and Treatment of Diffraction Data, Distortions of Diffraction Spectra, Crystallite Size, Applications, Crystal-Phase Identification, Quantitative Measurement , Wide-Angle X-Ray Diffraction and Scattering, Wide-Angle Diffraction, Wide-Angle Scattering. Problem on XRD (Calculation of d values, assigning planes, calculation of crystal parameters)

2. Transmission Electron Microscopy (Ref-1) (4 L)

Instrumentation, Electron Sources, Thermionic Emission Gun, Field Emission Gun, Electromagnetic Lenses , Specimen Stage, Specimen Preparation, Prethinning, Final Thinning, Electrolytic Thinning, Ultramicrotomy, Image Modes (Mass–Density Contrast, Diffraction Contrast, Phase Contrast), Selected-Area Diffraction (SAD), Selected-Area Diffraction Characteristics.

3. Scanning Electron Microscopy (Ref-1) **(4 L)**

Instrumentation, Optical Arrangement , Signal Detection, Detector, Probe Size and Current Contrast Formation, Electron–Specimen Interactions, Topographic Contrast, Compositional Contrast, Operational Variables, Working Distance and Aperture Size, Acceleration Voltage and Probe Current, Astigmatism, Specimen Preparation, Preparation for Topographic examination.

4. X-Ray Spectroscopy for Elemental Analysis (Ref-1) **(10 L)**

Features of Characteristic X-Rays, Types of Characteristic X-Rays, Selection Rules, Comparison of K, L, and M Series, X-Ray Fluorescence Spectrometry, Wavelength Dispersive Spectroscopy, Analyzing Crystal, Wavelength Dispersive Spectra, Energy Dispersive Spectroscopy, Detector, Energy Dispersive Spectra, Advances in Energy, Dispersive Spectroscopy, XRF Working Atmosphere and Sample Preparation, Energy Dispersive Spectroscopy in Electron Microscopes, Special Features, Scanning Modes, Qualitative and Quantitative Analysis, Qualitative Analysis, Quantitative Analysis, Quantitative Analysis by X-Ray Fluorescence, Fundamental Parameter Method, Quantitative Analysis in Electron Microscopy, Numerical.

References:

1:Yang Leng, Materials Characterization -Introduction to Microscopic and Spectroscopic Methods, Second Ed. Wiley-VCH,

2:R. D. Braun, Introduction to Instrumental Analysis, Second Ed.

3:Elaine A. Moore, Lesley E. Smart - Solid State Chemistry - an Introduction. Fourth Ed. CRC Press (2012)

Learning outcomes:
At the end of course student will understand / able to explain

1. Different characterization technique of solids.
2. Principle of XRD, instrumentation of powder XRD, Brags law, applications of XRD for crystal structure determination, numerical problems.
3. Principle of SEM, instrumentation of SEM and interpretation of surface morphology of solid from SEM.
4. Principle of TEM, instrumentation of TEM and interpretation of TEM images.
5. Basics of X-rays, Principle of XRF, types of XRF, instrumentation, qualitative and quantitative analysis, numerical.

Elective Option - B: Organometallic and Inorganic Reaction Mechanism

1. Organometallic Chemistry (08 L)

Organic ligands and nomenclature, 18 electron rule: counting electrons, ligands having extended pi system, bonding between Metal Atoms and organic pi systems: linear pi system, cyclic pi system, **s**pectral analysis and characterization of organometallic complexes: IR and NMR, examples.

2. Organometallic Reactions and Catalysis (08 L)

Reactions involving gain and loss of ligands: ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophelic displacement, **r**eactions involving modification of ligands: insertion, carbonyl insertion, 1-2 insertion, hydride elimination, abstraction, organometallic catalysis: Hydroformylation, Monsanto acetic acid process, Wacker Process, Hydrognation by Willkinsons catalyst, Olefin metathesis, heterogeneous catalysis: Ziegler Natta Polymerization, Water gas reduction.

3. Coordination Compounds: Reactions and Mechanism (08L)

History and principles, Substitution reactions: Inert and labile complexes, mechanism of substitution, Kinetics Consequences of reaction pathway: dissociation, interchange, association, Experimental evidences in Octahedral Substitution: dissociation, linear free energy relationship, associative mechanism, the conjugate base mechanism, the kinetic chelate effect, Stereochemistry of reactions: substitution in trans complexes, substitution in cis complexes, isomerisation of chelate rings, substitution reactions in Sq. Pl. Complexes.

Reference

1) Inorganic Chemistry: Gary Miessler and Donald A. Tarr, Third Ed., Pearson (Chapter-12, 13 and14 pages: 422 to 561)
2) IUPAC Nomenclture of Organometallic Compounds of Transition Metals by Salzer http://publications.iupac.org/pac/1999/71_08_pdf/7108salzer_1557.pdf

Learning Outcomes:
At the end of course students will able to explain

1. Valence electron count, back bonding in organometallics, spectral characterization of organometallic compounds.
2. Catalytic reaction involving organometallic compounds and mechanism of these reactions
3. Types of reaction involving organometallic compounds

4. Types of reactions in coordination compounds, inert and labile complexes, substitution reactions in coordination complexes and their mechanism, stereochemistry of reaction, kinetics of reactions.

Elective Option– C: Introduction to Chemical Biology-II

1. Enzymes (06 L)

Classification w.r.t. reaction catalysis, Theory of Enzyme -Substrate (ES) formation, Active sites and its features, Enzyme specificity, Factors affecting enzyme activity, enzyme Kinetics (MM equation, LBW equation), Allosteric enzymes, Types of enzyme inhibition, Industrial applications of enzymes

2. Nucleic Acid (06 L)

Central dogma of molecular biology, Differences between DNA and RNA, Overview of replication transcription, Genetic code, translation, Gene cloning, Gene Therapy, Applications of Biotechnology

3. Metabolism of Biomolecules (06 L)

Aerobic and Anaerobic glycolysis, TCA Cycle, Beta oxidation of fatty acids, Trans amination, deamination, decarboxylation of amino acids, Urea cycle

4. Biochemical Techniques (06 L)

Protein purification and characterization, Dialysis, Chromatography, Electrophoresis, Native and SDS-PAGE

References:

1. Principals of biochemistry, Albert Lehninger (CBS Publisher and Distributers Pvt. Delhi.
2. Harper's Biochemistry by R.K. Murray, D. I. Granner, P. A. Mayes, (Prentice Hall International Inc.)
3. Biochemistry by U. Satynarayana
4. Biochemistry by J. L. Jain
5. Biophysical Techniques by Upadhyaya Nath

Learning outcomes:

The goal of this course is to introduce students to fundamental concepts in Chemical Biology and methods of chemistry used to solve problems in molecular and cell biology. After completion of this course, successful students will:

1) Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
2) Students will be able to function as a member of an interdisciplinary problem solving team.
3) To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
4) Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
5) Develop skills to critically read the literature and effectively communicate research in a peer setting.
6) Describe the importance of chemical biology research and interdisciplinary work.

SECTION-II: Practical Course (2 Credits, 48 L, 12T)
(Any one option to be selected by candidate)

Elective Option-A: Electrochemical Methods of Analysis

Time allotted: One practical Session of 4 hours per week for one semester

Total 11 practical to be conducted

Part-I: Conductometry: (Any three)

1. Hydrolysis of NH_4Cl or CH_3COONa or aniline hydrochloride.
2. Determination of λ_0 or $\lambda\alpha$ and dissociation constant of acetic acid.
3. Hydrolysis of ethyl acetate by NaOH.
4. Determination of ΔG, ΔH, and ΔS of silver benzoate by conductometry.
5. Determination of critical micellar concentration (CMC) and ΔG of micellization of sodium Lauryl Sulphate / Detergent

Part-II: Polarography (any one)

6. Determination of half wave potential E 1/2 and unknown concentration of Cu or Pb or Zn ion.
7. Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.

Part-III: Potentiomerty: (Any three)

8. Stability Constant of a complex ion.
9. Solubility of a sparingly soluble salt.
10. To determine the ionic product of H_2O
11. Estimation of halide in mixture.

Part-IV: pH metry (any two)

12. Determination of the acid and base dissociation constant of an amino acid and hence the isoelectric point of the acid.
13. Determination of dissociation constants of tribasic acid (phospheric acid)
14. Construct pH curve for titration of strong base – strong acid, strong base - weak acid and predict the best indicator in these titrations (methyl orange, methyl orange, brocresol green, phenolphthalein, etc.)

Part-V: Table Work (any two)

15. Analysis of powder XRD of $SrTiO_3$ and Ag metal or any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)
16. Cyclic voltamogram of $K_3Fe(CN)_6$ in KCl/H_2O / Ferrocene in TEAP//MeCN
17. Detailed interpretation of Raman spectra of diatomic molecules

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett(Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.).
4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Physical chemistry by Wien (2001)
6. Advance Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut)

7. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
8. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**

Elective Option-B: Chemical Biology-II Practical

Time allotted: One practical Session of 4 hours per week for one semester

Perform at least 11 Practical

1. Dialysis and Reverse dialysis of protein salt solution
2. Separation of protein by Gel filtration method
3. Separation of protein by affinity chromatography method
4. Separation of protein by Ion exchange chromatography
5. Native and SDS PAGE of proteins
6. Separation of amino acids by paper chromatography
7. Separation of nucleic acid by Agarose gel electrophoresis
8. Effect of pH on enzyme activity
9. Effect of Temperature on enzyme activity
10. Effect of substrate concentration on enzyme activity
11. Detection of λ Max of proteins
12. Detection of λ Max of Nucleic acid

References:

1. A reference book of Biochemistry Practicals by Sadashivam
2. Practical approach to biochemistry by Plummer
3. Martin Holtzhauer, Basic Methods for the Biochemical Lab, First Edition, Springer

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**

Semester-I

CCPP-1: CHP-107: Practical Course – I: Semester -I

Basic Practical Chemistry (Compulsory) **(4 Credits, 96 L, 24T)**

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for Section-I and one practical session for Section-II per week is compulsory)

Sec-I: Physical Chemistry Practical (11 Experiments)

1. Statistical treatment of experimental data (calculation of mean and standard deviation for given data and least square method for calibration curve method) (compulsory)

Part-I: Chemical Kinetics: (Any three)

2. Kinetic decomposition of diacetone alcohol by dilatometry.
3. Determination of an order of a reaction.
4. Brönsted primary salt effect.
5. Kinetics of oxidation of ethanol by $K_2Cr_2O_7$

Part-II: Non-Instrumental: (Any Three)

6. Determination of surface excess of amyl alcohol or TX-100 surfactant by Capillary rise method.
7. Determination of molecular weight by steam distillation.
8. Glycerol radius by viscosity.
9. Partial Molar Volume (Polynometry) Determination of the densities of a series of solutions and to calculate the molar volumes of the components.

Part-III: Colorimetry and spectrophotometry (Any four experiments)

10. Simultaneous determination of Ni and Co by spectrophotometry (Ref-1)
11. Simulations determination of $KMnO_4$ and $K_2Cr_2O_7$ by spectrophotometry.(Ref-7)
12. To study the adsorption of certain dyes such as methyl violet, picric acid or malachite green on charcoal. (Ref-2)
13. To determine the indicator constant of bromocresolpuple by half height method (Ref-8)
14. Estimation of Cu(II) by titration with Na_2 EDTA by colorimetry
15. a. Determination of energy of n to Π^* transition in acetone and study of effect of solvent on energy of this transition by recording absorbance spectra in n-hexane and water. b. To study the effect of the extended conjugation on the λ_{max} of p-nitro phenol by recording spectrum in acidic and alkaline medium (Ref-8).

Part -IV: Radioactivity: (Any one)

10. Estimation of Mn in tea leaves by NAA.
11. Half-life of a radioactive nuclide and counting errors.
12. Determination of E-max of β radiation and absorption coefficients in Al.

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W.
Richett(Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.).

4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Physical chemistry by Wien (2001)
6. Advance Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut),
7. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
8. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books

Sec-II: Organic Chemistry (11 Experiments)

Introduction to Laboratory Safety: Meaning of safety signs on container of chemicals, safety handling of chemicals, MSDS sheets: Detailed explanation at least for 4 different types of substances (e.g. nitric acid, benzene, potassium dichromate, bromine, etc.), Handling of glassware's and care to be taken, handling of organic flammable as well as toxic solvents in laboratory, use of safety goggles, shoes and gloves, fire extinguisher and its use, action to be taken in accidental cases e.g. cleaning of acid spill over, use eye wash station and bath station in emergency, etc. (compulsory)

Part-I: Purification Techniques (Compulsory) (8 Experiments)

a) Purification of **two** organic solids by recrystallization using solvents other than water
b) Purification of **two** organic liquids by upward/downward/traditional distillation technique
c) Column Chromatography technique should be performed for any one of the following preparation
d) Sublimation by Cold Thumb Method
e) Thin Layer Chromatography technique **two mixtures**

Part-II: Introduction to Green Chemistry (Compulsory 1 Practical)

Concept of green chemistry, twelve principals of green chemistry, applications of green chemistry for sustainable development, Atom economy, Monitoring of reaction using TLC.

Green Chemistry Experiments (any two)

1. Preparation of Schiff's bases in aqueous medium.
2. Preparation of dihydropyrimidinone under solventfree conditions
3. Preparation of acetanilide from aniline and acetic acid using Zn dust

1. Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**
3. **One experiment from Physical chemistry and any one experiment from organic section will be assigned.**

Semester-II

CCPP-2: CHP-227: Practical Course-II: Semester -II

Basic Practical Chemistry (Compulsory) **(4 Credits, 96 L, 24T)**

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for Section-I and one practical session for Section-II per week is compulsory)

Section-I: Inorganic Chemistry (11 Experiments)

Part-I: Synthesis of coordination complexes (any three) (Ref. 2)

1. Synthesis and Purity of $[Mn(acac)_3]$
2. Synthesis and Purity Chloropentaamminecobalt(III) chloride.
3. Synthesis and Purity Nitro pentaamminecobalt(III) chloride.
4. Synthesis and Purity Bis[TrisCu(I)thiourea]

Part-II: Inorganic Conductometry (any two)

4. Structural determination of metal complexes by conductometric measurement. (Ref-3)
5. To study complex formation between Fe(III) with sulfosalicylic acid by conductometry (Ref-3).
6. To verify the Debye Huckel theory of ionic conductance for strong electrolytes KCl, $BaCl_2$, K_2SO_4 and $[K_3Fe(CN)_6]$ (Ref-3)
7. Determination of Pb(II) in solution with Na_2SO_4 solution and determination of solubility product of $PbSO_4$ (Ref-4)

Part-III: Inorganic characterization techniques (any two of the following)

8. Determination of equilibrium constant of M – L systems Fe(III)–Sulphosalicylic acid or Fe(III)–β–resorcilic acid by Job's continuous variation method. (Ref.-3, 5)
9. Solution state preparation of $[Ni(en)_3]S_2O_3$, $[Ni(H_2O)_6]Cl_2$, $[Ni(NH_3)_6]Cl_2$. Record absorption spectra in solution of all three complexes and calculate 10 Dq. Arrange three ligands according to their increasing strength depending on your observations. (Ref. -5)
10. Determination of magnetic susceptibility (χg and χm) of mercury tetracyanato cobalt or $Fe(acac)_3$ or Ferrous ammonium sulfate by Faraday or Gouy method. (Ref. -3, 5)

Part-IV: Inorganic Kinetics Experiment (any two)

11. Synthesis and photochemistry of $K_3[Fe(C_2O_4)_3].3H_2O$. (Ref-4)
12. Kinetics of substitution reaction of $[Fe(Phen)_3]^{2+}$ (Ref-3)
13. Kinetics of formation of Cr(III)-EDTA complex (Ref-3)

Part-V: Ion – Exchange Chromatography (Ref. -1 and 3)

1. Separation of mixture of Zn(II) and Mg(II) using Amberlite IRA 400 anion exchanger and quantitative estimation of separated ions Zn(II) and Mg(II)

Part-VI: Solvent Extraction and colorimetric (any one experiment) (Ref. -1 and 3)

2. Determination of Cu(II) by solvent extraction as Dithiocarbamate complex (Ref-1)
3. Determination of iron by solvent extraction techniques in a mixture of Fe(III) +Al(III) or Fe(III) + Ni(III) using 8–hydroxyquinoline reagent. (Ref. -1)

References:

1. Vogel's Textbook of Inorganic quantitative analysis
2. Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horwood publishing, Chichester) 1999.

3. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
4. General Chemistry Experiments, Anil. J Elias, University Press (2002)
5. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books

Section -II: Organic Chemistry (11 Experiments)

1. Base catalyzed aldol condensation using $LiOH.H_2O$ as a Catalyst.
2. Bromination of *trans*-stilbene using sodium bromide and sodium bromate
3. [4+2] cycloaddition reaction in aqueous medium at room temperature
4. BenzilBenzilic acid rearrangement under solvent free condition
5. Clay catalyzed solid state synthesis of 7-hydroxy-4-methylcoumarin
6. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate
7. Bromination of acetanilide using ceric ammonium nitrate in aqueous medium
8. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst,
9. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature.
10. Solvent free aldol condensation between 3,4-dimethoxybenzaldehyde and 1-indanone
11. Preparation of azlactone from hippuric acid
12. Preparation of thioamide from benzaldehyde in water.

Note: Students should perform a) Relevant chemical analysis. b) Column chromatography. c) Elemental analysis. d) Spectroscopic interpretation. e) How to draw schemes and mechanism using Chem Draw / ISIS Draw etc.

N B. :

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of microscale technique is recommended wherever possible**

References:

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry TaskForce Committee, DST

Learning Outcomes:

1. This course is designed to make students aware of how to perform organic compounds in laboratory.
2. The course includes synthesis of some derivatives and organic compounds, which will help them while working in research laboratory in future.
3. Making derivatives of organic compounds will help them in industry or while doing research in medicinal chemistry for Drug development.
4. This practical course is also designed to make student aware of green chemistry and role of green chemistry in pollution reduction.
5. The students learn how to avoid solvents and do solvent free reaction.
6. Also the work-up procedure in many experiments is made more eco-friendly to environment.

Course Outcomes:

1. Students are trained to different purification techniques in organic chemistry like recrystallization, distillation, steam distillation and extraction.
2. Students are made aware of safety techniques and handling of chemicals.

3. Students are made aware of carrying out different types of reactions and their workup methods.
4. This practical course is designed to make student aware of green chemistry and role of green chemistry in pollution reduction.

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**
3. **Any one experiment from inorganic chemistry and any one experiment from organic section will be assigned time the time of examination.**

Pattern of Question Paper

For theory courses, end semester question papers will be set by the University and centralized assessment for theory papers done as per the rules laid down by the University. Questions will be designed to test the conceptual knowledge and understanding of the basic and advanced concepts of the subject. There will be **two sections** for each paper. Each section will be of **35 marks** and the pattern of question paper shall be:

Question 1 (10 Marks)	5 compulsory sub-questions, each of 2 marks; precisely answerable in 2-5 sentences (such as define, short problem, draw the structure / neat labelled diagram, short reasons, characteristics, applications, etc.)
Question 2 (10 Marks)	2 out of 4 – descriptive answer type questions of 5 marks each; answerable in sufficient length with graph or diagram or flow sheet if necessary.
Question 3 (10 marks)	2 out of 4 – Critical analysis / differentiation / evaluative / summarize interpret, write notes, numerical problem type of questions of 5 marks each; answerable in 15 lines with graph or diagram if applicable.
Question 4 (5 Marks)	1 out of 2 – numerical problem type question; spectral analysis, For descriptive course critical notes, decryption of technique, how you will apply your knowledge to solve particular problem, etc. types of question.

In question paper setting wattage for each chapter will be proportional to number of theory lectures assigned to that chapter.

University of Pune

Revised Syllabus 2014

M.Sc. II: Organic Chemistry

Semester III

CHO-350	**Organic Reaction Mechanism**	**48 Lectures, 4 Credits**
CHO-351	**Spectroscopic Methods in Structure Determination**	**48 Lectures, 4 Credits**
CHO-352	**Organic Stereochemistry**	**48 Lectures, 4 Credits**
CHO-353	**Pericyclic Reactions, Photochemistry and Heterocyclic Chemistry**	**48 Lectures, 4 Credits**

Semester IV

CHO-450	**Natural Products**	**48 Lectures, 4 Credits**
CHO-451	**Advanced Synthetic Organic Chemistry**	**48 Lectures, 4 Credits**
CHO-452	**Carbohydrate and Chiron approach/ Chiral Drugs and Medicinal Chemistry**	**48 Lectures, 4 Credits**
CHO-453	**Designing Organic Synthesis and Asymmetric Synthesis**	**48 Lectures, 4 Credits**

M.Sc. II: Organic Chemistry Practical

CHO-347	**Single Stage Preparations**	**6 Credits**
CHO-447	**Two Stage Preparations**	**6 Credits**
CHO-448	**Project/Industrial training/ Green Chemistry and Chemical Biology Experiments**	**6 Credits**

Equivalence of previous Syllabus

	New Syllabus 2014 Pattern		Old Syllabus 2008 Pattern
CHO-350	**Organic Reaction Mechanism**	**CH-350**	**Organic Reaction Mechanism**
CHO-351	**Spectroscopic Methods in Structure Determination**	**CH-351**	**Spectroscopic Methods in Structure Determination**
CHO-352	**Organic Stereochemistry**	**CH-352**	**Organic Stereochemistry**
CHO-353	**Pericyclic Reactions, Photochemistry and Heterocyclic Chemistry**	**CH-353**	**Free Radicals, Photochemistry, Pericyclic Reactions and their Applications**
CHO-450	**Chemistry of Natural Products**	**CH-450**	**Chemistry of Natural Products**
CHO-451	**Advanced Synthetic Organic Chemistry**	**CH-451**	**Synthetic Methods in Organic Chemistry**
CHO-452	**Carbohydrate and Chiron Approach/ Chiral Drugs and Medicinal Chemistry**	**CH-452**	**Heterocyclic Chemistry, Chiron Approach and Medicinal Chemistry**
CHO-453	**Designing Organic Synthesis and Asymmetric Synthesis**		
CHO-347	**Single Stage Preparations**	**CH-347**	**Ternary Mixture Separation**
CHO-447	**Double Stage Preparation**	**CH-447**	**Single Stage and Two Stage Preparation**
CHO-448	**Project/Industrial Training/ Green Chemistry and Chemical Biology Experiments**	**CH-448**	**Project and Practicals**

M.Sc. Organic Chemistry PART-II

REVISED SYLLABUS-2014

CHO-350: Organic Reaction Mechanism [4 credits, 48 Lectures]

1. Carbanions-Formation, stability and related name reactions [14L]
   Ref. 1, 2, 3 Vol.A and 7
2. Enamines –formation and applications, Ref. 3 [4L]
3. NGP :Neighbouring group participation , Ref. 1 [6L]
4. Reactions of carbenes and nitrenes Ref.3 Vol B [4L]
5. Free radicals: [14L]
   Generation of radiacls, Stable free radicals, Nucleophilic and electrophilic radicals, Characteristics reactions, -Free radical substitution, addition to multiple bonds, Radicals in synthesis: Inter and intra molecular C-C bond formation via mercuric hydride, tin hydride, thiol dionors, cleavage of C-X, C-Sn, C-Co, C-S, O-O bonds. Oxidative coupling. C-C bond formation in aromatics, SNAr reactions
   Ref. 1, 3 Vol A, 6
6. Mechanisms in Biological Chemistry (Ref. 5) [6L]

References:

1. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
2. Advanced organic chemistry by J. March, 6th Ed.
3. Advanced organic chemistry. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
4. A guidebook to mechanism in organic chemistry – Peter Sykes 6th Ed. Orient Longman
5. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers. Oxford University Press (2001)
6. Radicals in Organic Synthesis B. Giese, Pergamon press (1986)

CHO-351: Spectroscopic Methods in Structure Determination

[4 credits, 48 Lectures]

^{1}H NMR Spectroscopy (14 L)

Chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), chemical exchange, effect of deuteration, spin-spin coupling, (n+1) rule, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), factors effecting coupling constant "J", classification of spin system like AB, AX, AX_2, ABX, AMX, ABC, A_2B_2. Spin decoupling, Factors affecting coupling constant, simplification of complex spectra, nuclear magnetic

double resonance, spin decoupling, contact shift reagents, solvent effects, nuclear over-hauser effect (NOE), resonance of other nuclei like ^{31}P, ^{19}F

^{13}C NMR spectroscopy (8 L)

FT NMR, Types of ^{13}C NMR Spectra: un-decoupled, Proton decoupled, Off resonance, APT, INEPT, DEPT, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts, Homo nuclear (^{13}C-^{13}C) and Hetero nuclear (^{13}C-^{1}H)coupling constants.

2D NMR Techniques (6 L)

General idea about two dimensional NMR spectroscopy, Correlation spectroscopy (COSY)- Homo COSY (^{1}H-^{1}H), TOCSY, Hetero COSY (HMQC, HMBC), Homo and Hetero nuclear 2D resolved spectroscopy, NOESY and 2D-INADEQUATE experiments and their applications.

Mass Spectrometry (10 L)

Instrumentation, various methods of ionization (field ionization, field desorption, SIMS, FAB, MALDI, Californium plasma), different detectors (magnetic analyzer, ion cyclotron analyzer, Quadrupoule mass filter, time of flight (TOF). Rules of fragmentation of different functional groups, factors controlling fragmentation

Problems based on joint application of UV, IR, PMR, CMR, and Mass. (10 L)

(Including reaction sequences)

References:

1. Introduction to Spectroscopy – D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers).
2. Spectrometric identification of organic compounds R. M. Silverstein, F. X. Webster, 6th Ed. John Wiley and Sons.
3. Spectroscopic methods in organic chemistry - D. H. Williams and I. Flemming Mc Graw Hill
4. Absorption spectroscopy of organic molecules – V. M. Parikh
5. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer-Verlag (1986).
6. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).
7. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998)
8. Organic structural Spectroscopy- Joseph B.Lambert, Shurvell, Lightner, Cooks, Prentice-Hall (1998).
9. Organic structures from spectra –Field L.D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and sons Ltd.

10. Spectroscopic identification of organic compound- R M Silverstein, G C Bassler and T C Morril, John Wiley
11. Introduction to NMR spectroscopy-R J Abrahm, J Fisher and P loftus Wiley
12. Organic spectroscopy-William kemp, E L B with McMillan
13. Spectroscopy of organic molecule-PS Kalsi,Wiley, Esterna, New Delhi
14. Organic spectroscopy-RT Morrison and RN Boyd
15. Practical NMR spectroscopy-ML Martin, J J Delpench, and D J Martyin
16. Spectroscopic methods in organic chemistry-D H Willson, I Fleming
17. Spectroscopy in organic chemistry- C N R Rao and J R Ferraro
18. NMR –Basic principle and application-H Guntur
19. Interpretation of NMR spectra-Roy H Bible
20. Mass spectrometry organic chemical applications, J H Banyon

CHO-352: Organic Stereochemistry

[4 credits, 48 Lectures]

1. Stereochemistry of six membered rings. Ref. 1, 4, 5, 6 (12L)
2. Stereochemistry of rings other than six membered Ref. 1, 4, 5, 6 (8L)
3. Fused Bridged and caged rings Ref. 1, 2, 4, 5 (6L)
4. Resolution of racemic modification Ref. 1, 4 (6L)
5. Geometrical Isomerism and Stereochemistry of olefins Ref.1, 2 (10L)
6. CD and ORD Ref. 1,2,4 (2L)
7. Determination of stereochemistry organic compounds using NMR. (4L)
   Ref. 3 Chapters 32 (1st Edition)

References:

1. Stereochemistry of carbon compounds - E. L. Eliel
2. Stereochemistry of carbon compounds - E. L. Eliel and S. H. Wilen
3. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 1st. Ed.
4. Stereochemistry of organic compounds –Nasipuri
5. Stereochemistry of organic compounds-Kalsi
6. Organic stereochemistry – Jagdamba Singh

CHO-353: Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry [4 credits, 48 Lectures]

1. **Photochemistry** [12L]

   General basic principles, photochemistry of carbonyl compounds, alkenes, dienes, polyenes and aromatic compounds, photorearrangements, Barton reaction
   Ref. 1,2,3,4

   Application of photochemical reactions in synthesis– Isocomene, Cedrene
   Ref. 8, 9

2. **Pericyclic reactions** [12L]

   Electrocyclic, cycloaddition, sigmatropic and ene reactions. 1,3-dipolar additions, Analysis by correlation diagrams, FMO approach and ATS concept. Application of pericyclic reactions.
   Ref. 1, 3, 5, 6, 7, 13

3. **Heterocyclic Chemistry** (24 L)

   a) Five and six membered heterocycles with one and two hetero atoms:
   Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, Pyrimidine
   b) Condensed five and six membered heterocycles:
   Benzofuran, Indole, Benzothiophene, Quinoline
   c) Condensed five membered heterocycles:
   Benzoxazole, Benzthiazole, Benzimidazole
   d) Five and six membered heterocycles with more than two hetero atoms:
   Synthesis, reactivity, aromatic character and importance of following heterocycles: 1,2,3-triazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole, tetrazole,
   Ref. 14-20

References:

1. Advanced Organic Chemistry, Part A – F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
2. Excited states in Organic Chemistry- J.A. Barltrop and J.D.Coyle, John Wiley & sons
3. Photochemistry and Pericyclic reactions-Jagdamba Singh, Jaya Singh 3rd Ed.
4. Organic photochemistry: A visual approach-Jan Kopecky, VCH publishers (1992).
5. Conservation of orbital symmetry – R. B. Woodward and R. Hoffmann; Verlag Chemie, Academic press (1971).
6. Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P. Marchand; Academic (1972)
7. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr; Cambridge, University Press.
8. Classics in total synthesis- K. C. Nicolaou and E. J. Sorensen; VHC (1996)
9. P. A. Wender and J. J. Howbert **J. Am. Chem. Soc**. **103**, 688-690 (1981)
10. Pericyclic reactions: A text book –S. Sankararaman
11. Pericyclic reactions- Gill and Willis

12. Frontier orbitals and organic chemical reactions-Ian Fleming, John Wiley & sons
13. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers
14. Heterocyclic Chemistry -T. Gilchrist
15. An introduction to the chemistry of heterocyclic compounds-R M Acheso
16. Heterocyclic Chemistry- J A Joule and K Mills
17. Principles of modern heterocyclic chemistry- A Paquette
18. Heterocyclic Chemistry- J A Joule and Smith
19. Handbook of Heterocyclic Chemistry- A R Katritzky, A F Pozharskii
20. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt

CHO–450 Chemistry of Natural Products [4 credits, 48 Lectures]

1. Structure and stereochemistry of Hardwickiic acid, Camptothecin and podophyllotoxin (8L)
   Ref. 1 to 4 and 11
2. Synthesis of (16L)
   i) Taxol Ref. 6
   ii) Estrone and Mifepristone Ref. 6, 7
   iii) Juvabione (K.Mori and Matsui, Pawson and Cheung Synthesis) Ref.12
   iv) Fredericamycin A Ref. 5
3. Biogenesis – The building blocks and construction mechanism of (24L)
   1. Terpenoids – Mono, Sesqui, Di and Triterpenoids and cholesterol
   2. Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan.
   3. The shikimate pathway – cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids and terpenoid quinones.
      Ref. 8, 9, 10

References:

1. **J. Am Chem. Soc**. **88,** 3888 (1966).
2. M. C. Wani and M. E. Wall **J. Org. Chem. 34**, 1364 (1969).
3. (i) **Tetrahedron Letters**, 3751 (1964).,
   (ii) **Tetrahedron Letters**, 2861 and 2865 (1968).
4. Chemistry of Natural products- Kalsi
5. Principles of organic synthesis by R. O. C. Norman and J.M.Coxon; Chapman and Hall
6. Classics in organic synthesis – K. C. Nicolaou & E. J. Sorensen
7. **J.Indian Inst.Sci**. 81,287 (2001)
8. Medicinal Natural Products - A Biosynthetic approach by Paul M. Dewick 2nd Ed.(Wiley)
9. Secondary metabolism - J. Mann, 2nd edition.
10. Chemical aspects of Biosynthesis – J. Mann (1994).
11. i) **J.C.S. Perkin Transactions II**, 288-292, (1973). ii) **J.Am.Chem.Soc**. Vol.77.432-437, (1955).
12. Advanced Organic Chemistry- Carey and Sundberg Part B 5th Ed.

CHO-451: Advanced Synthetic Organic Chemistry [4 credits, 48 Lectures]

1. Transition metal complexes in organic synthesis ; only Pd, Ni, Co, Fe (Metal mediated C-C and C-X bond formation reactions: Suzuki, Heck, Sonogashira, Stille, Fukuyama, Kumada, Hiyama, Negishi, Buchwald-Hartwig, Noyori, Reppe, Oxo process [16L]
2. C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions, Titanium-carbene mediated olefination: Tebbe, Petasis and Nysted reagent [8L]
3. Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reactions [4L]
4. Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization [3L]
5. Click chemistry: criterion for click reaction, Sharpless azides cycloadditions [2L]
6. Metathesis: Grubbs 1st and 2nd generation catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, applications [4L]
7. Use of Boron and Silicon in organic synthesis [8L]
8. Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction [3L]

References:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Designing of organic synthesis – S. Warren (Wiley)
4. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
5. Organic synthesis – Michael B. Smith
6. Organometallics in organic synthesis – J. M. Swan and D. C. Black (Chapman and Hall)
7. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
8. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
9. Organic synthesis- Robert E Ireland
10. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako

CHO-452: Carbohydrate and Chiron approach, Chiral Drugs and Medicinal Chemistry [4 credits, 48 Lectures]

1. Carbohydrates [4L]

Introduction of sugars, structures of triose, tetrose, pentose, hexose, stereochemistry and reactions of Glucose, conformation and anomeric effects in hexoses Ref. 1, 2

2. Chiron approach [8L]

a) Introduction

b) The concept of chiral templates and chirons wherein the carbon skeleton is the chiral precursor.

c) Utilisation of the basic concepts for retrosynthetic strategy and synthesis of the following – (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine,

(-) Multistratin, (-) Pentenomycin, (-) Shikimic acid, Ref. 1,2,3

3. **Chiral Drugs** **[12L]**

a) Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio,

b) Distomers-a) with no side effects b) with undesirable side effects Synthesis and pharmacological activity of S-Ibuprofen, S-Metaprolol, Ininvir sulfate, Dextropropoxyphen, (+) Ephedrine, Griseofulvin, R-Indacrinnone, hydrochloride, S-S-captopril

Ref. 4, 5

References:

1. Organic Chemistry – R. P. Morrison and R. N. Boyd
2. Organic Chemistry – I. L. Finar, volume II
3. Chiron Approach in organic synthesis – S. Hanessianh
4. Pharmaceutical Chemistry and drug synthesis –Rot and Kleeman
5. Drug Design –E.J. Arienes

4. Medicinal Chemistry

1. Introduction to drugs, their action and discovery Ref. 1,2,3 [4L]
2. Relation of Drug structure and its chemical and biological properties [4L]
   Ref. 1,2,3
3. Structure, activity and quantitative relationship Ref. 1,2,3 [3L]
4. Drug targets Ref. 3 [4L]
5. Antimicrobial drugs: [9L]

Antibactaerials: Discovery and development of Penicillins, Cephalosporins, Sulphones and sulphonamides, Tetracyclins, Macrolides, Polypeptides, Chloromycetin

Antifungals: Fungal Diseases and Anti-fungal agents

Antivirals: Viral diseases and Anti-viral drugs

Anti-protozoals: Anti-malarials, Anti-amoebic

Ref. 4,5,6

References:

1. Medicinal Chemistry an Introduction-Gareth Thomas 2nd Ed. Wiley
2. An introduction to medicinal chemistry-Graham L. Patrick 5th Ed. Oxford
3. Introduction to Medicinal Chemistry-Alex Gringauz (Wiley)
4. Foye's Medicinal Chemistry
5. Medicinal Chemistry-A. Burger
6. Medicinal Chemistry-Ashutosh Karr

CHO-453: Designing Organic Synthesis and Asymmetric Synthesis

[4 credits, 48 Lectures]

1. Designing of organic synthesis: Protection and de-protection of hydroxyl, amino, carboxyl, ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide, enamines, Umpolung in organic synthesis, Reterosynthesis. (24L)

2. Principles and applications of asymmetric synthesis: (24L)
   stereoselectivity in cyclic compounds, enantio-selectivity, diastereo-selectivity, enatiomeric and diastereomeric excess, stereoselective aldol reactions. Cram's rule, Felkin Anh rule, Cram's chelate model, Asymmetric synthesis, use of chiral auxiliaries, chiral reagents and catalysts, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation. Ref. 3 chapters 33, 34, 35

1. Designing of organic synthesis – S. Warren (Wiley)
2. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
3. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako

M.Sc. II: Organic Chemistry Practical

CHO-347: (A) Single stage preparations **[6 Credits]**

At least Fourteen single stage and three Isolation of Natural products should carried out. The preparation should be carried out on micro scale.

1. 2-Phenyl indole (Fischer indole synthesis),
2. 7-Hydroxy -3-methyl flavone (Baker-Venkatraman reaction),
3. Benzyl alcohol and benzoic acid from benzaldehyde (Cannizzaro reaction)
4. 4-Chlorotoluene from p-toluidine (Sandmeyer reaction)
5. Benzilic acid from benzoin (Benzilic acid rearrangement)
6. Benzopinacol (Photochemical reaction),
7. 7-Hydroxy-4-methyl coumarin (Pechmann Reaction)
8. 4-Methyl benzophenone (Friedal Craft reaction)

9. Benzanilide (Beckmann rearrangement)
10. Vanillyl alcohol from vanillin ($NaBH_4$ reduction)
11. 2- and 4-nitrophenols (nitration and separation by steam distillation)
12. Stilbene from benzyl chloride (Wittig reaction)
13. Ethyl cinnamate from benzaldehyde (Wittig reaction)
14. Triphenyl or diphenyl methyl carbinol (Grignard reaction)
15. Benzotriazole
16. 1-Phenyl-3-methyl pyrazol-5-one
17. Glucose pentaacetate
18. 2,4-diethoxycarbonyl-3,4-dimethyl pyrrole from ethyl acetoacetate
19. Quinoline from aniline Skraup synthesis)
20. Benzimidazole from benzyl
21. Cyclohexanol from cyclohexanone (LAH reduction)

B) Isolation of Natural products (Any three)

1. Caffeine from tea leaves (Soxhlet extraction)
2. Piperine from pepper (Soxhlet extraction)
3. Eucalyptus oil from leaves (Steam distillation)
4. Lycopene from tomatoes
5. Trimyristin from nutmeg
6. Cinnamaldehyde from cinnamom
7. Eugenol from clove

References:

1. Practical organic chemistry by Mann & Saunders
2. Text book of practical organic chemistry –by Vogel
3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin

CHO-447 : Two stage preparations (any Ten) [6 Credits]

1. Benzaldehyde → Benzalacetophenone → Epoxide
2. 4-Nitro toluene → 4-Nitro benzoic acid → 4-Amino benzoic acid
3. Resorcinol → 4-methyl-7-hydroxy coumarin → 4-Methyl-7-acetoxy coumarin
4. Cyclohexanone → Phenyl hydrazone → 1,2,3,4-Tetrahydrocarbazole
5. Hydroquinone → Hydroquinone diacetate → 1,2,4-Triacetoxy benzene
6. Acetanilide → p-Acetamidobenzene sulphonyl chloride → P. Acetamidobenzene sulphonamide
7. p-Amino phenol → p-Acetyl amino phenol → p-Ethoxy acetanilide
8. Hippuric acid → Azalactone → 4-Benzylidene 2-phenyl oxazol-5-one
9. p-Cresol → p-Cresyl benzoate → 2-Hydroxy-5-methyl benzophenone
10. Phthalimide → N-Benzylphthalimide → Benzylamine

11. o-Nitroaniline → o-Phenylene diamine → Benzimidazole
12. Phthalic acid → Phthalimide → Anthranilic acid
13. Benzyl cyanide→ p-Nitrobenzyl cyanide→p-Nitro phenyl acetic acid
14. Hydroquinone → Hydroquinone diacetate → 2,5-Dihydroxy acetopheneone
15. Cyclohexanone→ Enamine→2-Acetyl cyclohexanone
16. α-Pinene→ Disiamyl borane→Pinanol

CHO-448: Project/Industrial training/Green Chemistry and Chemical biology experiments (any Twelve) [6 Credits]

1. Preparation of acetanilide from aniline and acetic acid using Zn dust
2. Base catalyzed aldol condensation using $LiOH.H_2O$ as a Catalyst.
3. Bromination of *trans*-stilbene using sodium bromide and sodium bromate
4. [4+2] cycloaddition reaction in aqueous medium at room temperature
5. Benzil Benzilic acid rearrangement under solvent free condition
6. Thiamine hydrochloride catalyzed synthesis of benzoin from benzaldehyde
7. Clay catalyzed solid state synthesis of 7-hydroxy-4-methylcoumarin
8. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate
9. Bromination of acetanilide using ceric ammonium nitrate in aqueous medium
10. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst
11. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature.
12. Solvent free aldol condensation between 3,4-dimethoxybenzaldehyde and 1-indanone
13. Solvent free quantitative solid phase synthesis of azomethines from substituted anilines and substituted benzaldehydes.
14. Sucrose to ethyl alcohol (Baker's yeast)
15. Asymmetric reduction of EAA by using Baker's yeast

Note: i) Project/Industrial training students have to perform 6 practical from the above experiments.

ii) 20% students should be given project or industrial training.

Reference:

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST

3. M.Sc. (II) Organic Chemistry

Course Structure

Sr. No.	Paper No. & Course Code	Course Nam e	Credits
		Semester - III	
1	**CCTP-7** CHO-350	Organic Reaction Mechanism and Biogenesis	4
2	**CCTP-8** CHO-351	Structure Determination of Organic Compounds by Spectroscopic Methods	4
3	**CCTP-9** CHO-352	Stereochemistry and Asymmetric Synthesis of Organic Compounds.	4
4	**CBOP-3** CHO-353 Theory	CHO-353-A) Protection - De-protection, Chiron approach and Carbohydrate Chemistry	4
		Or	
		CHO-353B) Designing Organic Syntheses and Heterocyclic Chemistry	4
5	**CCPP-3** CHO-354	**Practical I**: Solvent Free Organic Synthesis	4
		Semester – IV	
6	**CCTP-10** CHO-450	Chemistry of Natural Products	4
7	**CCTP-11** CHO-451	Organometallic Reagents in Organic Synthesis	4
8	**CBOP-4** CHO-452 **Theory**	CHO-452 A) Medicinal Chemistry CHO-452 B) Applied Organic Chemistry	4 4
9	**CBOP-5** CHO-453 Practical	**Practical III: Select any two Sections**	4
		Section-I: Ternary Mixture Separation	2
		Section-I: Carbohydrates Synthesis and Isolation of Natural Products	2
		Section-I: Project / Industrial Training/ Internships/ Summer Project	2
10	**CCPP-4** CHO-454	**Practical II**: Convergent and Divergent Organic Syntheses.	4

Equivalence of Previous Syllabus

New Course (2019 Pattern)	Old Course – 2014 Pattern
CHO-350: Organic Reaction Mechanism and Biogenesis	CHO-350 Organic ReactionMechanism
CHO-351: Structure Determination of Organic Compounds by Spectroscopic Methods	CHO-351 Spectroscopic Methods in Structure Determination
CHO-352: Stereochemistry and Asymmetric Synthesis of Organic Compounds.	CHO-352 Organic Stereochemistry
CHO-353A: Protection - De-protection, Chiron approach and Carbohydrate Chemistry.	CHO-452 Carbohydrate and Chiron Approach/ Chiral Drugs and Medicinal Chemistry
CHO-353B: Designing Organic Syntheses and Heterocyclic Chemistry	CHO-453 Designing Organic Synthesis and Asymmetric Synthesis
CHO-354: **Practical I**: Solvent Free Organic Synthesisis	CHO-347 Single Stage Preparations
CHO-450: Chemistry of Natural Products	CHO-450 Chemistry of Natural Products
CHO-451: Organometallic Reagents in Organic Synthesis	CHO-451 Advanced Synthetic Organic Chemistry
CHO-452B: Medicinal Chemistry	
CHO-452B: Applied Organic Chemistry	CHO-353 Pericyclic Reactions, Photo-chemistry and Heterocyclic Chemistry
CHO-453: **Practical III**: **Select any two Sections from I, II,III** Section-I: Ternary Mixture Separation Section-II: Carbohydrates Synthesis and Isolation of Natural Products Section-III: Project / Industrial Training/ Internships (including Summer Project)	CHO-448 Project/Industrial Training/ Green Chemistry and Chemical Biology Experiments
CHO-454: **Practical II**: Convergent and Divergent Organic Syntheses.	CHO-447: Double Stage Preparation Preparation

The detailed course wise syllabus of M. Sc-II Organic Chemistry is as follows:

Semester-III

CCTP-7, CHO-350: Organic Reaction Mechanism and Biogenesis [48L+12T]

Section I: Organic Reaction Mechanism, [24 L + 6 T]

1. Methods for determining Reaction Mechanisms
(Kinetic and nonkinetic methods), Ref -1, **[4 L]**

2. Free Radicals: Generation, stability, reactivity, Free radical substitution, addition to multiple bonds, radicals in synthesis, Inter- and intra-molecular bond formation via mercury hydride, tin hydride, thiol donors, cleavage of C-X , C-Sn, C-S, O-O bonds, Oxidative coupling, C-C bond formation in aromatics, SNAr reactions, Free Radicals in Organic Synthesis. *(**Ref-**2, 3, 6, 7)*. **[8 L]**

3. Linear Free Energy Relationships, *Ref. 3, 4*. **[6 L]**

4. Hammet plots, Hammet equation, substituent constants, reaction constants, use of Hammet plots, calculation of k and K, Deviations from straight line plots, Taft equation, solvent effects. *Ref. 3, 4, 5* **[6 L]**

Section II: Biogenesis: The Bbuilding Blocks and Cconstruction Mmechanism, [24 L + 6 T]

1. Terpenoids: Mono-, Sesqui-, Di-, tri-terpenoids and cholesterol, *Ref.- 8, 9, 10* **[6 L]**

2. Alkaloids: Derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan. *Ref.- 8, 9, 10* **[6 L]**

3. The Shikimate pathway: Cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids and terpenoid quinones. *Ref.- 8, 9, 10* **[6 L]**

3. A case study: Alkaloids isolated from the Roots of ***Piper nigrum,*** *Ref. -11, 12* **[6 L]**

References:

1. Mechanism and structure in Organic Chemistry E. S. Gould (Holt, Rinehart and Winston)
2. Advanced Organic Chemistry –J. March, 4th edition
3. Advanced Organic Chemistry- Part A: Structure and Mechanism- F. A. Carey and R. J. Sundberg, 5th Edition, Springer 2007)
4. A guidebook to mechanism in Organic Chemistry- Peter Sykes
5. The Hammett Equation by C. D. Johnson
6. Organic Chemistry-J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford University Press
7. Radical in Organic Synthesis- B. Giese, Pergamon Press (1986)
8. Natural Product Biosynthesis: Chemical Logic and Enzymatic Machinery by Christopher T Walsh, Yi Tang
9. From Biosynthesis to Total Synthesis: Strategies and Tactics for Natural Products- Editor Alexandros L. Zografo
10. Medicinal Natural Products: A Biosynthetic Approach, 3rd Edition By Paul M. Dewick
11. J. Nat. Prod. 2004, 67, 1005-1009.
12. J. Org. Chem. 2005, 70, 4, 1164–1176

Additional Study Material: Organic Reaction Mechanism

https://nptel.ac.in/courses/104/101/104101005/
https://nptel.ac.in/courses/104/101/104101115/

CCTP-8, CHO-351: Structure Determination of Organic Compounds by Spectroscopic Methods [48L +12L]

Section-I: NMR Spectroscopy [24 L + 6 T]

1. **NMR in Stereochemistry Determination:** Homotopic, enatiotopic and distereotopic protons, Chemical and Magnetic equivalence; First and second order splitting, Complex multiplicity patterns and coupling constants in asymmetric compounds; Simplification of complex spectra, NOE, Diastereomerism, Atrop or axial chirality, % Enantiomeric excess, chiral NMR solvents etc in structure elucidation. **[10 L]**
2. **^{13}C NMR spectroscopy -** APT, DEPT and INEPT **[6 L]**
3. **^{15}N, ^{19}F and ^{31}P NMR spectroscopy**
   Fundamentals and applications in structure elucidation of organic compounds, catalysts and biomolecules. *(**Self learning and for internal assessment only).** **[*0 L]**
4. **2D NMR** spectroscopy in structure elucidation: (a)Homonuclear: COSY, TOCSY, 2D-INADEQUATE, 2D- ADEQUATE, NOESY, ROESY (b) Heteronuclear: HSQC, HMQC, HMBC **[8 L]**

Section-II: Mass Spectrometry [24 L + 6 T]

1. **Mass Spectrometry:** Principle, ionization methods like EI, CI, ES, MALDI and FAB-Fragmentation of typical organic compounds, stability of fragments, Rearrangements, factors affecting fragmentation, ion analysis, ion abundance, High-Resolution mass spectrometry in determination of molecular formula. **[6 L]**
2. **Applications of Mass Spectrometry:** Determination of the elemental composition, Isotopic Abundance in structure establishment; Analysis of Biomolecules: Proteins and Peptides, Oligonucleotides and Oligosaccharides **[6 L]**
3. **Problems solving:** Structure elucidation using UV, IR, 1D (1H and13C) NMR and 2D NMR (1H-1H, 13C- 1H COSY /HETCOR only), APT, DEPT and MS data as well as spectra. **[12 L]**

References:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
2. One and Two dimensional NMR Spectroscopy by Atta-Ur-Rehman, Elsevier (1989).
3. Organic Structure Analysis-Phillip Crews, Rodriguez, Jaspars by Oxford University Press (1998).
4. Organic Structural Spectroscopy by Joseph B. Lambert, Shurvell, Lightner, Cooks, Prentice-Hall (1998).
5. Organic Structures from Spectra by Field L.D. Kalman J.R. and Sternhell S. 4th Ed. John Wiley and Sons Ltd.
6. Mass Spectrometry Basics by Christopher G. Herbert Robert A.W. Johnstone
7. Mass Spectrometry Principles and Applications by Edmond de Hoffmann and Vincent Stroobant.

CCTP-9, CHO-352: Stereochemistry and Asymmetric Synthesis of Organic Compounds [48L + 12T]

Section I- Stereochemistry [24L + 6T]

1. Conformations of polysubstituted cyclohexane, six membered rings with SP^2 carbon, heterocycles with N and O, anomeric effect, stereochemical principles involved in reactions of six membered rings and other than six membered rings, concept of I- Strain. *(**Ref.** 1, 2, 3, 4, 5, 6)* **[8 L]**
2. **A) Stereochemistry of fused and bridged ring systems**: Nomenclature, synthesis; stereochemical aspects of Perhydrophenanthrene, Perhydroanthracene, hydrindane, Steroids; Bridged system (bi, tri and polycyclo system) including heteroatoms, Bredt's Rule. **(*Ref.-1, 2, 3, 4, 5, 6)*. 2. B) Conformations of following compounds with**

justification of each: cis and trans -1,3- and l,4-di-t-butyl-cyclohexanes; Cis-4-di-t-butyl-cis-2,5-dihydroxycyclohexane; Twistane; bicyclo- [2.2.2]octane; Trans-anti-trans-Perhydro-anthracene and the lactone; cyclohexane-l,4-dione; 1,2,2,6,6-penta-methyl-4-hydroxy-4-phenylpiperidine; ψ-tropine; 2-hydroxy-2-phenyl quinolizidine; 4-t-butyl-4-methyl-l,3-dioxane; cis- and trans-2,5-di-t-butyl-l,3-dithianes;cis-2,5-di-t-butyl-l,3,2-dioxaphosphorinan-2-one ***(Ref.** 1, 7, 8)* **[8 L]**

3. Determination of configuration, Cram's rule, Cram's cycle model, Cram's dipolar model, Felkin-Anh Model; Resolution and analysis of stereomers - formation of racemization and methods of resolution. (***Ref.*** 1, 2, 4), Stereochemistry of a polymer chain – Types and examples of Tacticity **(Ref. 7),** **[8 L]**
4. Decalols, Decalones, Octahydronaphthalenes, decahydroquinolines

***(Self learning and for internal assessment only)** **[*0 L]**

1.

References:

1. Stereochemistry of Carbon compounds - E. L. Eliel
2. Stereochemistry of carbon compounds - E. L. Eliel and S. H. Wilen
3. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 1st. Ed.
4. Stereochemistry of organic compounds –Nasipuri
5. Stereochemistry of organic compounds-P. S. Kalsi
6. Organic stereochemistry – Jagdamba Singh
7. Topics in Stereochemistry (Volume 2) By Norman L. Allinger and Ernest L. Eliel.
8. Topics in Stereochemistry (Volume 8) By Ernest L. Eliel and Norman L. Allinger.

Additional Study Material: Stereochemistry

https://nptel.ac.in/content/syllabus_pdf/104105086.pdf

https://nptel.ac.in/courses/104/105/104105086/

Section II- Asymmetric Synthesis [24L + 6T]

1. Introduction of Asymmetric Synthesis, Chirol pool and Chiral auxillaries.
2. Asymmetric Organocatalysis
3. Asymmetric Aldol Reaction, Enantioselective, diastereoselective and double diastereoselective Aldol reactions.
4. Transition Metal-Catalyzed Homogeneous Asymmetric Hydrogenation
5. Transition Metal-Catalyzed Homogeneous Asymmetric Hydroxylation and Epoxidation
6. Asymmetric Phase-Transfer and Ion Pair Catalysis **(*Self learning)**

References:

1. Catalytic Asymmetric Synthesis, 3rd ed,Ed: I. Ojima, John Wiley & Sons, New Jersey, 2010
2. Catalysis in Asymmetric Synthesis by Vittorio Caprio and Jonathan M. J. Williams
3. Angew. Chem. Int. Edn. 2008, 47, 4638–4660.
4. Principles and Applications of Asymmetric Synthesis by Guo-Qiang Lin, Yue-Ming Li, Albert S. C. Chan, A John Wiley & Sons, Inc., Publication.

15. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 2nd. Ed.

Additional Study material: Catalytic Asymmetric Synthesis

https://nptel.ac.in/content/syllabus_pdf/104103067.pdf

https://nptel.ac.in/courses/104/103/104103067/

CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and Carbohydrate Chemistry OR
CHO-353(B): Designing Organic Syntheses and Heterocyclic Chemistr [48L + 12T]

CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and Carbohydrate

Section I: Protection - De-protection, Chiron approach [24L + 6T]

1. Protection and de-protection of functional group in organic synthesis: Hydroxyl group- alkyl ether, benzyl ether,acyl, PMB, Trityl, TMS, TBDMS, THP, MOM, MEM, MIP ether; **Diol** - Acetone,Cyclohexanone; **Amines**- Benzyl, Acyl, CBZ, BOC, FMOC, **Carboxyl group**-Ester, DCCI, DIPCDI; **Ketone and aldehydes**- Glycol, Thioglycol, Ketal, Acetal; Othroesters as protecting groups, Protection de-protection approach - In Solid phase synthesis of polypeptide; polynucleotide, cyclitols, and amino-sugars. ***(Ref. 1, 2, 3, 4)*** **[12 L]**

2. Chiron approach: a) Introduction, b) The concept of chiral templates and chirons wherein the carbon skeleton is the chiral precursor, c) Utilization of the basic concepts in synthesis of (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine, (-) Multistratin, (-) Pentenomycin and (-) Shikimic acid (***Ref.*** 2, 5, 6, 7). **[12 L]**

Section - II: Carbohydrate Chemistry [24 L + 6T]

a) Basics of Carbohydrates: Introduction of sugars, structures of monosaccharides, triose, tetrose, pentose, hexose, D/L forms of aldoses and ketoses in Fisher projections, cyclic hemiacetal forms of monosaccharides, representation of monosaccharide structure (Fisher, Zig-zag, Mills, Haworth projection and Chair conformation), The structure of Glucose, the anomeric configuration, mutarotation (D-Glucose), Conformations of monosaccharides, the anomeric effect. Modified monosaccharides, Alditols, Cyclitols, Nomenclature of monosaccharides, Cyclic forms of the α and β-D-aldoses.

b) Synthesis of Glycosides: glycosyldonar acceptor concept, general methods for glycosyl bond formation: Glycosyl halides, Trichloroacetimides, Glycals and Glycal derivatives, Thioglycosides, Phosphites, n-Pentyl glycosides, SulfoxidesDiazarines, Alkylation of reducing sugars

c) Synthesis of disachharides, trisachharides, polysaccharies: Stereoselective synthesis of □-Mannosides, Synthesis of 2-Deoxy Sugars, Orthogonal strategy in Oligosaccharide synthesis, Effect of protecting groups on glycosylation stereoselectivity and coupling efficiency, Intramolecular glycosylation, Total synthesis of natural products: Oligosaccharides and Glycoconjugates. (**Ref. 5, 8, 9, 10, 11, 12)**

[24 L]

References:

1. Greene's protective groups in organic synthesis – Peter G. M. Wuts and Theodor R. A. Green 4th Edn. Wiley-India
2. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Modern organic synthesis-An introduction- George S. Zweifel, Michael H. Nantz.
4. Advanced Organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
5. Chiron Approach in organic synthesis – S. Hanessianh
6. Organic Chemistry – R. P. Morrison and R. N. Boyd
7. Organic Chemistry – I. L. Finar, volume II.
8. Essentials of Carbohydrate Chemistry and Biology: Thisbe K. Lindhorst, WILEY-VCH, 2000, Chapter 3.
9. Monosaccharide's: Their Chemistry and their Roles in Natural Products: Peter M. Collins, Robert J. Ferrier: John Wiley & Sons, 1995.
10. Carbohydrate in Chemistry and Biology: Part 1 Chemistry of Saccharides Vol.1. WILEY-VCH, 2000.
11. The Organic Chemistry of Sugars; By: Daniel E. Levy Peter Fugedi Publication: Taylor & Francis, Published on 2006
12. Handbook of Chemical Glycosylation by Alexei V. Demchenko, Wiley VCH, 2008

CBOP-3, CHO-353(B): Designing Organic Syntheses and Heterocyclic Chemistry

[48 L + 12 T]

Section I: Designing Organic Syntheses [24 L + 6 T]

1. Concepts of Retrosynthesis: Retrosynthetic analysis, disconnection approach, Synthons, multiple step synthesis, functional group intercoversion, Illogical two group intercoversion, C-C disconnection, Donor and acceptor Synthons, two group disconnection, 1,5 related functional group disconnection, Umpolung, convergent synthesis, special methods for small rings, Heteroatom and Heterocyclic compounds, problems, (***Ref***.-1, 2, 4). **[12 L]**

2. Application of Retrosynthetic Approach: Retrosynthesis and synthesis of following Molecules: Strychnine, Reserpine, Thienamycin, Asteltoxin, Indolizomycin, Erythronolide B**. Ref**-3 **[12 L]**

References:

1. Designing Organic Syntheses by Stuart Warren
2. Organic Chemistry from Retrosynthesis to Asymmetric Synthesis, by Vitomir Sunjic, Springer; 1st ed. 2016 edition
3. Classics in Total Synthesis by K.C. Nicolaou and E.J.Sorensen

Additional Study material: NPTEL Lecture:
A Study Guide in Organic Retrosynthesis: Problem Solving Approach (https://nptel.ac.in/content/syllabus_pdf/104105087.pdf)

Section II: Advanced Heterocyclic Chemistry [24 L + 6 T]

1. Systematic nomenclature (Hantzsch-Widman System) for monocyclic, fused and bridged heterocycles. Tautomerism in aromatic heterocycles. Strain-bond angle, torsional strains and their consequences in small ring heterocycles. **[4 L]**

2. General chemical behaviour of heterocyclic compounds and their applications in: Biological systems (Anthocyanins, Flavones, Neurotransmitters), Natural Products (Alkaloids: Nicotin, Quinine), Drugs and Medicines (Omeprazole, Amlodipine, Cilostazol) **[4 L]**

3. Synthesis, reactions and structural effects of heterocyclic rings [16 L]

a) Common Methods in Ring Synthesis of Aromatic Heterocyclic Systems**:** Typical ring synthesis involving C – Heteroatom, C – C bond formations, Electrocyclic processes in heterocyclic Synthesis: 1,3 -dipolar cycloadditions producing five - membered heterocycles, Nitrenes in heterocyclic synthesis, Palladium catalysis in the synthesis of Benzo - Fused heterocycles, Fischer synthesis, Epoxidation, Use of Sulphur Ylides, Azides for small rings

b) Three and four membered heterocylces: Aziridines, Oxiranes, Thirienes, Azetidines, Oxitanes and Thietanes

c) Five-membered and benzo-fused five memberedheterocycles:Oxazole, Isoxazole, Thiazole, Pyrazole, Imidazole, Benzothiazole and Benzimidazole

d) Six membered and benzo-fused six membered heterocycles:Pyrazine, Pyridazine, Pyrimidine, Quinazoline, Quinoxaline, Aziridines, Quinoline

Self Learning: Isoquinoline, Indoles

References

1. Heterocyclic Chemistry by T. Gilchrist.
2. An Introduction to the Chemistry of Heterocyclic Compounds by RM Acheson.
3. Heterocyclic Chemistry by J A Joule and K. Mills.
4. Principles of Modern Heterocyclic Chemistry by A Paquette.

5. Heterocyclic Chemistry by J A Joule and Smith.
6. Handbook of Heterocyclic Chemistry by A R Katritzky

Additional Study Material: Heterocyclic Chemistry

https://nptel.ac.in/content/syllabus_pdf/104105034.pdf

https://nptel.ac.in/courses/104/105/104105034/

CCPP-3, CHO-354: Practical-I Solvent Free Organic Synthesis

[96L +24T]

Note:

The students should perform any 24 Syntheses from the following list. Students should acquire **pre-experiment** (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and **post-experiment** skills (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

A) Solvent Free Carbon–Carbon Bond Formation

1. Pinacol coupling reaction (Page 36)
2. Reformatsky reaction/Luche reaction (Page 36)
3. Knoevenagel condensation (Page 40)
4. Dieckmann condensation (Page 42)
5. Corrole Synthesis (Page 42)
6. Knoevenagel condensation, 3-carboxycoumarin (Page 45)
7. 3-(ethoxycarbonyl)-4-hydroxy-5-(1-hydroxyalkyl)-2-isoxazoline-2-oxide (Page 46)
8. Biginelli reaction (Page 46)
9. Claisen reaction(Page 47)
10. Pechmann reaction (Page 50)
11. calix[4]resorcinarene (Page 50)

B) **Solvent-Free C–N Bond Formation**

1. terephthalic acid dihydrazide (Page 205)
2. azomethine synthesis (Page 213)
3. diazepinone synthesis (Page 218)
4. dibenzyl sulfone Synthesis (Page 297)

C) **Solvent-Free C–S Bond Formation**

1. 1,3-dithiolane synthesis (Page 299/300)

D) **Solvent-Free C–X Bond Formation**

1. Cinnamic acid/ stilbene halogenations (Page 319)
2. Phenol bromination using , *N*-bromosuccinimide (Page 320)

E) **Solvent-Free N–N Bond Formation**

1. Triazenes Synthesis (Page 335)
2. Beckmann rearrangement (Page 346)

F) **Other Solvent-Free Reactions**

1. D-mannitol protection using phenylboronic acid (Page 388)
2. Baeyer-Villiger reaction
3. 2-Hydroxybenzaldehyde oxidation using urea-hydrogen peroxideComplex (Page 13)
4. Alumina-supported permanganate oxidation (Page 15)
5. Sulfide oxidation using MnO_2 (Page 21)
6. Oxidative coupling of thiol using MnO_2 (Page 22)
7. Iodine catalysed S-S bond formation of Cystine (Page 28)

G) Solvent free supramolecular assembly formation

1. Caffeine and oxalic acid (Page 420)
2. *rac-Bis*-beta-naphthol and benzoquinone
3. Isovaleraldehyde and pyrogallol

Reference:

Solvent-free Organic Synthesis by Koichi Tanaka (Copyright © 2009 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 978-3-527-32264-)

Additional Study Material: https://nptel.ac.in/courses/104/106/104106108/

Semester IV

CCTP- 10, CHO-450: Chemistry of Natural Products [48L +12T]

Section I: **[24 L + 6 T]**

1. Understanding and planning of total synthesis while maintaining the stereochemistry. A case study: **Longifolene –** (All Nine syntheses from Advanced Organic Chemistry Carey, Sundberg; Part B). **[12 L]**

2. Total Synthesis of

i. Hirsutellone B (Angew. Chem. Int. Ed. 2009, 48, 6870 –6874.)

ii. Ribisins A and B : (J. Org. Chem. 2019, 84, 15165−15172)

iii. Subincanadine E : **(*For Self-Learning)** (J. Org. Chem. 2017, 82, 11126-11133) **[12 L]**

Section II : **[24 L + 6 T]**

A) Vannusals

References:

1.J. Am. Chem. Soc. 2010, 132, 20, 7138-7152.
2.J. Am. Chem. Soc. 2010, 132, 20, 7153-7176.
3.Angew. Chem. Int. Ed. 2009, 48, 5642 –5647.
4.Angew. Chem. Int. Ed. 2009, 48, 5648–5652

B) **Pinnaic acid**

References:

1. Angew. Chem. Int. Ed. 2001, 40 (23), 4450-4452.
2. Angew. Chem. Int. Ed. 2001, 40, (23), 4453-4456.
3. Angew. Chem. Int. Ed. 2007, 46, 5746–5749

CCTP- 11, CHO-451: Organometallic Reagents in Organic Synthesis [48 L + 12T]

1. Transition metal complexes in organic synthesis; Pd, Ni, Ru, Fe, Ir and Cu only (C-C, C-N, C-O bond formation reactions with catalytic cycle, ligand and % mole concepts)**[18 L]**
2. C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions. **[6 L]**
3. Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reaction **[3 L]**
4. Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization **[3 L]**
5. Click chemistry: criterion for click reaction, Sharpless azides cycloadditions. Click reactions in synthesis of bioconjugates **(sugars and proteins)** **[4 L]**
6. Metathesis: Schrock and Grubbs catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, application in polymerization and synthesis of small organic molecules**.** **[6 L]**
7. Use of Boron and Silicon reagents in organic synthesis. **[8 L]**
8. Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction**. [*Self Learning]**

References:

1. C–N bond forming cross-coupling reactions: an overview: by Jitender Bariwalab and Erik Van der Eycken *Chem. Soc. Rev.,* 2013, **42**, 9283
2. Iron Catalysis in Organic Synthesis Chem. Rev. 2015, 115, 3170–3387.

3. Recent advances in homogeneous nickel catalysis Nature 2014, Vol 509, Page 299-309.
4. Ruthenium-Catalyzed Reactions for Organic Synthesis *Chem. Rev.* **1998**, *98,* 2599-2660.
5. Organic Synthesis Involving Iridium-Catalyzed Oxidation Chem. Rev. 2011, 111, 1825–1845.
6. Aerobic Copper-Catalyzed Organic Reactions Chem. Rev. 2013, 113, 6234−6458.
7. Transition Metals for Organic Synthesis Volume 1 *Edited by M. Beller and C. Bolm* WILEY-VCH Verlag GmbH & Co. KGaA ISBN: 3-527-30613-7
8. Multicomponent Reactions Edited by Jieping Zhu, Hugues Bienayme WILEY-VCH Verlag GmbH & Co. KGaA
9. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press),
10. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
11. Organic synthesis – Michael B. Smith
12. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).
13. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
14. Name Reactions Jie Jack Li (Fourth Expanded Edition), Page No: 1-582.
15. Organic Synthesis Using Transition Metals, by Roderick Bates, Second Edition, A John Wiley & Sons, Ltd., Publication.

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry
OR
CHO-452(B): Applied Organic Chemistry [48L + 12T]

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry [48L + 12T]

Section-I: [24 L + 6 T]

1. Introduction to Peptides and proteins, Proteins as biological catalyst Nucleic acids, Metabolism, Chemistry of cofactors/coenzymes, Chemistry of TPP, PLP, Folic Acid and other vitamins, Principle of drug design, Chemistry of diseases and Drug development, Proton pump inhibitors and Problem solving. **[8 L]**
Additional study material: NPTEL lecture: Organic Chemistry in Biology and Drug Development (full course) https://nptel.ac.in/content/syllabus_pdf/104105120.pdf) https://nptel.ac.in/courses/104/105/104105120/

2. Peptides, sequencing and applications in therapeutics, Solution phase and solid phase peptide synthesis and Modern techniques for biomolecules and disease diagnosis. **[6 L]**
Additional study material: NPTEL lecture (only 3 topics): Essentials of Biomolecules: Nucleic Acids and Peptides https://nptel.ac.in/content/syllabus_pdf/104103121.pdf https://nptel.ac.in/courses/104/103/104103121/

3. Introduction to medicinal Chemistry. History, drug targets, Drug discovery, design and development, Case Study: Design of Oxamniquine. **[4 L]**

4. Pharmacokinetics and Pharmacodynamics of drug: Drug absorption, distribution, metabolism, elimination and toxicity, drug metabolism, biotransformation, Drug receptor interactions, Hansch Equation and significance of terms involved in it. **[6 L]**

Section II: [24 L + 6 T]

1. Structure and activity Relationship: QSAR, Applications of SAR and QSAR in drug design, physio-chemical parameters lipophilicity, partition coefficient, electronic ionization constant, Case Study: Statins **[10 L]**
2. Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents, Beta lactam antibacterial agents (Penicillins, Cephalosporins), Tetracyclins, Macrolides, Chloramphenicol, Polyenes, Amphotrecin-B, Azoles, Amantadine,Acyclovir, Quinine, Quinolines, Quinolones, Refamycine, Sulphonamides [**14 L]**

References:

1. Medicinal Chemistry and Drug Discovery by Burger
2. Introduction to Medicinal Chemistry by Grham and Patrick
3. Introduction to Drug Design by J. R. Dimmock and S.S. Pandeya
4. The Organic Chemistry of Drug Design and Drug Action, 3rd Edition, R. B. Silverman, Academic Press, 2014
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F Dorge, 12th Edition, 2010
6. Chemistry of Heterocycles by T. Eicher and S. Hauptmann, Thieme

CBOP-4, CHO-452(B): Applied Organic Chemistry [48 L + 12T]

Section-I: [24 L + 6 T]

1. Covalent Organic Frameworks: Structures, Synthesis, and Applications. [12 L]

(Ref: Review article by Maria S. Lohse and Thomas Bein ***Adv. Funct. Mater***. 2018, 28(33), 1705553.)

2. Organic Electroluminescent Materials, [12 L]

(Ref: Review article by L.S. Hunga and C. H. Chen ***Materials Science and Engineering*** 2002, R 39, 143–222)

Section –II : [24 L + 6 T]

1. Supramolecular Organic Compounds [8 L]

(Ref: Review by Matthew C. T. Fyfe and J. Fraser Stoddart ***Accounts of Chemical*** *Research* 1997, 30 (10), 393-401.)

(Ref: Review article by Wei Chen and et al. ***Chem. Soc. Rev.***, **2015**, *44*, 2998-3022)

2. Single Molecule Switches [8 L]

(Refs: Review article by Wei Chen and et al. ***Chem. Soc. Rev.***, **2015**, *44*, 2998-3022.)

2. Molecular Machines [8 L]

(**References:**

1. Review article by David A. Leigh and et al. *Chem. Rev.* 2015, *115*, 10081−10206.

2. Redox-Gated Tristable Molecular Brakes of Geared Rotation. *J. Org. Chem*., 2017, 82(10), 5354-5366.

3. Massimo Baroncini, Serena Silvi, Alberto Credi. *Chem. Rev.* 2020, *120* (1), 200-268).

References:

1. The Chemistry of Metal–Organic Frameworks- Wiley Online. Print ISBN: 9783527338740, Online ISBN:9783527693078, DOI:10.1002/9783527693078
2. Covalent Organic Frameworks - 1st Edition - Atsushi Nagai, ISBN 9789814800877, Published January 24, 2020 by Jenny Stanford Publishing.

CBOP-5, CHO-453: Practical-III: Select ANY TWO Section I, II and III [96 L + 24 T]

Section-I: Ternary Mixture Separation [48 L + 12 T]

Separation of minimum 12 mixtures containing three components. The mixtures should also involve separation of nitrophenols, amino acids, low boiling and water soluble and insoluble compounds solids and liquids with **multifunctional groups**. The mixture separation should be carried out on micro-scale using ether or water.

The students should be able to

1. Understand and employ concept of type determination and separation
2. Meticulously record physical constants
3. Perform micro scale chemical elemental analysis
4. Perform qualitative estimation of functional groups
5. Recrystallize /distill the separated compounds
6. Extend these skills to organic synthesis

Section-II: Carbohydrates Synthesis and Isolation Natural Products [48 L + 12 T]

Unit I: Carbohydrate Synthesis (Any 3)

1) Synthesis and structural determination of α- and β-D-glucose penta- acetate.
2) Selective deacylation of α- and β-D-glucose penta-acetate.
3) Benzoylation of D-glucose.to D-glucose penta-benzoate.
4) Selective debenzoylation of D-glucose penta-benzoate
5) Synthesis 1,2:5,6-di-O-isopropylene-D-glucofuranose.
6) Synthesis of 1,2: 5,6 – di-O-isopropylene-3-O-benzyl –D-glucofuranose.

Note:

Carbohydrate (sugar molecules) are highly soluble in water, to derivatives the sugar molecules require special practical skill in order to get product in hand.

i) To understand the meaning of dry condition in reaction.
ii) How to prepare dry solvents.
iii) Workup of reaction in minimum quantity of water.
iv) To acquire skill in handling of carbohydrates reaction.

Unit II: Isolation of pigments from the natural products (Any 3)

1. Orange Marigold
2. Rose
3. Sunflower
4. Hibiscus
5. Any colored flowers/fruits available in the local area **(only one is allowed).**

Note: Students should be able to collect reasonable quantities of color pigments to do the characterization (Physical Constant, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to use these pigments for developing food grade natural colors from lesser known plant sources.

Unit III: Isolation of essential oils from the natural products (Any 3)

1. Ginger
2. Lemongrass
3. Garlic
4. Ajwain/ajowan/Trachyspermum ammi
5. Vekhand (achourus calamus) root

6. Any natural products available in the local area **(only one is allowed)**

Note: Students should be able to collect a reasonable quantities of essential oils to do the characterization(Physical Constant, Density, Elemental analysis functional group test) Should form the appropriate derivative. They are encouraged to use these essential oils for the development of the products like soap, perfumes etc.

Unit IV: Isolation of medicinally important component from the natural products (Any 3)

1. Nimbin from Neem leave
2. Amyrin from Apati/Apta bark
3. Eujenol from Tulsi leaves
4. D-Galacturonic Acid from Jeshtamadh
5. Piper from Betel leaf
6. Any medicinally important plants available in the local area **(only one is allowed)**

At least one natural product should be isolated by using column chromatographic techniques (Use micro columns to avoid excess use of solvents)

Note: Students should be able to collect a reasonable quantities natural products to do the characterization (Physical Constant, solubility, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to study novel medicinal plants from their local area.

References for Carbohydrates:

1. Essentials of Carbohydrate and Chemistry and Biology: Thisbe K. Lindhorst, WILEY-VCH, 2000.
2. Kawanata , K. P. R. Tretrahedron Lett. 1986, 27, 3415.
3. Bessodes, M., Shamszar, J. Antonakies, K., Synthesis, 1988, 560.

Section-III: Project [48 L + 12 T]

Project/ Industrial Training/Summer Training/ Internships

1. Students should carry out a small research project.
2. This should make them familiar with
   i. Literature survey, research methodologies
   ii. Data Analysis
   iii. Column and TLC chromatographic techniques
   iv. Characterization of the products by analytical and spectral methods.
3. **Project report must be written and submitted in a proper format as follows;**
   i) Certificate (Signed by Project guide and Head of the Department)
   ii) Certificates for Poster/Paper presented in conferences (if any)
   iii) Self declaration certificate for plagiarism
   iv) Introduction (not more than 6 pages)
   v) Results and Discussions
   vi) Experimental Section
   vii) Conclusion
   viii) References (Use ACS format)
   ix) Spectroscopic or other relevant supporting data
   x) Acknowledgement
4. Interdisciplinary projects shall be encouraged; however there **must be some organic chemistry component**.
5. Students should spend enough time for the project works (**at least** 4 hours per week for **15 weeks**)
6. At least 30% students should undertake projects/summer training/Internships etc.
7. If student is performing project in another institute, for such a student, internal mentor must be allotted and he will be responsible for internal assessment of a student. In this

case student has to obtain certificate from both external and internal mentor. ***Systematic record of attendance of project students must be maintained by a mentor.*** Project will be evaluated jointly by three examiners and there will not be any practical performance during the examination. Typically, student has to present his practical work, discuss results and conclusions in details (20-30 min.) which will be followed by question-answer session (10 min). It is open type of examination.

CCPP-04, CHO-454: Practical-II: Convergent and Divergent Organic Syntheses [96 L + 24T]

Note: Any **3 sets** should be conducted from the following convergent and divergent synthesis sets.

Students should acquire **pre-experiment** (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and **post-experiment skills** (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

SET-I

A) Convergent Synthesis 1 (Three Stage Synthesis)

1. Stage I: Anisole to 4-nitro anisole to 4-amino anisole (2 steps)
2. Stage II: Toluene to 4-nitro toluene to 3-acyl nitro toluene (2 steps)
3. Stage III: Synthesis of N-(1-(2-methyl-5-nitrophenyl) ethyl) aniline from 4-amino anisole, 3-acyl nitro toluene and SBH (One pot synthesis: MCR)

B) Divergent Synthesis 1 (5 Single Stage Synthesis from Acetyl acetone):

1. Acetyl acetone to Pyrimidine
2. Acetyl acetone to 2,4-dimethyl-1H-benzo[b][1,4]diazepine
3. Acetyl acetone to Pyrazole
4. Acetyl acetone with 1mmol benzaldehyde to 3-benzylidenepentane-2,4-dione
5. Acetyl acetone with 3 mmol benzaldehyde into 3-benzylidene-6-phenylhex-5-ene-2,4-dione

SET-II

A). Convergent Synthesis 2(Three Stage Synthesis)

1. Stage I: 4-Nitro toluene to 4-amino toluene (Reduction by using Sn/HCl)
2. Stage II: Phenol into 2-hydroxy benzaldehyde (Reimer-Tiemann reaction)
3. Stage III: Synthesis of amidoalkyl-2-naphthols from β-Naphthol,4-amino toluene and of 2-hydroxy benzaldehyde (One pot synthesis: MCR)

B). Divergent Synthesis (5 Single Stage Synthesis from β-Naphthol)

1. β-Naphthol to Synthetic dye (By diazonium coupling)
2. β-Naphthol to 6-Bromo-2-naphthol (Bromination reaction)
3. β-Naphthol to β-Naphthyl methyl ether (Methylation reaction)
4. β-Naphthol to temperature dependent sulfonation (Sulfonation reaction)
5. β-Naphthol to (±) Binol then Resolution of Binol (Resolution technique)

SET-III

A). Convergent Synthesis-3 (Three Stage Synthesis)

1. Stage I: Salicylic acid to 5-Chloro-2-hydroxybenzoic acid
2. Stage II: o- Anisidine to 2-methoxy-4-nitroaniline
3. Stage III: Synthesis of 5-chloro-2-hydroxy-N-(2-methoxy-4-nitrophenyl) benzamide from 5-Chloro-2-hydroxybenzoic acid, -methoxy-4-nitroaniline (One pot synthesis: MCR)

B). Divergent Synthesis-3 (5 Single Stage Synthesis from Salysaldehyde)

1. Salicylaldehyde to Salicylaldehyde phenylhydrazone
2. Salicylaldehyde with melanonitrile to 2-iminochromene by intramolecular cyclization.
3. Salicylaldehyde to 2-hydroxy-3,5-dinitrobenzaldehyde

4. Salicylaldehyde to o-Formylphenoxy acetic acid
5. Salicylaldehyde to catechol

SET-IV

A) Convergent Synthesis- 4 (Three Stage Synthesis)

1. Stage I: Benzene to actophenone (F.C acylation)
2. Stage II: 4-Nitrochlorobenzene into 4-amino chlorobenzene (Reduction by using hydrazine)
3. Stage III: Quinoline synthesis by using acetophenone, 4-amino chloro benzene and styrene (One pot synthesis: [3 + 2 + 1] cycloaddition reaction)

B). Divergent Synthesis-4 (5 Single Stage Synthesis from Acetophenone)

1. Acetophenone to Ethyl benzene by Wolf Kishner reduction
2. Acetophenone to m-Nitro acetophenone by nitration
3. Acetophenone to Chalcone using aromatic aldehyde
4. Acetophenone into Schiff base using aromatic amine
5. Acetophenone to Benzoic acid and Iodoform

References

1. Practical organic chemistry by Mann and Saunders
2. Text book of practical organic chemistry –by Vogel
3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F.
4. Hermann, Terence C. Morrill and David Y. Curtin

Important Notes for Practical Courses

- All experiments should be carried out on micro-scale and by considering stoichiometric quantities of reactants and reagents with the proper understanding of the mechanism.
- Post graduate departments should arrange at least **one study visit to relevant industry/national research laboratory/premier academic institute**.
- Students must read MSDS and should handle chemicals and reactions accordingly.
- The necessary reactions should be carried out in fume hood and appropriate safety measures should be taken during the laboratory experiments and projects.
- All reactions should be **monitored using alumina coated TLC plates**.
- Certified journals should be presented at the time of final examination.
- Students opting for the projects are encouraged to participate in AVISHKAR, national and international conferences and other project competitions.
- Teachers are encouraged to give the project ideas based on the societal needs.

Cyber Security

Programme Objective:

This programme aims to help the learners to navigate the foundations and skills necessary to build a career in the field of cyber security.

Expected Outcome:

After completion of this programme the learners will be able to understand the basic security objectives and the countermeasure the threats by using various security models and mechanisms.

Syllabus

Theory		
Module	**Chapter No.**	**Topic**
Module – 1 Introduction to Information Security and Potential Threats	Chapter – 1	Introduction to Cyber Space, Cyber Security and Information Systems
	Chapter – 2	Cyber Attacks and their Classification
	Chapter – 3	Types of Malware and Threats
Module – 2 Cyber Vulnerability and Network Security	Chapter – 4	Assessment of Vulnerability
	Chapter – 5	Intrusion : Detection and Prevention Systems
	Chapter – 6	Internet Protocols, Operating System Security and Network Security
Module – 3 User Authentication Tools and Information Security Models	Chapter – 7	User Authentication Methods,
	Chapter – 8	Information Security Models and Security Mechanisms
	Chapter – 9	Biometric Systems and Biometric Authentication Processes
Module – 4 Web and Mobile App security Methods	Chapter – 10	Web Security and Email Security
	Chapter – 11	Security of Mobile Devices and Cloud Space
	Chapter – 12	Social Media Security and IoT Security
Module – 5 Cyber Crimes and Digital Forensic Science	Chapter – 13	Cyber Crimes, Scams and Frauds
	Chapter – 14	Digital Forensic Investigation Methods, Cyber Trails
	Chapter – 15	Branches of Digital Forensics, Reporting, Management of Evidence
Module – 6 Prohibitory Laws for Cyber Security	Chapter – 16	Jurisdiction of Cyber Crime, Information Technology Act 2000 and its Amendments
	Chapter – 17	Validity of Digital Communication Evidences (Call Records /Emails/SMS)
	Chapter – 18	RBI Act and IPR Act

Practical		
Module – 7 Practical	Practical – 1	Performing the web security audit and report preparation
	Practical – 2	Biometric Authentication Processes
	Practical – 3	Explore the Nmap tool and list how it can be used for network defense.
	Practical – 4	Explore the NetCat tool
	Practical – 5	Examine SQL injection attack
	Practical – 6	Perform online attacks and offline attacks of password cracking.
	Practical – 7	Evaluate network defense tools for DOS attack
	Practical – 8	Evaluate network defense tools for IP spoofing
	Practical – 9	Consider a case study of cyber crime, where the attacker has performed online debit card fraud. Prepare a report and also list the laws to be imposed on attacker
	Practical – 10	To ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
	Practical – 11	Set Firewall security for windows
	Practical – 12	To gather information from any PC's connected to the LAN

Course Duration :

Theory : 18 Hours
Practical : 12 Hours

The syllabus

Course I

Introduction to Human Rights and Duties

Credit: 1

I) Basic Concept

a) Human Values- Dignity , Liberty, Equality , Justice, Unity in Diversity, Ethics and Morals

b) Meaning and significance of Human Rights Education

II) Perspectives of Rights and Duties

a) Rights: Inherent-Inalienable-Universal- Individual and Groups

b) Nature and concept of Duties

c) Interrelationship of Rights and Duties

III) Introduction to Terminology of Various Legal Instruments

a) Meaning of Legal Instrument- Binding Nature

b) Types of Instruments: Covenant-Charter-Declaration-Treaty-Convention-Protocol-Executive Orders and Statutes

IV) United Nations And Human Rights

a) Brief History of Human Rights- International and National Perspectives

b) Provision of the charters of United Nations

c) Universal Declaration of Human Rights- Significance-Preamble

d) Civil and Political Rights-(Art. 1-21)

e) Economic, Social and Cultural Rights-(Art.22-28)

f) Duties and Limitations-(Art. 29)

g) Final Provision (Art. 30)

Course II

Human rights of vulnerable and disadvantaged groups

Credit: 1

I) General Introduction

a) Meaning and Concept of Vulnerable and Disadvantaged
b) Groups, Customary, Socio-Economic and Cultural Problems of
c) Vulnerable and Disadvantaged Groups

II) Social status of women and children in International and national perspective

a) Human Rights and Women's Rights –International and National Standards
b) Human Rights of Children-International and National Standards

III) Status of Social and Economically Disadvantaged people

a) Status of Indigenous People and the Role of the UN
b) Status of SC/ST and Other Indigenous People in the Indian Scenario
c) Human Rights of Aged and Disabled
d) The Minorities and Human Rights

IV) Human rights of vulnerable groups

a) Stateless Persons
b) Sex Workers
c) Migrant Workers
d) HIV/AIDS Victims

Course III

Human Rights and Duties in India: Law, Policy, Society and Enforcement Mechanism

Credit: 1

I. Human Rights in Indian Context

a) Indian Bill of Rights And Sarvodaya
b) Preamble- Fundamental Rights- Directive Principles-Fundamental Duties

II. Human Rights- Enforcement Mechanism

a) Human Rights Act, 1993
b) Judicial Organs- Supreme Court (Art 32) And High Courts(Art 226)
c) Human Rights Commission- National and State of Maharashtra
d) Commission of Women, children , Minority, SC/ST
e) Survey of International Mechanism

III. Human Rights Violations and Indian Polity

a) Inequalities in society-population-illiteracy-poverty-caster-inaccessibility of legal redress
b) Abuse of Executive Power-Corruption-Nepotism and favoritism
c) Human Rights and Good Governance
d)

IV. Role of Advocacy Groups

a) Professional Bodies: Press, Media, Role of Lawyers-Legal Aid
b) Educational Institutions
c) Role of Corporate Sector
d) NGO's

SAVITRIBAI PHULE PUNE UNIVERSITY

PHYSICAL EDUCATION SCHEME

(Syllabus and Guidelines for First Year Under Graduate Students of All the Faculties)

Effective from Academic Year 2019 - 2020

PHYSICAL EDUCATION SCHEME

Syllabus and Guidelines for First Year Under Graduate Students of All the Faculties

Effective from Academic Year 2019 - 2020

COURSE – 101 PHYSICAL EDUCATION AND SPORTS (2 CREDITS)

OR

COURSE – 102 PHYSICAL EDUCATION AND YOGA (2 CREDITS)

Note: College / Institute should offer 2 credits either of Physical Education and Sports or Physical Education and Yoga depending upon facilities available at the college / institute.

SAVITRIBAI PHULE PUNE UNIVERSITY

COURSE – 101

PHYSICAL EDUCATION AND SPORTS

Syllabus

(For First Year Under Graduate Students of All the Faculties)

Effective from Academic Year 2019 - 2020

PHYSICAL EDUCATION AND SPORTS

COURSE – 101 PHYSICAL EDUCATION AND SPORTS (2 CREDITS) (SEM- II)

AIM OF THE COURSE:

The aim of the course is to make Physical Education as an integral part of educational system and Promote physical activity among sedentary students / non-sportsmen. Students studying in the colleges should have the benefit of physical education to improve their health during the course of college education. It is designed to ensure that on completion of this course, they would attain the minimum prescribed standard.

OBJECTIVE OF THE COURSE*:*

The objective of the course is to enhance physical efficiency and maintain fitness of mind, and body, which would help the student to be mentally alert and physically efficient to withstand the strain and fatigue of daily life. It would prepare them for the strenuous training which will help them to be fit to face the different barriers in life. The students will undergo this course for the first year of his/her under graduate course education.

COURSE CREDITS :

Semester - II

Course – 101 Physical Education and Sports (02 Credits)

Credit 1: Introduction to Physical Education and Sports

- **Concept of Physical Education, its Definition and Scope.**
- **Concept of Physical Fitness**
  - Components of Health Related Physical Fitness(Cardio-vascular Endurance, Muscular StrengthEndurance, Flexibility, and Body Composition) and Activities to improve these components.
- **Physical Activity Guidelines(Physical activity for health benefits)**
- **Concept of Health, Wellness, and Health & Hygiene.**
- **Participation in Games and Sports :**
  A student will have to select one game/sport from the list of Association of Indian Universities, New Delhi (List of events available on website **www.aiuweb.org**). The choice of game/sports will be according to the facilities available in the college.
  The following points to be covered:
  - History of the Game/sport
  - Ground measurements
  - Skills of the game/sport
  - Basic rules of the game/sport

Every student should participate in game/sport selected by him/her for 10hours.

Credit 2: Fitness Assessment

- In order to improve the physical fitness standards of students, they should be given opportunity and facilities to participate in a game / sport from the list of Association of Indian Universities, New Delhi (List of events available on website **www.aiuweb.org**). The choice of game / sports will be according to the facilities available in the college.
- Fitness Assessment
    - Cardiovascular Endurance
    - Flexibility
    - Muscular Strength Endurance and
    - Body Composition (No marks)

REFERENCE BOOKS:

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EVALUATION STRUCTURE

Table 1

Semester	Course	Credit	Marks	Mode of Evaluation
II	COURSE – 101 PHYSICAL EDUCATION AND SPORTS (2 CREDITS)	1*	25	**Project(15 marks)** and **Practical(10 marks)** (10 hrs. of participation in selected game/sport).
		1**	25	Practical – **Fitness Test** (Table 2)

*indicate first credit **indicate second credit

- To complete first credit of Course – 101 Physical Education and Sports, Teacher will have to **conduct 5 theory lectures** (college may schedule these lecture during first or second semester before fitness assessment) and student will have to attend 5 theory lectures and has to participate in selected game / sport for **minimum 10hrs.** and will have to prepare a handwritten project work on the sports event selected for that year in his/her language selected for studies. **The project** to be prepared will be based on the following contents:
  - History of the Game
  - Ground measurements
  - Skills of the game
  - Basic rules of the game

- Procedure for fitness tests are given in the guidelines section which also includes Norms Table. Marks to be awarded in accordance with the norms table.

Fitness Test:

Table 2

Sr. No.	Component	Test	Marks
1	Cardiovascular Endurance (Any One)	1. Modified Queens College Test or 1. 12 Min. Run Walk	10
2	Flexibility	2. Sit and Reach Test	05
3	Muscular Strength Endurance	3. Bent Knee Sit Ups	10
4	Body Composition	4. Fat Percentage	--
		Total :	25

In the second semester the students will have to appear for the Fitness Test (25 marks). Test wise weightage of marks is as per Table 2. The examination will be conducted as per the convenience of the college in second semester.

CRITERIA OF PASSING

Table 3

Semester	Course	Credit	Max. Marks	Minimum Passing %	Max. Marks	Minimum Passing %
II	COURSE – 101 PHYSICAL EDUCATION AND SPORTS (2 CREDITS)	1	25	40%	50	40%
		1	25	40%		

- To pass a student shall have to get minimum 40% in each credit and aggregate 40% in each course.
- Student who have failed/who have been absent for the entire course/who have not completed any task will have to complete the entire course during the 4th semester.
- Student will not be considered eligible for 5th semester without completing the Course (i.e. Course 101 PHYSICAL EDUCATION AND SPORTS).

CONSIDERATIONS AND EXEMPTIONS:

Differently Able Students

Differently able students will be exempted from the course 101 PHYSICAL EDUCATION AND SPORTS after producing the valid documents.This is not depriving them from the equality of opportunity with other students. The student shall have to submit his/her medical certificate at the time of admission from a Civil Surgeon of respective District Civil Hospital.

Important Note:

- Temporary illness will not give students exemption from the course. If he / she miss any assessment/task he / she will be given opportunity in the ensuing semester.

Exemption

Any Student representing college / institute in the enlisted games of Association of Indian Universities / Indian Olympic Association / State Olympic Association shall be **exempted from mandatory participation in selected game / sport for minimum 15 sessions** of first credit of Course – 101 Physical Education and Sports.

GRADING:

Grading for course 101 will be done as follows.

Table 4

Range of Marks	Grade	Grade Points
41-50	O	10
35-40	A+	09
30-34	A	08
28-30	B+	07
25-27	B	06
23-24	C	05
20-22	P	04
00-19	F	00
Absent	Ab	00
	Ex	Exempted

SAVITRIBAI PHULE PUNE UNIVERSITY

PHYSICAL EDUCATION AND SPORTS

Guidelines

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

(for First Year Under Graduate Students of All the Faculties)

Effective from Academic Year 2019 - 2020

ORGANIZATIONAL GUIDELINES :

1) **STAFF:** The colleges are expected to have qualified teachers in Physical Education and Sports. The Course can be managed with the help of contributory teachers but, the regular teacher in-charge of sports and physical education will have to be appointed to streamline the working of the department.
   For facilitating the smooth working of the course, every class should be divided into a group of 30 students each with a team leader who would help the college Director of Physical Education and Sports in the organization of the work.
   The evaluation of students should be done by the Director of Physical Education with the help of other teaching staff.

2) FACILITIES AND EQUIPMENT:

a) PLAYGROUD : The sports facilities available at the college should be maintained for the regular practices and should be made available to conduct the tests.

b) EQUIPMENT : According to the playing facilities available in the college, the required equipment for the same needs to be made available to the students.

3) FINANCIAL PROVISION:

a) FEES : For the conduct of this scheme fees of Rs. 100/- (per student) should be collected by college and the amount collected thereof should be strictly utilized in consultation with Director of Physical Education and Sports for the promotion of sports and for the conduct of Physical Education Scheme.

GENERAL GUIDELINES TO IMPLEMENT THE COURSE

1. **APPOINTMENT OF STUDENT LEADERS :**

   To run the program throughout the year effectively, every college shall appoint student leaders amongst the students as per their requirement.

   Normally after every 30 students, the college may appoint 01 student leader who shall extend his/her help to conduct the program under the supervision or as per the guidelines given by the college Director of Physical Education.

2. **STUDENT LEADERS ORIENTATION PROGRAM :**

   The College Director of Physical Education at the beginning of the academic session shall organize at least three days orientation program for the selected student leaders. It is expected that the entire course related important responsibilities shall be conveyed to the student leaders, if possible with the required demonstrations.

3. **TRAINING TO STUDENT LEADERS :**

   The College Director of Physical Education at the beginning of the academic session, selects the student leaders as per his/her requirement and shall train them to conduct the decided program. Normally, following training shall be given to the student leaders.

   - Method of taking attendance
   - Preparation of weekly program
   - Record keeping
   - Preparation of test sheets
   - Marking of play grounds
   - Checking of equipment specifications
   - Class Controlling

Program and Activities to be arranged during orientation of Student Leaders:

- Warming up Exercises
- Conditioning Exercises
- Demonstration of Various Tests
- Imparting of training schedule
- Group dynamics
- Various methods of testing
- Introduction and operational use of the equipments
- Method of extension of help during the tests

4. ADMINISTRATION IN ABSENTIA :

The College Director of Physical Education normally shall have to supervise, guide, control and has to visit various places during the conduct of Intercollegiate Sports programs, hence, in his/her absence the student leaders shall conduct the decided programs as per the guidelines issued by the Director of Physical Education of Sports from time to time.

5. REQUIREMENT OF FINANCIAL ASSISTANCE TO CONDUCT THE STUDENT LEADERS' ORIENTATION PROGRAM :

The head of the institution shall make available the required financial assistance to the College Director of Physical Education to conduct the student leaders' orientation program. The college authorities may seek the help of the team leaders rendering the services through Earn and Learn Scheme.

Every year at the beginning of the session the College Director of Physical Education shall submit the required budget to the Head of the College. The expenditure on the same shall be incurred from the fees collected for this program.

6. INFORMATION ABOUT THE COURSE :

The College Director of Physical Education and Sports at the beginning of the academic session shall inform and explain the course to the admitted students.

7. APPLICATION FORM :

The College Director of Physical Education at the beginning of the academic session shall issue and collect the duly filled prescribed application form from the students admitted to First year of the Courses. (Appendix –II)

The College Director of Physical Education at the beginning of the academic session shall sort the duly filled in application forms and accordingly make the required arrangements.

8. CLASSES OF THE ACTIVITIES :

5 Lectures of the decided time shall be conducted by the College Director of Physical Education or with the help of Guest Faculty. Although the evaluation will be done in second semester theory lectures and practical sessions may be arranged in first semester also.

9. CERTIFICATE TO STUDENTS LEADER :

Every year at the end of the academic year the Director of Physical Education and Sports of the College shall award certificate to the student leader as per the Appendix - III.

APPENDIX – I

Achievement Card for

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

Fitness Test

Name of the Student : .....

College : .....

Sr. No	Activity	Particular	Out Of Marks	Perfor-mance	Marks
1	Fitness Assessment	• Cardiovascular Endurance	10		
		• Flexibility	5		
		• Muscular Strength Endurance	10		
		• Body Composition	--		--
		Total :	25	--	

Signature of the Student

Signature of Teacher In- charge : .....

Signature of Principal : .....

Date : / /

College Seal

APPENDIX – II

Application Form

Paste latest passport size photograph

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

Name of Student	
Address for Correspondence	
Class	

Section	
Semester	
Sex	**Male / Female**
Date of Birth	
Age	
Blood Group	
Height	
Weight	
Game Selected	
Medical History / Illness If any	

** The Student shall have to choose any one game/sports event as per the availability of the infrastructure and equipments in the college. For his/her convenience they may consult the College Director of Physical Education.

I, the undersigned declare that, I shall practice the selected events as per the instructions given by the College Director of Physical Education and abide by the rules made thereof. Further, I certify that, I shall not change or switch over to any other event in the mid of the session and appear the final test in the events selected under this form.

.....

Signature of the Student

Date : / /
Place : .....

APPENDIX – III

Certificate of Appreciation

This is to certify that Shri/ Smt/ Kum. ..... of .....

.....

Has successfully rendered his/her valuable services for the smooth conduct of theSports and Physical Education Course designed by the University for the Academic Year .....

.....

Date: / /

Director of Physical Education of the College	Seal of College	Principal of the College

APPENDIX – IV

Exemption Form

(Sports Participation)

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

(**Mandatory participation in selected game / sport for minimum 10 hours)**

Name of Student	
Address for Correspondence	
Class	

Section	
Semester	
Sex	**Male / Female**
Sports/Game	
Date of competition	
Place of competition	
Level of Competition	

Signature of the Student

Date : / /
Place : .....

Exemption Granted / Exemption Not Granted

Director of Physical Education of the College	**Seal of College**	**Principal of the College**

APPENDIX – V

Exemption Form

(Differently Able Students)

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

Name of Student	
Address for Correspondence	
Class	

Section	
Semester	
Sex	**Male / Female**
Nature of Disability	
Yes / No	**Copy of certificate from competent authority attached**

.....

Signature of the Student

Date : / /
Place : .....

Exemption Granted / Exemption Not Granted

Director of Physical Education of the College	**Seal of College**	**Principal of the College**

APPENDIX – VI

SPORTS / GAME PARTICIPATION LOG

COURSE – 101 PHYSICAL EDUCATION AND SPORTS

Name of Student	
Class	
Section	
Semester	
Sports/Game	

Date	Activity	Student Sign.	Student Leader Sign.

Signature of the Director of sports & PE

Date : / /
Place : .....

SAVITRIBAI PHULE PUNE UNIVERSITY

PHYSICAL EDUCATION AND SPORTS

COURSE – 101PHYSICAL EDUCATION AND SPORTS

FITNESS TEST MANUAL

(for First Year Under Graduate Students of All the Faculties)

Effective from Academic Year 2019 - 2020

TEST DESCRIPTION

1. MODIFIED QUEENS COLLEGE STEP TEST :

OBJECTIVE :

To provide a practical, convenient means for assessing cardio respiratory fitness.

VALIDITY :

using maximal oxygen consumption as the criterion, a correlation of - .75 was obtained between the first heart rate recovery score (5-20 seconds after exercise) and max. VO_2 expressed in ml/kg/min

RELIABILITY :

A reliability coefficient of .92 was reported

EQUIPMENT AND MATERIALS :

Bleachers serve as stepping bench (16.25 inches). A metronome is used for the cadence. Women 22 steps per minute and Men 24 steps per minute.

PROCEDURE :

Half of the class may be tested at one time with the other half serving as partners to count pulse. Following the explanations of the test and pulse-counting procedures, the counters are allowed several practices in counting their partners pulse rates for 15-seconds intervals.

The test consists of stepping up and down on the bleachers step for 3 minutes. At the end of the time period, the subjects remain standing while the partners count pulse rate for 15 seconds interval beginning 5 seconds after the cessation of exercise. The counters and steppers then exchange places and the other half of the class is tested.

SCORING :

The 15- seconds pulse count is multiplied by 4 to express the score in beats per minute.

NORMS :

Men & Women (Performance in Beats per minute)	Marks out of 10
≤ 148	10
149 – 156	9
157 – 160	8
161 – 163	7
164 – 166	6
167 – 170	5
171 – 172	4
173 – 180	3
181 – 184	2
≥185	1

Marks based on percentile norms Ref.: Johnson, B. L. & Nelson, J. K. (1986). Practical Measurement for evaluation in physical education (3rd edn) Mc Millan Publishing Company USA. Pg. 161

2. TWELVE MINUTE RUN AND WALK TEST (COOPER'S TEST) :

OBJECTIVE :

To measure cardio-respiratory endurance.

VALIDITY :

Validity is 0.90 when correlated with treadmill measurements of oxygen consumption and aerobic capacity.

RELIABILITY :

Reliability is 0.94 with test-retest method.

EQUIPMENT AND MATERIALS :

Stopwatch or clock with sweep second hand, whistle or starter's pistol, track, football field, or some running area marked so that distance travelled in 12 minutes can be calculated easily.

PROCEDURE :

Performers assemble behind starting line. At the starting signal, they run or walk as far as possible within the 12 minute time limit. An experienced pacer should accompany performers around the running area during the actual test. Performers should have experienced some practice in pacing. At the signal to stop, performers should remain where they finished long enough for test administrators to record the distance covered. Ample time should be given for stretching and warm-up as well as post-test cool down.

SCORING :

Score is distance in meter covered in 12 minutes.

NORMS :

Men (In meters)	Women (In meters)	Marks out of 10
≥2641	≥2261	10
2461 – 2640	2111 – 2260	9
2351 – 2460	2001 – 2110	8
2271 – 2350	1941 - 2000	7
2191 – 2270	1871 – 1940	6
2131 – 2190	1811 – 1870	5
2061 – 2130	1761 – 1810	4
1971 – 2060	1681 – 1760	3
1871 – 1970	1621 – 1680	2
≤ 1870	≤ 1620	1

(Marks based on percentile norms Ref: Hoffman J. (2006). Norms for fitness performance & health. Human Kinetics. USA. Pg. 73)

3. SIT AND REACH :

OBJECTIVE :

To measure the hip and back flexion as well as extension of the hamstring muscles of the legs.

VALIDITY :

Face validity was accepted for this test.

RELIABILITY :

An 'r' of 0.94 was found when the best score of three trials was recorded from separate testing and correlated.

EQUIPMENT AND MATERIAL :

Flexomeasure case with yard stick and tape.

PROCEDURE :

i. Line up the 15 inch mark of the yardstick with a line on the floor and tape the ends of the stick to the floor so that the flexomeasure case (window side) is face down.
ii. Sit down and line up your heels with the near edge of the 15 inch mark and slide your seat back beyond the zero end of the yardstick.
iii. Have a partner stand and brace his or her toes against your heels. Also, have and assistant on each side to hold your knees in a locked position as you prepare to stretch.
iv. With heels not more than 5 inches apart, slowly stretch forward, while pushing the flexomeasure case as far down the stick as possible with the fingertips of both hands. Take your reading at the near edge of the flexomeasure case.

SCORING :

The best of three trials measured in centimeter is your test score.

NORMS :

Men (in cms)	Women (in cms)	Marks out of 5
≥ 42.01	≥42.51	5
38.01 – 42.00	40.01 – 42.50	4
34.51 – 38.00	36.51 – 40.00	3
29.51 – 34.50	32.51 – 36.50	2
≤ 29.50	≤ 32.50	1

(Marks based on percentile norms Ref.: Hoffman J. (2006). Norms for fitness performance & health. Human Kinetics. USA. Pg. 102)

4. BENT KNEE SIT UPS :

OBJECTIVE :

To measure the dynamic (isotonic) endurance of abdominal muscles.

EQUIPMENT AND MATERIALS :

A stopwatch and a mat or dry turf or clean floor.

PROCEDURE :

The subject is asked to lie on the back with knees bent, feet on the floor with heels not more than 12 inches from the buttocks. The angle of the knees should not be less than 90degree. The subject is asked to put his or her hand on the back of the neck with finger clasped and to place the elbows squarely on the mat or turf or floor. The subject's feet are held by a companion to ascertain that the feet do not leave the surface and remain touching it. Then the subject is asked to tighten the abdominal muscles and to bring the head and elbows to the knees. The entire above process constitutes one sit up.

The subject is asked to return to starting position with his/her elbows on the surface before sitting up again. The tester gives the above demonstration to all the subjects to be tested before the actual performance of the test. The timer gives the starting signals ready, go ! at the word 'go' the timer starts the stopwatch and the subject starts the sit ups performance as quickly as possible with /her best efforts. The tester starts counting the number of sit ups performed. After 60 seconds, the timer gives the signal stop and the subject stops, while the tester records the number of correctly executed sit ups performed by the subject in 60 seconds. This gives the score of the test.

Only one trail is given unless the tester believes that the subject has not had a fair opportunity to perform. A subject is not allowed any rest in between sit ups during his performance. No incorrect sit ups is counted in which the subject does either of the following mistakes:

a) Keeps the fingers unclasped behind the neck.
b) Returns to the incomplete starting position with elbows not flat on the surface before starting the next sit up.
c) Brings both elbows forward by pushing of the floor with any elbow.

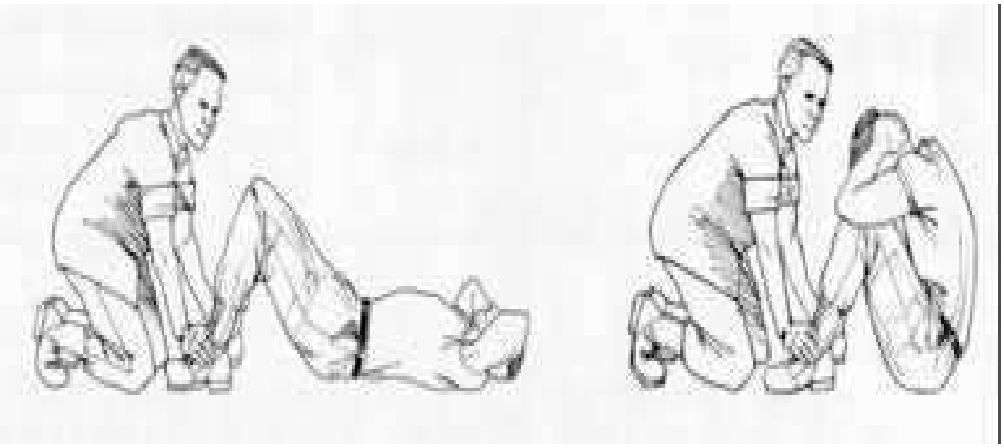
SCORING :

Number of correctly executed sit ups performed by the subject in 60 seconds

NORMS :

PERFORMANCE (NUMBER OF SIT UPS) Men	PERFORMANCE (NUMBER OF SIT UPS) Women	Marks out of 10
≥ 44	≥ 35	10
40 – 43	30 – 34	9
37 – 39	28 – 29	8
35 – 36	25 – 27	7
32 – 34	23 – 24	6
30 – 31	21 – 22	5
28 – 29	18 – 20	4
25 – 27	15 – 17	3
23 – 24	11 – 14	2
≤22	≤ 10	1

(Marks based on percentile norms Ref: The Cooper Institute (2006). Physical fitness specialist course and certification. Texas, USA. Pg. 29 & 36)



5. PERCENTAGE BODY FAT :

Bioelectrical Impedance (BI) :

Bio electrical is gaining popularity because of its ease in administration and its similarity to skin fold measurements regarding accuracy. BI is based on the relationship between total body water and lean body mass. Since water is an excellent conductor of electricity, a greater resistance to an electrical current passing through the body indicates a higher percentage of body fat. Likewise decrease when there is higher percentage of lean tissue. Since BI is sensitive to changes in body water, subject should refrain from drinking or eating within 4 hours of the measurement, void completely before the measurement, and refrain from consuming any alcohol caffeine, or diuretic agent before assessment. Failure to do so increases measurement error. For this Omron Body Fat Monitor can be used.

SAVITRIBAI PHULE PUNE UNIVERSITY

PHYSICAL EDUCATION AND YOGA

Syllabus

COURSE – 102 PHYSICAL EDUCATION AND YOGA

(For First Year Under Graduate Students of All the Faculties)

Effective from Academic Year 2019 - 2020

PHYSICAL EDUCATION AND YOGA

COURSE – 102:PHYSICAL EDUCATION AND YOGA (2 CREDITS)

AIMS & OBJECTIVES OF THE COURSE:

The aim of the course is to create awareness among students about Yoga, and to facilitate knowledge about Asanas, Pranayam and Shuddikriya. This will help them to incorporate yogic practices in their lifestyle.

COURSE CREDITS :

Semester - II

Course – 102 Physical Education and Yoga (02 Credits)

Credit 1: Introduction to Physical Education and Yoga

- **Concept of Physical Education, its Definition and Scope.**
- **Introduction to Yoga -** History of Yoga**,** Introduction to Ashtanga Yoga.
- **Prayer**
- **Mobility exercises – Neck up & down, Side to side, shoulder rotation, Twisting, Squats.**
- **Practice of Prone and Supine Asanas**

  A student will have to perform standing and seating asanas

  - Pavanmuktasana
  - Shavasana
  - Setubandhasana
  - Ardha Halasana
  - Salabhasana
  - Bhujangasana
  - Halasana
  - Makarasana
  - Dhanurasana

  The following points to be covered:
    - Benefits &Contraindication of each asana

Credit 2: Sitting and Standing Asanas and Pranayam

- **Practice of Sitting and Standing Asanas**

  A student will have to perform sitting and standing asana

  - Vajrasana
  - Dandasan
  - Vakrasana
  - Ushtrasana
  - Uttanmandukasana
  - Bhadrasan
  - Vrikshasana
  - Shashankasan
  - Trikonasana
  - Padahastasana
  - Chakrasana - sideward
  - Tadasana

  The following points to be covered:
    - Benefits & Contraindication of each asana

- **Practice of Pranayam**

  A student will have to perform pranayama

  - Anulom-Vilom
  - Bhramari
  - Kapalbhati

  The following points to be covered:
    - Benefits & Contraindication of eachPranayama

REFERENCE BOOKS:

- Iyengar, B.K. (2008).Light on Yoga. Orient LongmanPvt. Ltd.Mumbai
- Iyengar, B.K. (2008).Light on Pranayama. Orient LongmanPvt. Ltd.Mumbai
- Iyengar, B.K. (2008).Light on Astanga Yoga. Alchemy Publishers. New Delhi.
- Iyengar, B.K. (2008). Yoga the Path to Holistic Health. Dorling Kindersley. London.
- Gharote, M. L. (2013). Guidelines for Yogic Practices. The Lonavla Yoga Institute. India.
- अय्यंगार, गी. (२०१६). स्त्रियांसाठी योग- एक वरदान. रोहन प्रकाशन. पुणे.
- अय्यंगार, बी. के. (२०१७). आरोग्य-योग. रोहन प्रकाशन. पुणे.
- घरोटे ल. म. (२०१०) प्राणायाम – श्वासाचे शास्त्र. दि लोणावळा योग इन्स्टिट्यूट. इंडिया.

EVALUATION STRUCTURE

Table 1

Semester	Course	Credits	Marks	Mode of Evaluation
II	COURSE – 202 PHYSICAL EDUCATION AND YOGA – II (2 CREDITS)	2	50 (10marks x 5)	1. Demonstration and Explanation of Asana, and pranayam (total 5 – out of which 3 of student choice and2 of examiners choice)

EVALUATION OF THE ASANAS :

Each Asana will be awarded from 0-10 Marks. The evaluation is further distributed as under :-

a) Technical Execution (Presentation) 4 Marks
b) Complete Posture 4 Marks
c) Retention period 2 Marks

EXPLANATION :

a) Technical Execution (Presentation) 4 marks. It involves methodical approach in itspresentation which further depends on

i) Arriving to the posture,
ii)Alighting fromthe posture,
iii) Expression,
iv) Breathing

b) Complete Posture 4 marks. Attainment of the final posture and while being in thisposition certain aspects deem necessary to be taken into consideration to constitutea complete posture

i) Stability in the posture,
ii) Calmness & tranquillity,
iii)Exactness and correctness,
iv) Smoothness and degree of flexibility,
v) Bodyalignment, its angles and beauty.

c) Retention 2 marks. All postures are required to be held for20 seconds each. During retention period no shivering, no untoward movement, consistentbreathing, calm face expression and proper body language is essential.

PASSING CRITERIA

Semester	Course	Credits	Max. Marks	Minimum Passing %
II	COURSE – 202 PHYSICAL EDUCATION AND YOGA – II (2 CREDITS)	2	50	40%

- To pass a student shall have to get minimum 40% in aggregate in course.
- Student who have failed/who have been absent for the entire course will have to complete the entire course during the 4th semester.
- Student will not be admitted to 5th semester without completing the Course.

GRADING:

Grading for course 101 and course 201 will be done separately as follows.

Table 3

Range of Marks	Grade	Grade Points
41-50	O	10
35-40	A+	09
30-34	A	08
28-30	B+	07
25-27	B	06
23-24	C	05
20-22	P	04
00-19	F	00
Absent	Ab	00
	Ex	Exempted

|| Tamaso ma Jyotirgamaya ||
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar,Tel. Baramati, Dist: Pune (Pin : 412 306) Maharashtra, India
(Affilliated to Savitribai Phule Pune University, Pune)
Estd : 2007 Phone (02112) 282728 283187

Day Celebration record 2019-20

Index

Sr.No	Name of Day	Date
1	Birth Anniversary of Chatrapati Shivaji maharaj	19th February 2019
2	International Mother Tonque Day	27th Feb 2019
3	Birth anniversary of Savitribai Phule	03rd January 2019
4	Constitutional Day	26th November 2019

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

|| Tamaso ma Jyotirgamaya ||
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar, Tel. Baramati, Dist: Pune (Pin : 412 306) Maharashtra, India
(Affilliated to Savitribai Phule Pune University, Pune)
Estd : 2007 Phone (02112) 282728 283187

Govt. Rag. No. N.G.C. 2007(189/07) Mashi-3, Dt. 2 July 2007 College Code 827 University Appvl. No. IDNo. PU/PN/S/284/2007

Ref.No: SVM/ Date:- 19-02-19

Notice

All the Teachers, Student and Administrative staff member are here by informed that attend the programme of Birth Anniversary of **'chatrapati Shivaji Maharaj'** 19th February 2019 at 11:00 Am in the cultural hall.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Calibration of Birth Anniversary of Chatrapati Shivaji maharaj (Shivjayanti) on Tuesday 19th February 2019

Attendance Sheet

Sr.No.	Name of the participants	Sign.
1	Prof. Dhananjay V. Bamsode	
2	Mr. Thopate Vijay Dattatray	
3	Mr. yadav Atish Ashok	
4	Mr Pingale Santosh G	
5	Miss Jadhav Reshma S.	
6	Miss. Pandit R.A.	
7	Mrs. Ghadge Sunita.S	
8	Raut Priya N.	
9	Mr. P.D. Holkar	
10	Mrs. Shinde P.P.	
11	Jagtap J.M	
12	Tagdale Gaurav Bharat	
13	Karande Aniket Somnath	
14	Pharande Aditya Rajendra	
15	Mr. Salunke K.G.	
16	Jedhe Nikhil Manjing	
17	Miss Pawar Seema Bharat.	
18	Mr Agam Rohan Sanjay	
19	Thopate. Rushikesh. Suryakant	
20	Gadade Rohan Ganesh	
21	Hanhar Tanmay Bharat	
22	Dalvi Prachi Anil	
23	Pisal Vaibhav Arun	
24	Nimbalkar Prasad mahadev	
25	Pawar sahil sanjay	

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar, Tal – Baramati, Dist – Pune.

Report on –'Chatrapati Shivaji maharaj Jayanti (Shivjayanti)

19th February 2019

Birth Anniversary of Chatrapati Shivaji Maharaj was celebrated on Tuesday 19th February 2019 at Someshwar science college someshwarnagar. The principal of the college Asst.Prof Bansode D. V. greeted the gathering by offering a wreath. Cultural committee coordinator Yadav M.D. gave the information regarding 'swaraj sthapana by shivaji Maharaj' and all teaching and non-teaching staff were present for the program.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

|| Tamaso ma Jyotirgamaya ||
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar,Tel. Baramati, Dist: Pune (Pin : 412 306) Maharashtra, India
(Affilliated to Savitribai Phule Pune University, Pune)
Estd : 2007 Phone (02112) 282728 283187

Govt. Rag. No. N.G.C. 2007(189/07) Mashi-3, Dt. 2 July 2007 College Code 827 University Appvl. No. IDNo. PU/PN/S/284/2007

Ref.No: SVM/

Date:- 25-02-2019

Notice

All the Teachers, Student and Administrative staff member are here by informed that attend the programme of International Mother Tongue Day (Marathi Din) on 27th February 2019 at 10:00 Am in the cultural hall.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

लोकमत

सोमेश्वर महाविद्यालयात मराठी दिन साजरा

लोकमत न्यूज नेटवर्क

सोमेश्वरनगर : सोमेश्वर शिक्षण प्रसारक मंडळाच्या सोमेश्वर महाविद्यालयात मराठी दिन उत्साहात साजरा करण्यात आला. कार्यक्रमास ज्येष्ठ नागरिक, संस्थेचे संचालक, सचिव, सर्व शाखांचे प्रमुख शिक्षक उपस्थित होते.

मोबाइलवर मराठीचा वापर करत मराठी दिन साजरा करताना विद्यार्थी.

मराठी दिनानिमित्त प्रा. ज्योती थोरात यांनी वि. वा. शिरवाडकर ऊर्फ कुसुमाग्रज यांचा जीवनप्रवास व त्यांचे मराठी भाषेसाठीचे अनमोल योगदान विद्यार्थ्यांसमोर सादर केले. विद्यार्थ्यांनी समूहगीते, कविता सादर करुन आपल्या देशाबद्दल, राज्याबद्दल आणि भाषेबद्दलचे प्रेम व्यक्त केले.

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Institute Celebrating Marathi Bhasha Din 10th march 2019

Principal
Someshwar Science College,Someshwarnagar

सोमेश्वर विज्ञान महाविद्यालय सोमेश्वरनगर

मराठी भाषा गौरव दिन

विद्यार्थी विकास मंडळ आयोजित मराठी भाषा गौरव दिन 27 फेब्रुवारी 2019 विशेष कार्यक्रम दिनांक 27 फेब्रुवारी 2019 रोजी सकाळी 10 वाजता सोमेश्वर विज्ञान महाविद्यालय सोमेश्वरनगर येथे मराठी भाषा गौरव दिन विशेष कार्यक्रम आयोजित करण्यात आला होता कार्यक्रमाच्या अध्यक्षस्थानी महाविद्यालयाचे प्राचार्य माननीय श्री बनसोडे बीवी हे होते तसेच प्रमुख पाहुणे सोमेश्वर शिक्षण प्रसारक मंडळाचे सचिव श्री भारत खोमणे होते तसेच विद्यार्थी विकास अधिकारी श्री पिंगळे एसटी व सर्व शिक्षक व शिक्षकेतर कर्मचारी वर्ग व विद्यार्थी उपस्थित होते कार्यक्रमाचे सूत्रसंचालन प्राध्यापक होळकर पिढी यांनी केले प्रास्ताविक श्री पिंगळे यांनी केले त्यानंतर सरस्वती प्रतिमेचे पूजन उपस्थित मान्यवरांनी केले त्यानंतर सर्व प्रमुख उपस्थितांचे सत्कार करण्यात आला यानंतर कार्यक्रमाचे अध्यक्ष महाविद्यालयाचे प्राचार्य माननीय श्री बनसोडे यांनी आपले मनोगत व्यक्त केले व मराठी भाषेचे महत्व विद्यार्थ्यांना पटवून दिले त्यानंतर विद्यार्थी मनोगत त्यापैकी कोमल कोळेकर हिने आपले मनोगत व्यक्त केले तसेच निबंध स्पर्धांचे आयोजनही करण्यात आले होते तसेच प्रमुख पाहुण्यांच्या मनोगतानंतर प्राध्यापक जगदाळे यांनी उपस्थितांचे आभार व्यक्त केले अशा प्रकारे सोमेश्वर विज्ञान महाविद्यालयात मोठ्या उत्साहात मराठी भाषा गौरव दिन साजरा करण्यात आला.

Student's Development Officer
Someshwar Science College,Someshwarnagar.
Tal-Baramati,Dist-Pune-412306

Someshwar Science College
COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Calibration of Marathi Tuque Day
(Marathi Din) on
Tuesday 27th February 2019

Attendance Sheet

Sr.No.	Name of the participants	Sign.
1	prof. Dhananjay V. Bamude	
2	Mr. Thopate vijay Dattatray	
3	Mr. Yadav Atish Ashok	
4	Miss Jaytap Reshma S.	
5	Raut Priya N.	
6	Holkar P. D.	
7	Mrs. Shinde P. G.	
8	Mr. Salunke K. G.	
9	Asst. Prof. Shubhangi Kamble.	
10	Miss Pawar Seema Bharat	
11	Mrs. Ghadge Sunita. S	
12		
13	Jaytap J. M.	
14		
15	Gaikwad Gayatri Parameshwar	
16	Pingale S. C.	
17	Adsul sanket dnyaneshwar	
18	Mr. Agam Rohan Sanjay	
19	Mr. Thopate. Rohikesh. Suryakant	
20	Gadade Rohan Ganesh	
21	Harihar Yuvraj Bharat	
22	Dalvi Prachi Anil	
23	Konde Rushikesh Udaysinh	
24	Dhumal Prathmesh Jayant	
25	Jedhe Nikhil Mansing	

Principal
Someshwar Science College, Someshwarnagar

Someshwar Science College COLLEGE CODE 827

|| Tamaso ma Jyotirgamaya ||
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar,Tel. Baramati, Dist: Pune (Pin : 412 306) Maharashtra, India
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Govt. Rag. No. N.G.C. 2007(189/07) Mashi-3, Dt. 2 July 2007 College Code 827 University Appvl. No. IDNo. PU/PN/S/284/2007

Ref.No: SVM/

Date:- 01-01-2019

Notice

All the Teachers, Student and Administrative staff member are here by informed that attend the programme of Birth Anniversary of Savitribai Phule on 03rd January 2019 at 10:00 Am in the cultural hall.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Celebration Of Birth Anniversary of Savitribai Phule

Principal
Someshwar Science College,Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar, Tal – Baramati, Dist – Pune.

Report on –'Birth Anniversary of Savitribai Phule'

Thursday 03rd January 2019

Birth Anniversary of Savitribai Phule was celebrated on Thursday 03rd January 2019 at someshwar science college someshwarnagar. Guest offered garland to the **'Savitribai Phule'** frame and principal of the college Asst.Prof. Bansode D. V. greeted the gathering by offering a wreath and then cultural committee coordinator Yadav M.D. informed about Savitribai Phule. At that time girl students enlightened on 'Savitribai Phule.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Calibration of Birth Anniversary 'Savitribai Phule'
Thursday 03rd January 2019

Attendance Sheet

Sr.No.	Name of the participants	Sign.
1	Prof. Dhananjay V. Bawade	
2	Mr. Thopate Vijay Dattatray	
3	Mr. Yadav Atish Ashok	
4	Mrs. Shinde P. P.	
5	Miss Pawar Seema Bharat	
6	Miss. Pandit R.A.	
7	Miss. Ghadge Sunita S.	
8	Mr. Salunke K.G.	
9	Pingale S.G.	
10	Asst. Prof. Shubhangi Kamble	
11	Rajut Priya Nemdkumar	
12	Chavan Nikita Dilip	
13	Jagtap J.V.	
14	Gaikwad Harshicel Manohar.	
15	Jagtap Priyanka Dattatray	
16	Pawar Siddhant Bharat	
17	Gadade Rohan Ganesh	
18	Harihar Yuvraj Bharat	
19	Dalvi Prachi Anil	
20	Thopate. Rushikesh. Sunyakant	
21	Agam Rohan Sanjay	
22	Jadhav Sahil Mahesh	
23	Bamkar Uday Dadaso	
24	Mr. P. D. Holkar	
25	Jadhav Prajwal Tanaji	

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

SHRI SOMESHAWR SHIKSHAN PRASARAK MANDAL'S SOMESHWAR SCIENCE COLLEGE SOMESHWARNAGAR

26th November 2019 Constitutional Day Ceremony ON 26th November 2019

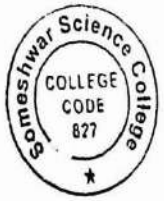
DETAILED REPORT

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

INDEX

Sr.No.	Contents
1	Photos
2	Magazine of Programme
3	Report letter
4	Attendance Letter
5	Detail Report



Celebrating Indian constitution day and lecture are delivered chief guest Sachin Patil Sir (A.P.I) by 2019-2020

Principal
Someshwar Science College,Someshwarnagar

Shree Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar.

Organized

26th November 2019 Constitutional Day

Programme Magazine

Date: **26th November 2019** Time: 12:30 P.M.

Chief Guest

Sachin Patil sir (A.P.I.)

Programme

Welcome of all Dignitaries
Idolatry
Introduction of president of the Program
Solute to all Martyred
Reading of Indian Constitution Preface
Introduction of the chief Guest
Presidential address
Vote of thanks

Venue

Cultural Hall, Someshswar Science College, Someshwarnagar.

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

SHRI SOMESHWAR SHIKHAN PRASARAK MANDALA'S

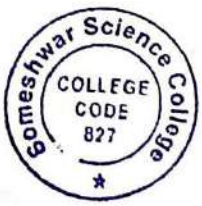
SOMESHWAR SCIENCE COLLEGE SOMESHWARNAGAR

CONSTITUTION DAY CEREMONY

ON

26 NOVEMBER 2021

DETAILED REPORT



INDEX

Sr. No.	Content
1	Photo's
2	Magazine of Programme
3	Report Letter
4	Attendance Letter
5	Detail Report

Shree Someshwar Shikhsan Prasark Mandal's

Someshwar Science College, Someshwarnagar

Organized

72th Constitution Day

Programme Magazine

Date: 26 Nov 2021, Friday Time: 11.00a.m.

Chief Guest

Adv. Ganesh Alandikar

Programme

Welcome of all Dignitaries

Idolatry

Introduction of the Programme

Salute to all Martyred

Reading of Indian Constitution preface

Introduction of the Chief Guest

Addressed by the Chief Guest

Presidential address.

Vote of thanks

Venue

Cultural Hall ,Someshwar Science College, Someshwarnagar

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Celebrated International constitutional day and Lecture delivered by adv. Ganesh Alandikar

Detail Report of Constitution Day

72nd Constitution day was celebrated on 26th November 2021 in the premises of Someshwar Science College, Someshwarnagar. Students, teaching staff and non-teaching staff, administration filled with a feeling of patriotism and dedication.

Asst. Prof. Mayuri Yadav started the celebration to facilated welcome of Chief Guest Adv. Ganesh Alandikar, The President of Ex-Serviceman Association Major Balasaheb Shendkar, Prof. S.K. Hajare, Principal of Sharadchandra Pawar Institute of Technology, Prof. Dhananjay Bansode, Principal of Someshwar science College and teaching staff and non- teaching staff.

Programme started by Idolatry then Asst Prof. N.N. Bhong has given Introduction of the programme. Everyone Salute to all Martyred of 26th /11/2008 at Hotel Taj and other six spots terrorist attack then Asst.Prof. P.D.Holkar read the Indian constitutional preface. After that Asst.Prof.N.J.Yadav gave the introduction of the Chief Guest After that The Chief Guest addressed to all then Principal Dhananjay Bansode President of program gave valuable guideness.

Asst. Prof. N.N. Bhong ended the celebration with the vote of thanks. On this occasion all rules and regulation was followed regarding to corona virus and 250 students were attended for this programme on online mode.

Someshwar Science College COLLEGE CODE 827

।। तमसो मां जोतिर्गमय ।।
श्री सोमेश्वर शिक्षण प्रसारक मंडळाचे
फोन नं.(०२११२) २८३१८७, २८२७२८

सोमेश्वर विज्ञान महाविद्यालय

सोमेश्वरनगर, ता.बारामती, जि.पुणे (पिन कोड : ४१२ ३०६) महाराष्ट्र, भारत
सावित्रीबाई फुले पुणे विद्यापीठ पुणे संलग्नीत
रजि.नं. एन.सी.जी.२००७(१८९/०७) माशि-३, दि.२ जुलै २००७ कॉलेज कोड ८२७ यु.आय.डी.नं. पी.यु./पी.एन./एस./२८४/२००७
स्थापना : २००७

जावक क्रमांक : सोविम/२८३२/२०२१-२२ दिनांक : २४/११/२०२१

प्रति,
मा.श्री. ॲड.गणेश आळंदीकर
सोमेश्वरनगर.

विषय : संविधान दिना निमित्त प्रमुख पाहुणे म्हणून उपस्थित राहणेबाबत.....

मा.महोदय,

उपरोक्त विषयास अनुसरून शुक्रवार दि.26.11.2021 रोजी सोमेश्वर विज्ञान महाविद्यालयामध्ये संविधान दिनाचे औचित्य साधून संबधित विषयावर मार्गदर्शनपर व्याख्यान आयोजित करण्यात आले आहे.

तरी सदर कार्यक्रमास व्याख्याता म्हणुन उपस्थित राहुन आपण विद्यार्थ्यास व कर्मचारी वर्गास मार्गदर्शन करून सहकार्य करावे ही विनंती.

कळावे,

आपला विश्वासू

24/11/2021
प्राचार्य
सोमेश्वर विज्ञान महाविद्यालय, सोमेश्वरनगर

Received

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Shri Someshwar shikshan Prasark mandal

Someshwar Vidnyan Mahavidyalaya Someshwarnagar

Teaching List 2021-22

Sr. No	Name of Teacher	
1	Asst.Prof. Vijay Dattatray Thopate	
2	Asst.Prof. Shubhangi Bhimrao Kamble	
3	Asst.Prof. Atish Ashok Yadav	
4	Asst.Prof. Santosh Ganpatrao Pingale	
5	Asst.Prof. Preeti Pralhad Shinde	
6	Asst.Prof. Mayuri Dnyanshwar Yadav	
7	Asst.Prof. Navnath Narayan Bhong	
8	Shri. Jitendra Babanrao Jagtap	
9	Miss.Reshma Balaso Chachar	
10	Miss. Mrunali Bhanudas Chavan	
11	Shri.Rajesh Suryakant Nikalje	
12	Shri.Pachukant Dnyandev Holkar	
13	Shri.Kiran Mahadev Jagdale	
14	Miss.Jayashree Mahadev Bhosale	
15	Miss.Priya Nandkumar Raut	
16	Miss. Seema Bharat Pawar	
17	Mrs. Sunita Sopan Ghadage	
18	Shri Navanath Jalindhar Yadav	
19	Miss. Pooja Kuber Chavan	
20	Shri.Kishor Ganpat Salunke	
21	Miss.Rupali Arvind Pandit	
22	Miss.Prajkta Subhash Adsul	
23	Mrs. Pratiksha Kishor More	
24	Shri.Dnyaneshwar Balaso Phalke	
25	Miss. Apurva Baban Tamhane	
26	Miss. Shraddha Yashwantrao Jagtap	
27	Mrs.Madhuri Santosh Bhandwalkar	
28	Miss. Monika Rajendra Gaikwad	
29	Miss.Reshma Sopan Jagtap	
30	Miss. Priti Sharad Thopate	
31	Shri Shubham P.Thombare	
32	Miss. Pooja Gitaram Kadam	

Someshwar Science College
COLLEGE CODE 827

Date-10th junary 2022

Notice

All staff of someshwar Science college Someshwarnagar are here by informed that, there will be a program scheduled on the occasion of **'NATIONAL YOUTH DAY'** organized on 12th January 2022(Wednesday),all staff member should be present in F.Y.B.Sc class room at 11:00 AM.

Coordinator

IQAC Coordinator

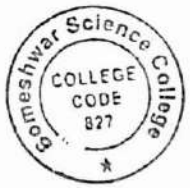
Principal

SHRI SOMESHAWR SHIKSHAN PRASARAK MANDAL'S SOMESHWAR SCIENCE COLLEGE SOMESHWARNAGAR

21st June 2023 INTERNATIONAL YOGA DAY ON 21ST JUNE 2021 DETAILED REPORT

INDEX

Sr.No.	Contents
1	Photo's
2	Magazine of Programme
3	Report letter
4	Attendance Letter
5	Detail Report



Shree Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar.

Organized

International Yoga Day

Programme Magazine

Date: 21th June 2021 Monday Time: 08:00 A.M

Event President

Vice Principal Asst.Prof. Bansode D.V.

Programme

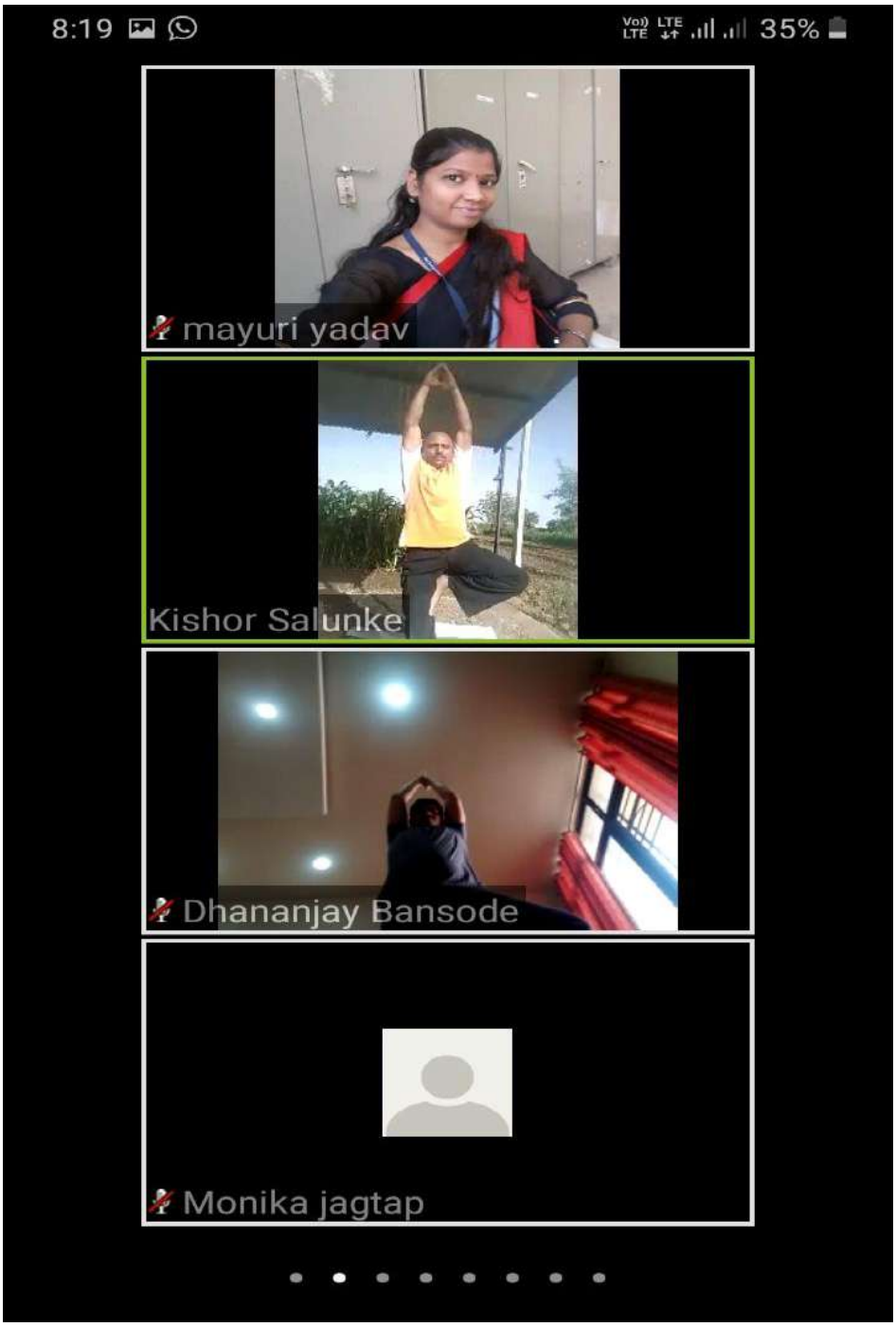
Welcome of all faculty member
Introduction of the Programme
Introduction of president of Event
President address.
Vote of Thanks

Venue

Online On Zoom Platform

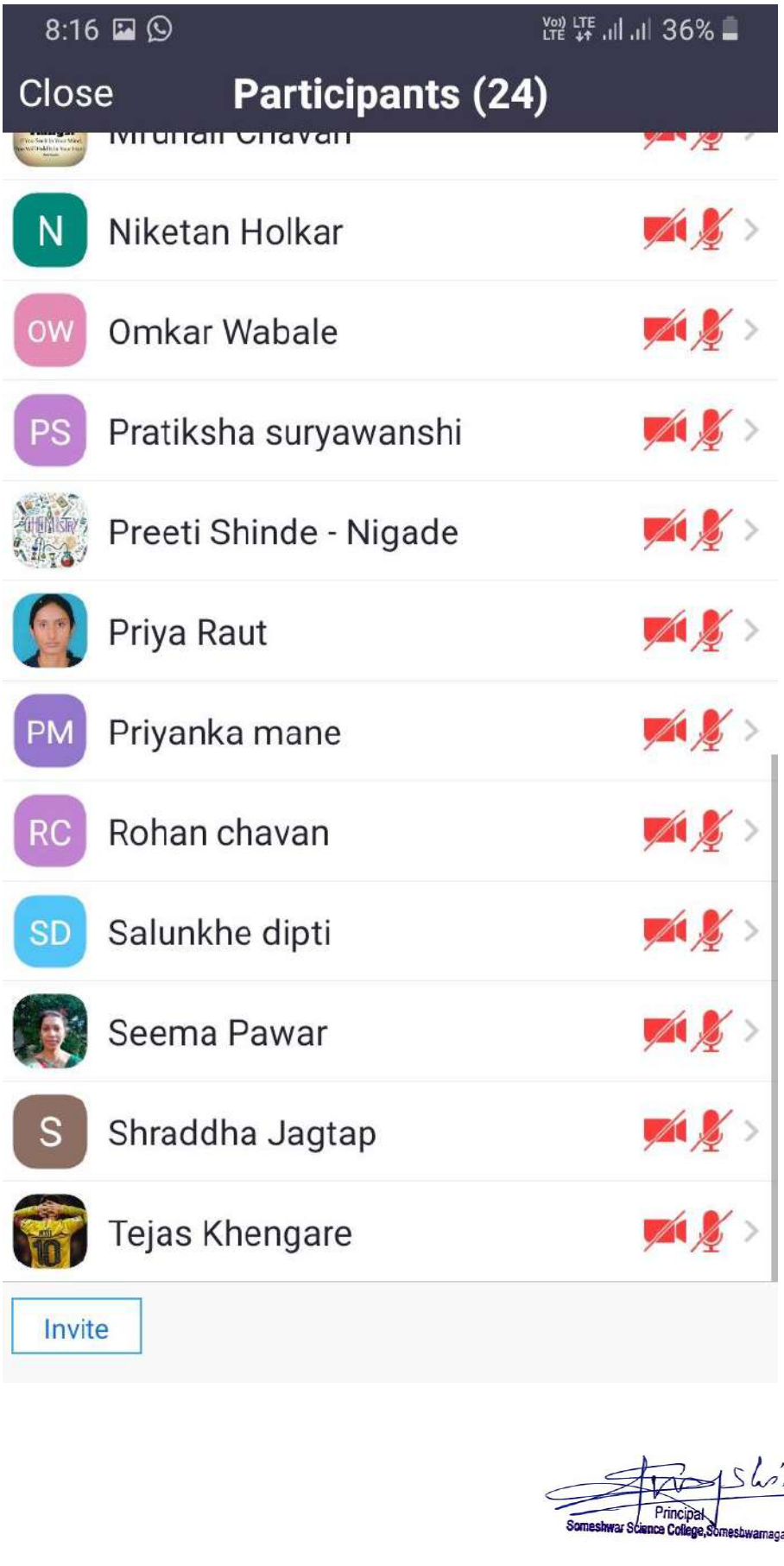
Someshwar Science College
COLLEGE CODE 827

Online Yoga Day celebration using zoom / Google meet platform 2021

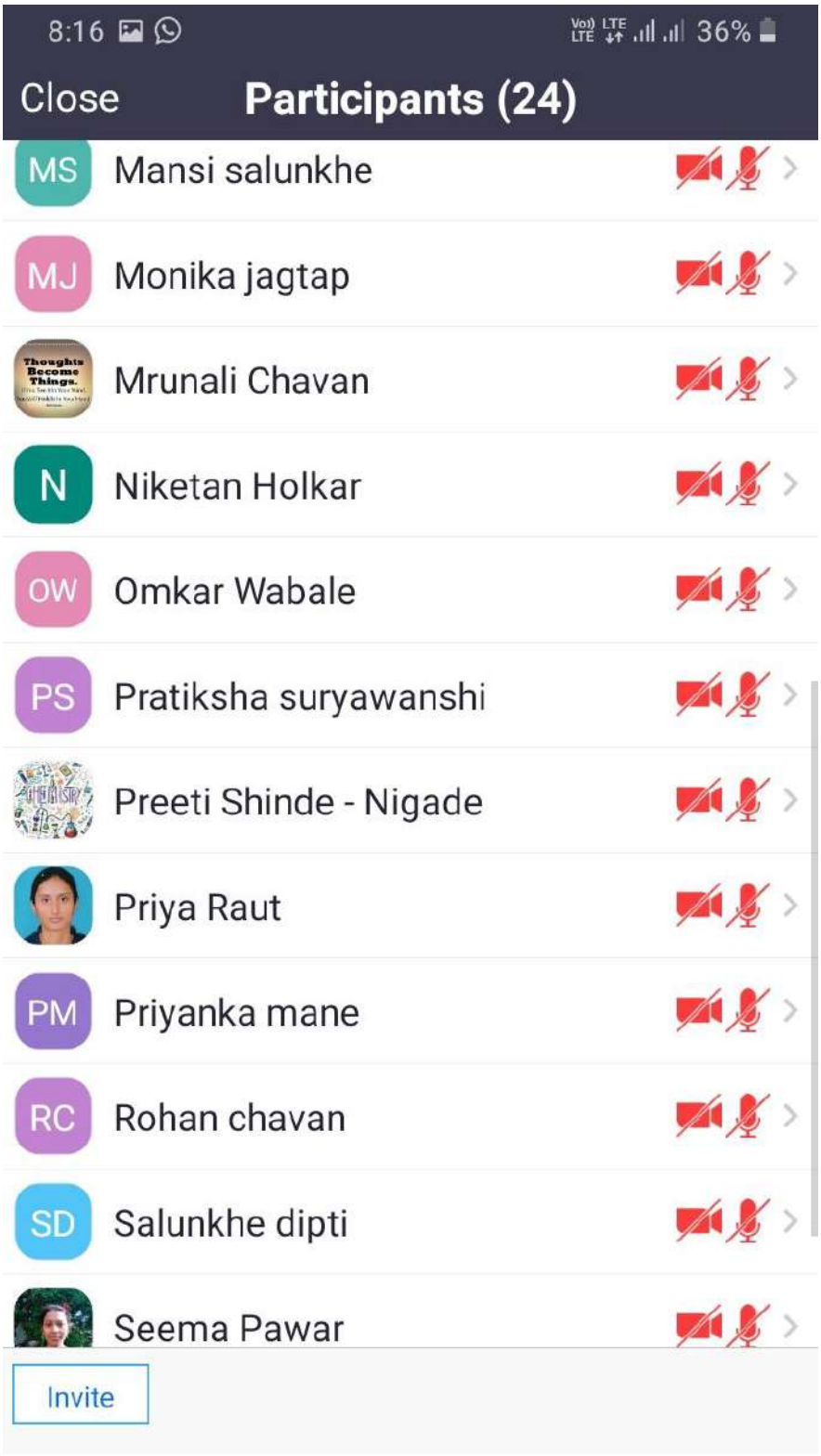


Principal
Someshwar Science College,Someshwarnagar

Principal
Someshwar Science College,Someshwarnagar



Principal
Someshwar Science College,Someshwarnagar



Principal
Someshwar Science College,Someshwarnagar

Tree plantation by N.S.S

Principal
Someshwar Science College,Someshwarnagar

Tree Plantation by Student Development Cell

Principal
Someshwar Science College,Someshwarnagar

|| Tamaso ma Jyotirgamaya ||
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE

Someshwarnagar, Tel. Baramati, Dist: Pune (Pin : 412 306) Maharashtra, India
(Affilliated to Savitribai Phule Pune University, Pune)
Estd: 2007 Phone (02112) 282728 283187

Govt. Rag. No. N.G.C. 2007(189/07) Mashi-3, Dt. 2 July 2007 College Code 827 University Appvl. No. IDNo. PU/PN/S/284/2007

Ref.No: SVM/ Date:-

Extension Programme

Report on Tree Plantation Programme

Date- 28th February 2020

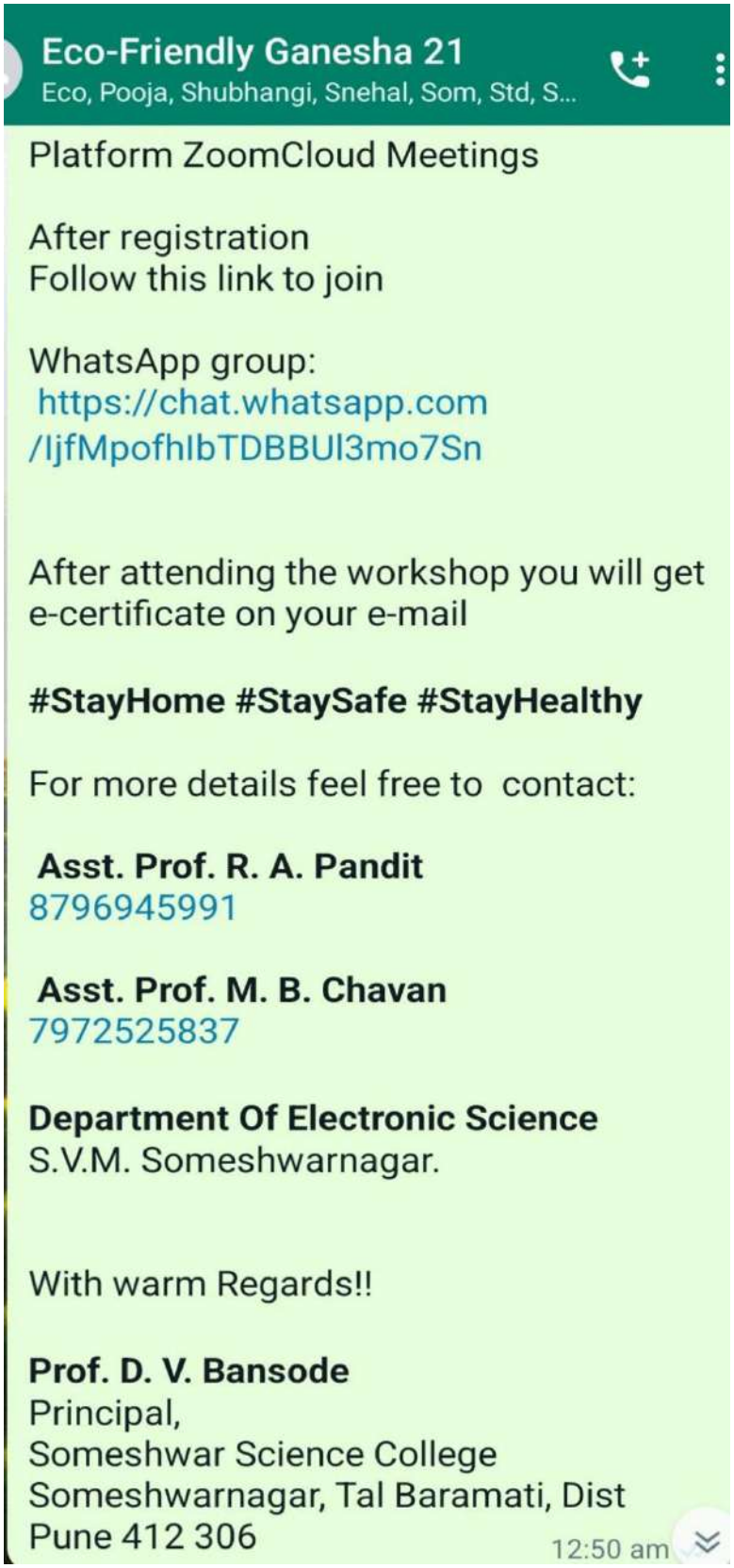
Tree Plantation programme was organized by NSS unit of the college, in which 05 *Pimple* plant, 02 *Karanja* plant, 01*ashoka* plant, 05 *Chich* Plant *was* successfully planted in the Adapted village Deulwadi, karanje on 28th February 2020 at 10:30 a.m. along the road from the Main gate of the Someshwar Temple, Bhakt Nivas and campus. Before tree plantation program Student were given the information regarding all the plants life cycle and there benefits to the Society and motivated to conserve them. Thus the tree plantation programme was successfully Completed.

Almost 03 Teachers staff and 25 students were present for this programme

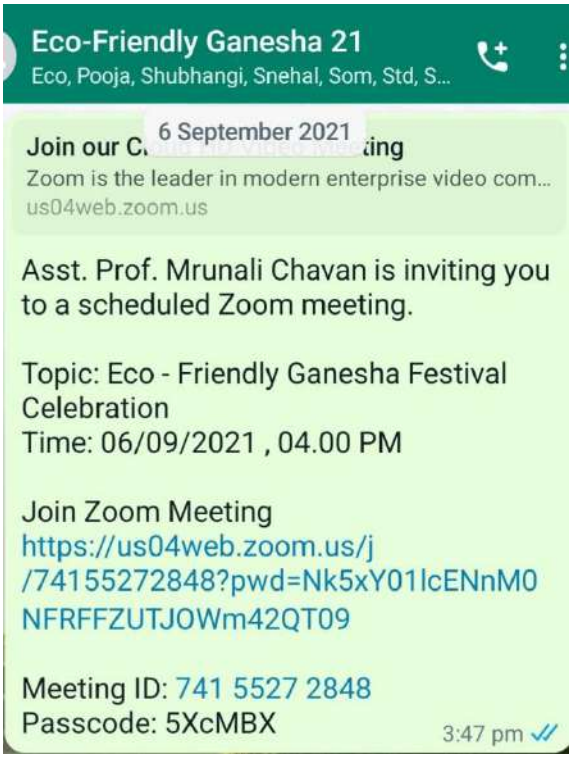
Someshwar Science College COLLEGE CODE 827

Eco-Friendly Ganesh Idol Online Workshop 2021

Principal
Someshwar Science College, Someshwarnagar



Principal
Someshwar Science College, Someshwarnagar



Principal
Someshwar Science College,Someshwarnagar

Eco-Friendly Ganesha 21
Eco, Pooja, Shubhangi, Snehal, Som, St

Rani

7 September 2021

Rani

Eco-Friendly Ganesha 21
Eco, Pooja, Shubhangi, Snehal, Som, Std, S...

6 September 2021

🎯 Announcement to all.....
It has been observed that many students have their schools at 11. 00 AM

So our workshop is rescheduled @4.00 pm....

Zoom link will be shared @ 3.45 pm
🙏

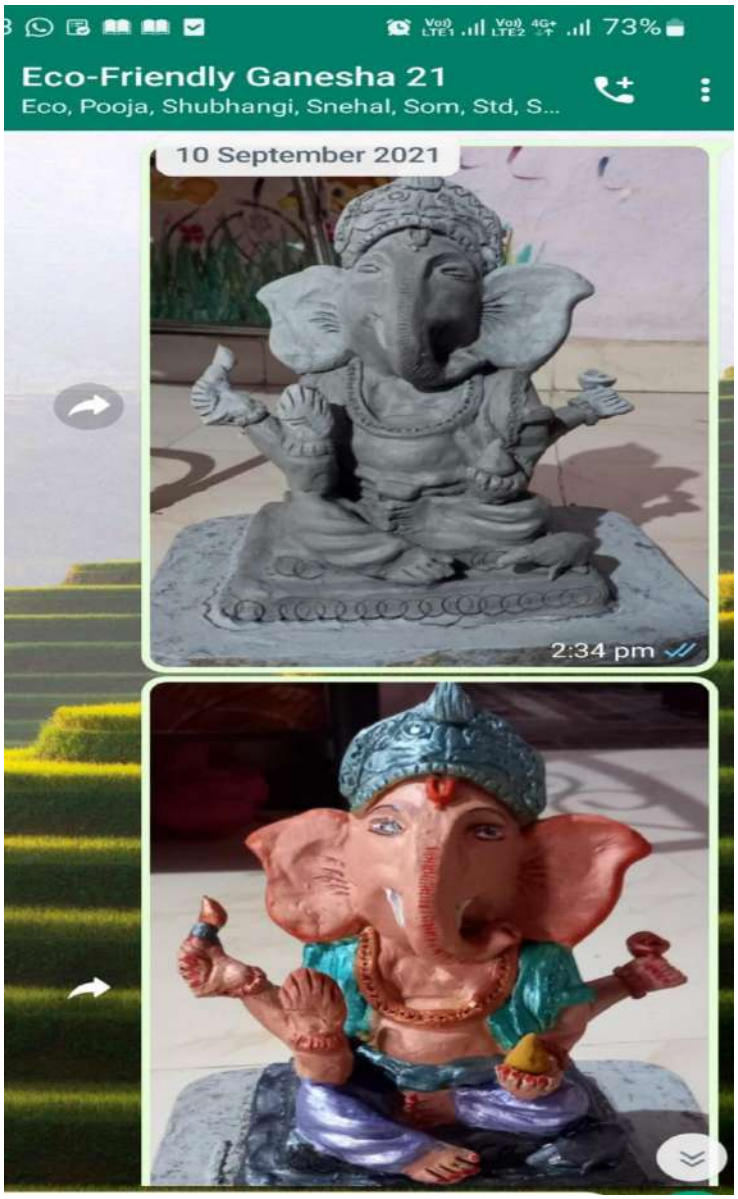
🎯 सर्वांसाठी एक सुचना आहे

असे निदर्शनास आले आहे की सकाळी 11.00 वाजता विद्यार्थ्यांचे शाळेचे वर्ग सुरू आहेत.

म्हणुन आपण आपली 11.00 ची कार्यशाळा 4.00 वाजता घेत आहोत.
कृपया सर्वांनी याची नोंद घ्यावी.
ठीक 3.45 वाजता zoom लिंक इथेच ग्रुप वर शेअर केली जाईल.
🙏

9:32 am ✓✓

Principal
Someshwar Science College,Someshwarnagar



Principal
Someshwar Science College, Someshwarnagar

Tree plantation in college campus 2020-2021

Tree plantation in college campus 2017-2018

Principal
Someshwar Science College,Someshwarnagar

Tree plantation in college campus by guest 2021-2022

Principal
Someshwar Science College, Someshwarnagar

Distribution of Indian tree plant by member of someshwar shikashan prasark mandalas 2021-2022

Tree plantation in college campus by Dr.Pawar R.G. Principal of someshwar science college someshwarnagar 2021-2022

Principal
Someshwar Science College,Someshwarnagar

Industrial visit at Someshwar sahkari sakhar karkhana

Principal
Someshwar Science College,Someshwarnagar

Industrial Field Visit 2018-2019

Principal
Someshwar Science College,Someshwaramagar

Hemoglobin checkup camp 2018-2019

Hemoglobin checkup camp for girls Students 2022

Principal
Someshwar Science College,Someshwarnagar

Hemoglobin checkup camp for girls Students 2017-2018

Environmental Day Poster Presentation

Principal
Someshwar Science College,Someshwarnagar

Notice

The Teacher assigned to Environmental Awareness are hereby informed that, **Environmental Awareness 2018-19** lectures will be starting from 10/01/2019 to 18/01/2019. Time table is attached behind the notice. All the teachers should take lectures on time and provide **multiple choice questions** on the syllabus allotted also compulsory take the attendance of your lectures.

Co-coordinator

09/01/19

Principle

Savitribai Phule Pune University

Examination Session April/May 2018

Marks Inward System for Colleges

Inward No.: 4899920827

College : (0827) SOMESHWAR SCIENCE COLLEGE,BARAMATI

Course Name : B.Sc. Regular(Rev.2013)

Subject : (89992) ENVIRONMENTAL AWARENESS

Exam Type : Grade

PRNO Seat No Marks/Grade	PRNO Seat No Marks/Grade	PRNO Seat No Marks/Grade	PRNO Seat No Marks/Grade
1171716706 10975(1171716706) O	1171716734 10976(1171716734) O	1171716774 10977(1171716774) O	1171716711 10978(1171716711) O
1171716710 10979(1171716710) A	1171716795 10980(1171716795) O	1171716761 10981(1171716761) A	1171716794 10982(1171716794) O
1171716784 10983(1171716784) O	1171603290 10984(1171603290) A	1171716723 10985(1171716723) O	1171716732 10986(1171716732) A
1171716729 10987(1171716729) A	1171716725 10988(1171716725) O	1171718483 10989(1171718483) O	1171716726 10990(1171716726) O
1171716722 10991(1171716722) A	1171716807 10992(1171716807) A	1171716746 10993(1171716746) O	1171716759 10994(1171716759) O
1171716783 10995(1171716783) O	1171716708 10996(1171716708) O	1171716799 10997(1171716799) A	1171716779 10998(1171716779) O
1171716719 10999(1171716719) O	1171716739 11000(1171716739) O	1171716772 11001(1171716772) O	1171716803 11002(1171716803) O
1171716798 11003(1171716798) O	1171716743 11004(1171716743) O	1171716752 11005(1171716752) C	1171716786 11006(1171716786) A
1171716777 11007(1171716777) A	1171716724 11008(1171716724) O	1171716764 11009(1171716764) A	1171716738 11010(1171716738) A

28/8/18

Stamp & Authorized Signatory

PRINCIPAL
SOMESHWAR SCIENCE COLLEGE

Coordinator

Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR SCIENCE COLLEGE, SOMESHWARNAGAR

Class : S Y BSc, S Y Bcs

Environmental Science Project Guide Teacher List 2017 - 18

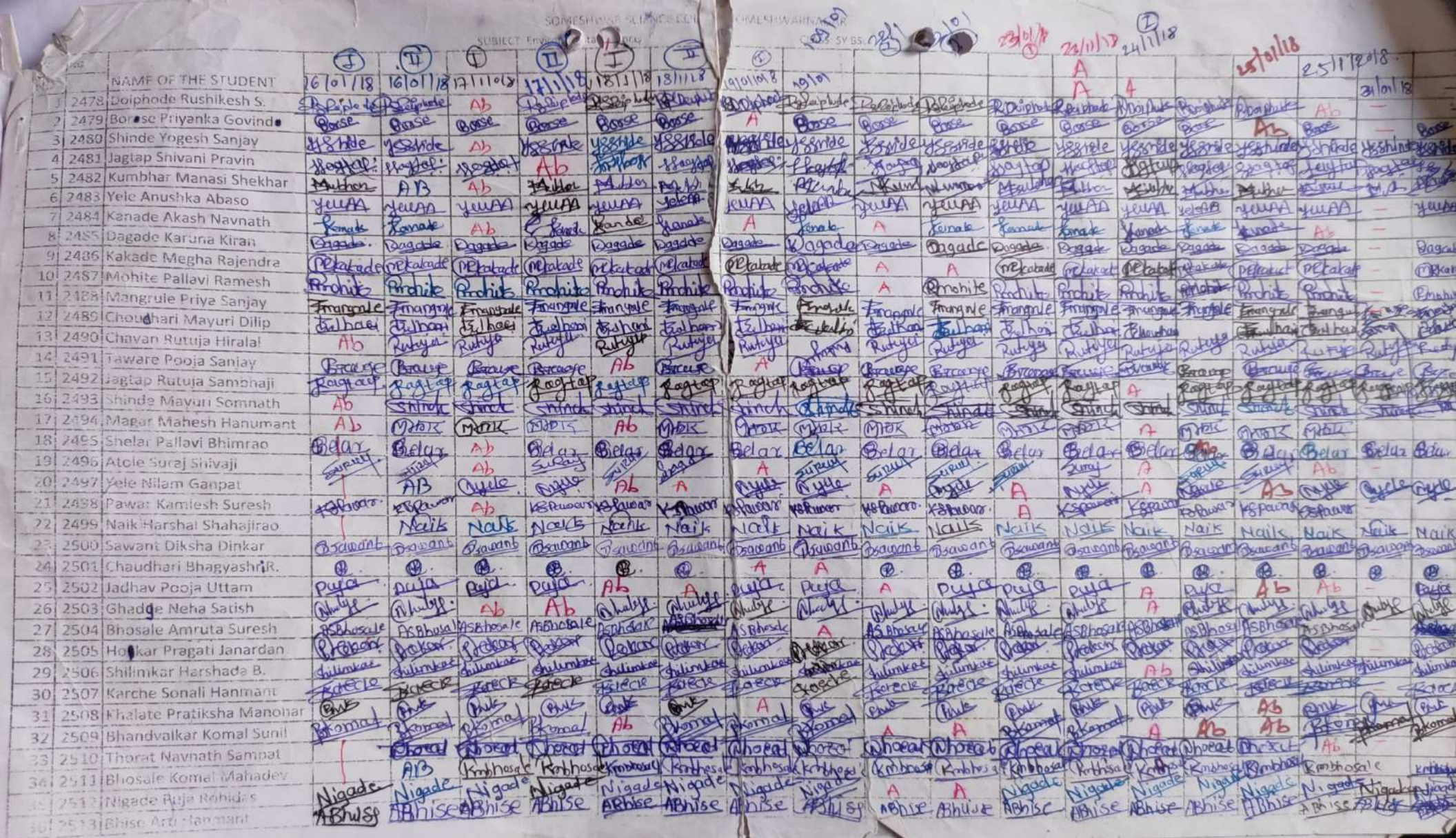
	ROLL NO	Name of student	Name of Staff	Sign
1	2478	Doiphode Rushikesh S.	Mr. V.D.Thopate	
2	2479	Borase Priyanka Govinde		
3	2480	Shinde Yogesh Sanjay		
4	2481	Jagtap Shivani Pravin		
5	2482	Kumbhar Manasi Shekhar		
6	2483	Yele Anushka Abaso	Miss. S.B. Kamble	
7	2484	Kanade Akash Navnath		
8	2485	Dagade Karuna Kiran		
9	2486	Kakade Megha Rajendra		
10	2487	Mohite Pallavi Ramesh		
11	2488	Mangrule Priya Sanjay	Mr. V.H. Kadam	
12	2489	Choudhari Mayuri Dilip		
13	2490	Chavan Rutuja Hiralal		
14	2491	Taware Pooja Sanjay		
15	2492	Jagtap Rutuja Sambhaji		
16	2493	Shinde Mayuri Somnath	Mr. R.S. Nikalje	
17	2494	Magar Mahesh Hanumant		
18	2495	Shelar Pallavi Bhimrao		
19	2496	Atole Suraj Shivaji		
20	2497	Yele Nilam Ganpat		
21	2498	Pawar Kamlesh Suresh	Mr. S. G. Pingale	
22	2499	Naik Harshal Shahajirao		
23	2500	Sawant Diksha Dinkar		
24	2501	Chaudhari Bhagyashr R.		
25	2502	Jadhav Pooja Uttam		
26	2503	Ghadge Neha Satish	Mr. P.D. Holkar	
27	2504	Bhosale Amruta Suresh		
28	2505	Hokkar Pragati Janardan		
29	2506	Shilimkar Harshada B.		
30	2507	Karche Sonali Hanmant		
31	2508	Khalate Pratiksha Manohar	Mr. [redacted] Jagdale K.M	
32	2509	Bhandvalkar Komal Sunil		
33	2510	Thorat Navnath Sampat		
34	2511	Bhosale Komal Mahadev		
35	2512	Nigade Puja Rohidas		
36	2513	Bhise Arti Hanmant	Miss. P.P. Shinde	
37	2514	Bhandalkar Pooja Bapu		
38	2515	Bhosale Pooja Parabati		
39	2516	Thopate Puja Hindurao		
40	2517	Gaikwad Suvidhya Santosh		
41	2518	Bhosale Komal Namdev	Miss. J.M. Bhosale	
42	2519	Bhujbal Rohit Dattatray		
43	2520	Bhagat Snehal Sunil		
44	2521	Tamboli Ashpak Abdul		
45	2522	Galave Tejal Babasaheb		
46	2523	Raykar Poonam Hanumant	Miss. T.S. Bhoite	
47	2524	Burungale Alisha Amarsinh		
48	2525	Rajguru Shweta Mangesh		
49	2526	Jagdale Asmita Nanaso		
50	2527	Kakade Sayali Pradip		
51	2528	Salunke Swapnil Sunil	Mr. R.D. Khalate	
52	2529	Bhosale Reshma Mahadev		
53	2530	Thopate Ujwala Popat		
54	2531	Shinde Nikita Dattatray		
55	2532	Bhujbal Rutuja Prashant		

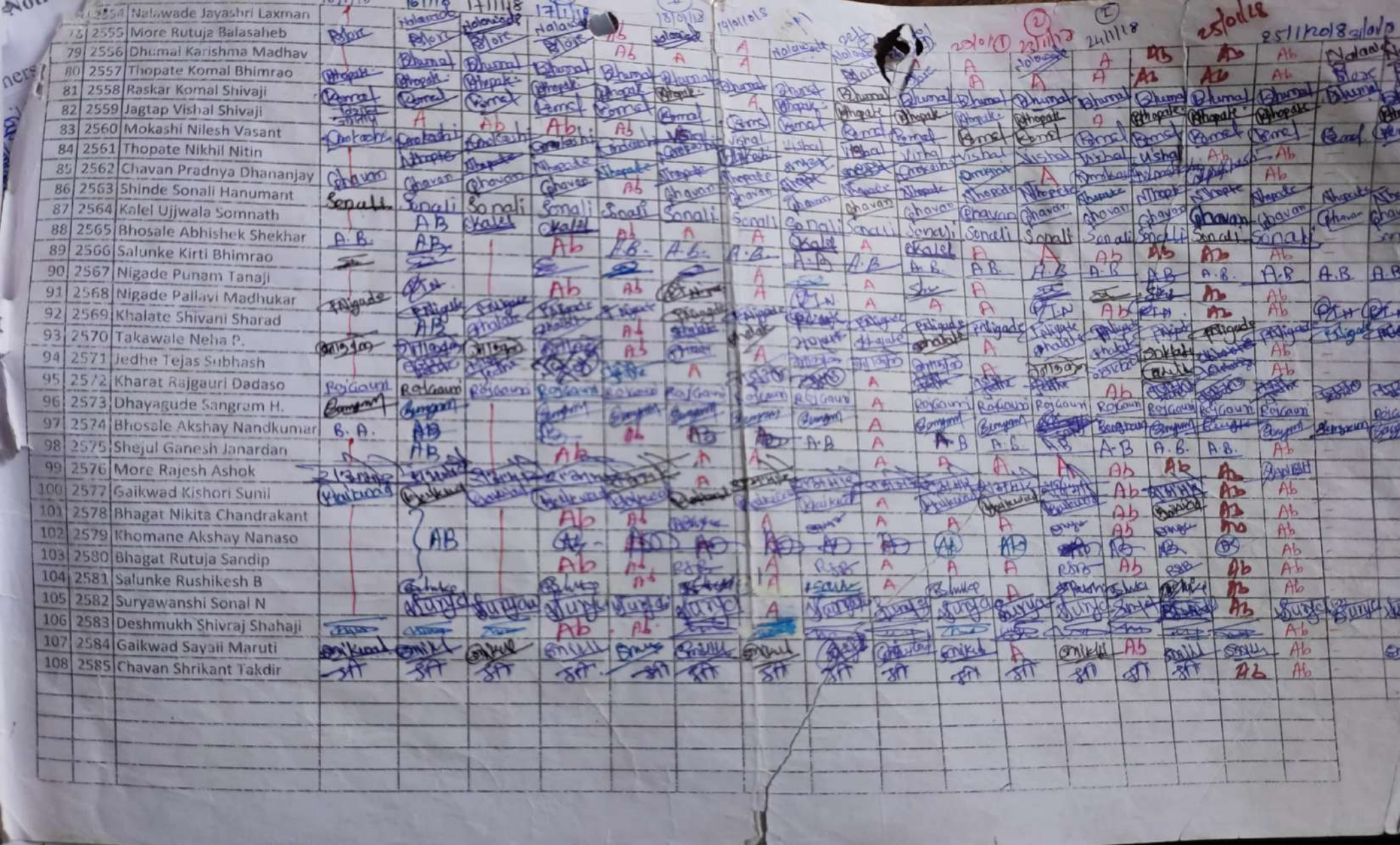
56	2533	Jagtap Prajkta Balasaheb	Miss. B.P. Nilakhe	
57	2534	Gaikwad Ankita Laxman		
58	2535	Khulape Nikita Mohan		
59	2536	Dalavi Rahul Balaso		
60	2537	Holkar Akash Mansing		
61	2538	Holkar Akshay Jagannath	Miss. A.D. Lakade	
62	2539	Shaikh Riyaj Chand		
63	2540	Kolekar Komal Krishan		
64	2541	Shendkar Rutuja R.		
65	2542	Gawade Sonali Pandurang		
66	2543	Lakade Adesh Anil	Miss. A.S. Pharande	
67	2544	Bhosale Milind Arvind		
68	2545	Bhosale Kunal Maruti		
69	2546	Dagade Mangesh Shankar		
70	2547	Kathe Shraddha Vijay		
71	2548	Bankar Kishori Bapu	Miss. P.N. Raut	
72	2549	Chavan Saurabh Balaso		
73	2550	Chaugule Pandurang Sunil		
74	2551	Rayakar Supriya Dadaso		
75	2552	Bhandalkar Swapnali M.		
76	2553	Tamboli Shahid Shakurbhai	Mr. R.N. Ghadge	
77	2554	Nalawade Jayashri Laxman		
78	2555	More Rutuja Balasaheb		
79	2556	Dhumal Karishma Madhav		
80	2557	Thopate Komal Bhimrao		
81	2558	Raskar Komal Shivaji	Miss. M.D. Yadav	
82	2559	Jagtap Vishal Shivaji		
83	2560	Mokashi Nilesh Vasant		
84	2561	Thopate Nikhil Nitin		
85	2562	Chavan Pradnya Dhananjay		
86	2563	Shinde Sonali Hanumant	Miss. S.B. Pawar	
87	2564	Kalel Ujjwala Somnath		
88	2565	Bhosale Abhishek Shekhar		
89	2566	Salunke Kirti Bhimrao		
90	2567	Nigade Punam Tanaji	Miss. S.S. Ghadge	
91	2568	Nigade Pallavi Madhukar		
92	2569	Khalate Shivani Sharad		
93	2570	Takawale Neha P.		
94	2571	Jedhe Tejas Subhash	Miss. P.N. Kare	19/11/2018
95	2572	Kharat Rajgauri Dadaso		
96	2573	Dhayagude Sangram H.		
97	2574	Bhosale Akshay Nandkumar		
98	2575	Shejul Ganesh Janardan	Miss. M.D. Atole	
99	2576	More Rajesh Ashok		
100	2577	Gaikwad Kishori Sunil		
101	2578	Bhagat Nikita Chandrakant		
102	2579	Khomane Akshay Nanaso	Miss. M.B. Chavan	
103	2580	Bhagat Rutuja Sandip		
104	2581	Salunke Rushikesh B		
105	2582	Suryawanshi Sonal N		
106	2583	Deshmukh Shivraj Shahaji	Miss. R.V. Pansare	
107	2584	Gaikwad Sayali Maruti		
108	2585	Chavan Shrikant Takdir		
109	5149	Harkal Dhiraj Ramnath		
110	5150	Sawant Rushikesh Balasaheb		
111	5151	Nadaf Aayesha Javed	Miss. S.B.Kanse	
112	5152	Kumawat Priyanka Tanaram		
113	5153	Shaha Pratiksha Ashish		
114	5154	Peshave Rachana Mukund		
115	5155	Gadekar Mrunal Manohar		
116	5156	Bhosale Varsha Rajendra	Miss. R.B.Chachar	
117	5157	Chavan Megha Mahadev		
118	5158	Malavade Darshan Dattatraya		
119	5159	Kadam Gauri Dattatray		
120	5160	Dhaygude Sheha Dattatray		

121	5161	Gaikwad Sweeti Santosh	Miss. V.V. Rajwade	
122	5162	Shelar Shubham C.		
123	5163	Holkar Vaibhav Maruti		
124	5164	Dalavi Gourav Hanumant		
125	5165	Karande Trupti Ramdas		
126	5166	Sonwalkar Vaishali Anil	Miss. T.R. Shendkar	
127	5167	Nimbalkar Mansi Ramchandra		
128	5168	Holkar Mukesh Prakash		
129	5169	Jagtap Sachin Ranjit		
130	5170	Jadhav Suhas Dadaso		

Adhe
coordinator

19/01/18
Principal





Notice

The Teacher assigned to Environmental Awareness are hereby informed that, **Environmental Awareness 2018-19** lectures will be starting from 10/01/2019 to 18/01/2019. Time table is attached behind the notice. All the teachers should take lectures on time and provide **multiple choice questions** on the syllabus allotted also compulsory take the attendance of your lectures.

Co-coordinator

09/01/19

Principal

Someshwar Science College , Someshwarnagar

ENVIRMENTAL AWARENESS 2016-2017 18-19

Time Table

Sr No	Date	Time	Name of the Staff	Topics Allocated	Sign
1	10/01/19	9.00 to 9.30	Miss. Bhong N. N.	Unit1(1.1-1.6)	
		2.0 to 2.30	Miss. Chachar R.B.	Unit 1(1.7-1.9)	
2	11/01/19	9.00 to 9.30	Miss. Kanse.S.B.	Unit 2 (2.1-2.4)	
3	12/ 01/19	9.00 to 9.30	Miss. Kare P. N.	Unit 3 (3.1 to 3.3)	
		3.10 to 3.40	Miss. Doiphode S.D.	Unit 3 (3.4 to 3.6)	
		3.40 to 4.10	Miss. Bhosale J. M.	Unit 4 (4.1 to 4.3)	
4	14/01/19	9.00 to 9.30	Mr. Holkar P. D.	Unit 6 (6.1 to 6.6)	
		2.0 to 2.30	Mr. Nikalje R. S.	Unit 4 (4.4 to 4.5)	
5	15/01/19	9.00 to 9.30	Miss. Sayyad I. Y.	Unit 5 (5.1 to 5.4)	
		11.10 to 11.55	Mr. Yadhav A.A.	Unit 5 (5.6 to 5.8)	
		2.0 to 2.30	Miss. Chavan P. K.	Unit 5 (5.5)	
6	16/01/19	9.00 to 9.30	Miss. Lakade A. D.	Unit 6 (6.7 to 6.9)	
		11.10 to 11.55	Mr. Khalate R.D.	Unit 5 (5.9)	
		2.0 to 2.30	Mr. Thopate V. D.	Unit 5 (5.10 to 5.14)	
7	17/01/19	9.00 to 9.30	Miss. Chavan M. B.	Unit5 (5.15 to 5.21)	
		11.10 to 11.55	Mr. Kadam V. H.	Unit 7 (7.1 to 7.4)	
		2.0 to 2.30	Miss. Desai P. R.	Unit 7 (7.5 to 7.8)	
8	18/01/19	11.10 to 11.55	Miss.Gaikwad S.N.	Unit 2 (2.5 to 2.7)	

Co-ordinator

09/01/19

Principal

Notice

(Environmental Awareness)

All the teachers informed that, they should submitte "**Environmental Awareness**", (2018-2019) project before 2/2/2019 ,towards co-ordinator Miss Raut P.N. The list of students and their guides is attached behind notice.

(Co-ordinator)

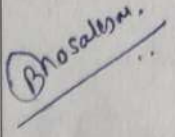
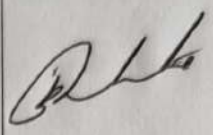
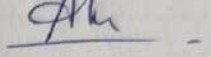
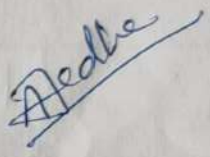
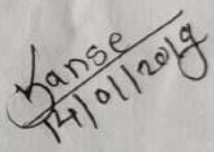
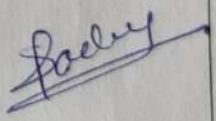
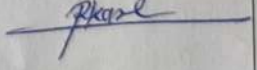
Principal

Shri someshwar shikshan prasarak mandal's

Someshwar Vidnyan Mahavidyalaya ,Someshwarnagar

Sub: Environmental Awareness Exam 2018-2019

Sr. No.		Name of Student	Project Guide	Signature
1	2001	Bhapkar Sayali Hitesh	Prof.Thopate V.D.	
2	2002	Dagade Utkarasha Sharad		
3	2006	Thopate Prathamesh Chandrakant		
4	2009	Ahirekar Prajakta Dhanaji		
5	2010	Pawar Srushti Shashikant		
6	2011	Nikam Rutuja Gorakh	Prof.Yadav A.A.	
7	2014	Choudhari Nilam Balaso		
8	2016	Dagade Harshad Pralhad		
9	2018	Jagtap Pranal Satish		
10	2022	Nigade Pallavi Sanjay		
11	2023	Karade Dhiraj Babaso	Prof.Shinde P.P.	
12	2024	Holkar Kaustubh Dananjay		
13	2026	Nigade Pranali Dhananjay		
14	2032	Rananaware Vinod Vitthal		
15	2033	Gejage Shrinath Sudhakar		
16	2036	Shinde Pratik Shivaji	Prof.Bhong N.N.	
17	2037	Rananaware Shubham Harishchandra		
18	2038	Chavan Prasad Dilip		
19	2039	Shinde Sourabh Dilip		
20	2040	Bandgar Sagar Bhauso		
21	2041	Thopate Manoj Balaso	Miss Chachar R.B.	
22	2042	Gawade Shahil Abaso		
23	2051	Nanaware Utkarsh Sanjay (Photo)		
24	2056	Rakshe Nirmala Rajendra (Photo)		
25	2069	Karande Prajakta Bharat		
26	2070	Tambe Prathmesh Kundlik	Miss Chavan M.B	
27	2071	Attar Jafar Harun		
28	2077	Dhumal Shital Mahadev		
29	2080	Pawar Gauri Mahadev		
30	2081	Jagtap Pooja Rajendra		
31	2082	Nigade Prajakta Anil	Shri .Nikalje R.S.	
32	2084	Wadkar Mohit Somnath		
33	2085	Shendkar Komal Nathuram		
34	2098	Kaule Anand Subhash		
35	2102	Raskar Aniket Shivaji		
36	2104	Holkar Manoj Shivaji	Shri Jagdale K.M.	
37	2106	Gaikwad Niranjan Anil		
38	2003	Pawar Harshita Kiran		
39	2004	Holkar Shubhangi Dadaso		

Sr. No.		Name of Student		
40	2005	Barkade Sayali Bhagawan		
41	2007	Shaikh Anisa Mahmadhasan	Miss Bhosale J.M	
42	2013	Holkar Supriya Santosh		
43	2015	Gaikwad Komal Dilip		
44	2025	Shingare Dipali Dilip		
45	2028	Dhumal Mayuri Jayant		
46	2031	Shinde Shital Dadaso	Shri.Khalate R.D.	
47	2034	Chavan Megha Dipak		
48	2035	Jagdale Rutuja Vilas		
49	2043	Jedhe Prerana Sandip		
50	2044	Kapare Priti Sanjay		
51	2045	Naik Kumodini Shahaji	Miss.Lakade A.D.	
52	2046	Bhapkar Prajakta Ananta		
53	2050	Shinde Shamal Sandip		
54	2054	Salunke Anuja Dattatray		
55	2057	Inamdar Rubina Hamid		
56	2058	Dhumal Shital Dilip	Miss Jedhe A.S.	
57	2059	Jagtap Harshada Chhotusaheb		
58	2060	Jagtap Komal Chandrakant		
59	2061	Nimbalkar Awanti Ravindra		
60	2062	Chavan Sanjeevani Sunil		
61	2063	Holkar Supriya Bhauso	Miss Kanse S.B	
62	2066	Mandhare Harshada Dashrath		
63	2068	Sankpal Kanchan Bhanudas		
64	2072	Kulkarni Mrunal Mukund		
65	2076	More Sonali Ramdas		
66	2078	Ghodake Pratiksha Dashrath	Miss Pawar S.B.	
67	2083	Jadhav Dipali Arvind		
68	2089	Chavan Pooja Phattesing		
69	2090	Thopate Charushila Kakaso		
70	2091	Hake Madhuri Abaso		
71	2093	Khomane Payal Appaso	Miss Ghadage S.S.	
72	2094	Mulik Rututa Jalindar		
73	2095	Jagtap Pratiksha Dasharath		
74	2097	Nigade Snehal Kundlikrao		
75	2099	Shinde Tejasvi Tanaji		
76	2100	Shinde Nikita Sunil	Miss Kare P.N.	
77	2101	Sakunde Gauri Rohidas		
78	2105	Bhujbal Komal Vijay		

Sr. No.		Name of Student		
79	2107	Korade Mayuri Balaso		
80	2109	Khomane Komal Dnyandeo		
81	2017	Jagtap Nikhil Balaso (Photo)	Miss Shedage B.D.	
82	2019	Pawar Tejes Sanjay		
83	2020	Mulik pooja Surykant		
84	2021	Mulik Aishwarya Ashok		
85	2027	Thopate Tejasvi Dattatray (Photo)		
86	2029	Ghodake Aishwarya Bharat (Photo)	Miss Takwale S.N.	
87	2030	Bhandalkar Varsha Dhansing (Photo)		
88	2049	Bhosale Abhijeet Sunil (Photo)		
89	2064	Rajpurohit Manisha Ratansing		
90	2065	RajPurohit Priyanka Ratansing		
91	2067	Shinde Dhanashree Surshng	Miss Sayyad I.Y.	
92	2073	Shendkar Yogita Shiledar		
93	2074	Lakade Sayali Sanjay		
94	2075	Gaikwad Abhishek Gautam		
95	2079	Jagtap Pooja Vikas		
96	2086	Sawant Ruchita Satish		
97	2087	Gore Megha Arun	Shri.YadavN.J.	
98	2088	Chavan Sampada Sanjay		
99	2092	Korade Manisha Ramchandra		
100	2096	Gophne Bapu KaKa		
101	2103	Madane Hemlata Nanaso	Miss Desai P.D.	
102	2008	Holkar Arti Bapu		
103	2012	Bhosale Kunal Rajaram (Photo)		
104	2047	Hume Sangram Satish (Photo)	Miss Gaikwad S.N.	
105	2048	Katkar Siddharth Ravindra (Photo)		
106	2052	Nanaware Dhiraj Sunil		
107	2053	Kadam Akash Hanumant		
108	2055	Gaikwad Pratik Nitin		
109	2108	Wabale Puja Dilip	Shri.Holkar P.D.	
110	2110	Salunke Chaitali Dnyaneshwar		
111	5201	Jagdale Vaishnavi Satish (New Admi)		
112	5202	Doiphode Akshay Rajendra		
113	5203	Ghate Tanaya Anant		
114	5204	Gadekar Prajakta Hanumant	Shri.Pingale S.G.	
115	5205	Jagtap Pratibha Ramesh		
116	5206	Gaikwad Renuka Balasaheb		
117	5207	Mulik Hema Harishchandra		

12/11/19

Sr. No.		Name of Student		
118	5208	Shinde Varsha Vishwas		
119	5209	Bhandalkar Sonali Balaso		
120	5210	Chavan Shweta Dharmaraj	Prof.Yadav M.D.	
121	5211	Jadhav Vasundhara Vikas (New Admi)		
122	5212	Salunke Kirti Ramesh		
123	5213	Thopate Shubhangi Tulashiram		
124	5214	Khamkar Pratik Suresh	Miss Chavan P.K.	
125	5215	Gaikwad Priyanka Govind		
126	5216	Jadgtap Nikita Bhagwan		
127	5217	Suryawanshi Prajakta Dilip		
128	5218	Shinde Vrushali Sanjay	1-pending	
129	5219	Gaikwad Mayuri Chandrkant		

12/01/19

प्राचार्य

सोमेश्वर विज्ञान महाविद्यालय,सोमेश्वरनगर

Shree Someshwar Shikshan Prasarak Mandals

Someshwar Vidnyan Mahavidyalaya, Someshwarnagar

ATTENDANCE SHEET 2018-2019

Subject: Environmental Science

Sr.NO	Roll No	Name of the student	10-1-19 Bhangsir	10-1- Chachar Mam	11-1- Kamse mam	12-1- Kampe mam	12-1-19 Doiphode mam	12-1-19 Bhosale mam	15-1-19 Holkar P.D	15-1-19 Nikam J.e	16-1-19 Lekhale A.D
1.]	2072	Kulkarni Mrunal M.	MMK.	MMK.	MMK.	MMK.	MMK.	MMK.	MMK.	MMK.	MMK.
2.	2044	Kapare Priti S.	Kapare	Kapare	Kapare	Kapare	Kapare	Kapare	Kapare	Kapare	Kapare
3.	2007	Shaikh Anisa M.	AShaikh	AShaikh	AShaikh	AShaikh	AShaikh	AShaikh	AShaikh	AShaikh	AShaikh
4.	2013	Holkar Supriya S.	Holkar	Holkar		Holkar		Holkar	Holkar	Holkar	Holkar
5.	2043	Jedhe preranas.	Jedhe	Jedhe	Jedhe	Jedhe	Jedhe	Jedhe	Jedhe	Jedhe	Jedhe
6.	2097	Nigade snehal	Nigade	Nigade	Nigade	Nigade	Nigade	Nigade	Nigade	Nigade	Nigade
7	2005	Barkade sayali B.	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade	S.B.Barkade
8	2109	Khomane komal D	Komal	Komal	Komal	Komal	Komal	Komal	Komal	Komal	Komal
9	2050	shinde shamal.s			Shamal	Shamal	Shamal	Shamal	Shamal	Shamal	Shamal
10	2066	Mandhare Harshada D.	H.D.M	H.D.M	H.D.M	H.D.M	H.D.M	H.D.M	H.D.M	H.D.M	H.D.M
11	2100	shinde Nikita.s	shinde	shinde	shinde	shinde	shinde	shinde	shinde	shinde	shinde
12	2068	Sankpal kanchan B.	Sankpal	Sankpal	Sankpal	Sankpal	Sankpal	Sankpal	Sankpal	Sankpal	Sankpal
13.	2054	Salunke Anuja.D	Salunke	Salunke	Salunke	Salunke	Salunke	Salunke	Salunke	Salunke	Salunke
14.	2015	Gaikwad komal.D	Komal	Komal	Komal	Komal	Komal	Komal	Komal	Komal	Komal
15.	2045	Naik Kumodini.S	PSNaik	PSNaik	PSNaik	PSNaik	PSNaik	PSNaik	PSNaik	PSNaik	PSNaik
16.	2009	Pawar Harshita K.	HKPawar	HKPawar	HKPawar	HKPawar	HKPawar	HKPawar	HKPawar	HKPawar	HKPawar
17.	2090	Thopate charushila K	Topate		Topate	Topate	Topate	Topate		Topate	
18	2089	chavan pooja P	poojac	poojac	poojac	poojac	poojac	poojac			
19	2004.	Holkar shubhangi	[illegible]	SHolkar	SHolkar	SHolkar	SHolkar	SHolkar	SHolkar	SHolkar	SHolkar
20	2095	Jagtap Pratiksha D	Jagtap	Jagtap	Jagtap	Jagtap	Jagtap	Jagtap			Jagtap
21	2025	shingare Deepali i		Shingare	Shingare	Shingare	Shingare	Shingare	Shingare	Shingare	
22	2028	Dhumal Mayuri S	DM	DM	DM	DM	DM	DM	DM	DM	
23	2062	chavan Sanjeevani	chavan	chavan			chavan	chavan	chavan	chavan	
24	2059	Jagtap Harshada	HJagtap	HJagtap			HJagtap	HJagtap	HJagtap	HJagtap	
25	2061	Nimbalkar Awanti	ANimbalkar	ANimbalkar			ANimbalkar	ANimbalkar	ANimbalkar	ANimbalkar	
26	2031	shinde shital	Shinde	Shinde			Shinde	Shinde	Shinde	Shinde	

Shree Someshwar Shikshan Prasarak Mandals

Someshwar Vidnyan Mahavidyalaya, Someshwarnagar

ATTENDANCE SHEET 2018-2019

Subject: Environmental Science

Sr.NO	Roll No	Name of the student	10-1-19	10-1-19	11-1-19	12-1-19	12-1-19	12-1-19	15-1-19	15-1-19	16-1-19
27	2107	Korade Mayuri B.	P	P			P	P	P	P	
28	2091	Hake Madhuri Abasaheb	P	P			P	P	P	P	
29	2063	Holke Supriya B.	P	P	P	P	P	P	P	P	
30	2101	Jakunde Gauri	P	P	P	P	P	P	P	P	P
31	2078	Ghodake Pratiksha	P	P	P	P	P	P	P	P	P
32	2076	More Sonali	P		P	P	P	P	P	P	P
33	2035	Jagdale Rutuja	P	P	P	P	P	P	P	P	P
34	2034	Chavan Megha	P	P	P	P	P	P	P	P	P
35	2105	Bhujbal Komal	P	P	P	P	P	P	P	P	P
36	2058	Dhumal Shital	P	P			P	P	P	P	
37	2060	Jagtap Komal	P	P			P	P	P	P	
38	2052	Nanaware Dhiraj	P	P	P	P	P	P	P	P	P
39	2049	Bhorale Abhijeet	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale	A.S.Bhosale
40	2019	Pawar Tejas S.	P	P	P	P	P	P	P	P	P
41	2048	Kalkar S.R	P	P	P	P	P	P	P	P	
42	2053	Kadam A. H	P	P		P	P	P	P	P	P
43	2055	Gaikwad P.N		Gaikwad	Gaikwad	Gaikwad	Gaikwad	Gaikwad	Gaikwad	Gaikwad	Gaikwad
44	2012	Bhosale K.R	P	P	P	P	P	P	P	P	P
45	2014	Jagtap N.B.	P	P	P	P	P	P	P	P	P
46	2108	Kakade P.D.	P	P	P	P	P	P		P	P
47	2020	Mulik Pooja.S		P	P	P	P	P	P	P	P
48	2088	Chavan S.S		P	P		P	P		P	
49.	2087	Gore Megha Arun		P			P	P	P	P	
50.	2067	Shinde Dhanashri		P		P	P	P	P	P	
51.	2073	Shendkar Yogita		P	P	P	P	P	P	P	P
52.	2074	Lakade Sayali		P	P	P	P	P	P	P	P

Date:-13/02/2020

Notice

All Staff of S.Y. B.Sc & S.Y.B.Sc. (Comp.Sci) are hereby informed that, their ***Environmental Awareness, 2019-20*** lectures will starts from **17 Feb. To 26 Feb. 2020** .Time table of lectures is given below . Submit multiple choice questions and long answer questions related to the topic to the coordinator of Evs and give the same questions to the students.

13/02/2020

Coordinator (EVS)

Principal

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness, 2019-20

Time Table

Sr.No.	Date	Time	Unit	Name of Staff
1	17/02/2020	8.30 am-9.00am	Unit 1(1.7 to 1.9)	Miss. Chachar R.B.
		10.35 am-11.20 am	Unit 1(1.1to 1.6)	Mr.Bhong N.N.
		1.30 pm-2.00 pm	Unit 2(2.1to 2.4)	Miss.Pandit R.A.
2	18/02/2020	8.30 am-9.00am	Unit 2(2.5 to 2.7)	Mr. Attar K.C.
		1.30 pm-2.00 pm	Unit 3(3.1 to 3.3)	Miss.Kare P.N.
3	20/02/2020	8.30 am-9.00am	Unit 3 (3.4 to 3.6)	Miss.Doiphode S.D.
		10.35 am-11.20 am	Unit 4(4.1 to 4.3)	Miss .Bhosale J.M.
		1.30 pm-2.00 pm	Unit 4(4.4 to 4.5)	Mr. Nikalje R.S.
4	22/02/2020	8.30 am-9.00am	Unit 5(5.1 to 5.4)	Miss.Adsul P.S.
		1.30 pm-2.00 pm	Unit 5(5.9)	Miss.Jagtap R.S.
5	24/02/2020	8.30 am-9.00am	Unit 5(5.6 to 5.8)	Mr. Yadav N.J.
		10.35 am-11.20 am	Unit 5(5.5)	Mr.Devmalkar V.S.
		1.30 pm-2.00 pm	Unit 5(5.10 to 5.14)	Mr.Thopate V.D
6	25/02/2020	8.30 am-9.00am	Unit 5(5.15 to 5.21)	Miss. Chavan M.B.
		1.30 pm-2.00 pm	Unit 6(6.1to 6.6)	Mr. Holkar P.D
7	26/02/2020	8.30 am-9.00am	Unit 6(6.7 to 6.9)	Miss.Dhumal K.R.
		10.35 am-11.20 am	Unit 7(7.1 to 7.4)	Mr. Phalke D.B.
		1.30 pm-2.00 pm	Unit 7(7.5 to 7.8)	Miss. Desai P.R.

[**NOTE:-** After 2:00 pm onward the practical's should be conduct as per schedule]

Patel.

Co-ordinator (EVS)

14/02/2020

Principal

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness, 2019-20

Project

Sr. No.	Roll. No	Name of student	Guide	Submit Sign
1	2001	TODKAR ASHWINI HANUMANT	Mr. Nikalje R.S.	
2	2002	MOHITE VAISHNAVI VISHNU		
3	2003	BHANDALKAR SUNITA DATTATRAY		
4	2004	SHINDE APURVA VIKRAM		
5	2005	JAGATAP VARSHA SATISH		
6	2006	DESHMUKH AMRUTA YUVRAJ	Miss. Kare P.N.	
7	2007	PAWAR ASHWINI SANJAY		
8	2008	KOKARE ANIKET SHIVAJI		
9	2009	KOKARE PRASAD DNYANDEV		
10	2011	MUJAWAR NABIR SIKANDAR		
11	2012	SALVE RACHANA YUVRAJ	Miss. Desai P.R.	
12	2013	KHALATE SHUBHAM VITTHAL		
13	2014	GAIKWAD AKSHAY DADA		
14	2015	PINGALE TEJAS RAMDAS		
15	2016	LOKHANDE RUPESH ANIL		
16	2017	PHARANDE SHITAL ASHOK	Mr.Devmalkar V.S.	
17	2018	MANE MAYUR PRAVIN		
18	2019	KHILARE RUTUJA CHANDRAKANT		
19	2020	SALUNKE KIRTI BALASAHEB		
20	2021	TAMBE RUTUJA KHASHABA		
21	2022	JUNNARKAR SHIVANI UMESH	Mr.Thopate V.D	
22	2023	GAIKWAD DHANASHREE LAXMAN		
23	2024	BHAGAT SNEHA SURYAKANT		
24	2025	MALSHIKARE NIKHIL JALINDAR		
25	2026	BHANDALKAR SURAJ BHIMRAO		
26	2027	DEVKAR DIPTEE BALASO	Miss Chavan M. B.	
27	2028	PAWAR POOJA NITIN		
28	2029	PISAL SHIVANI SHRIKANT		
29	2030	MANE UTKARSH ANIL		
30	2031	SURYAWANSHI DIVYA SAMBHAJI		
31	2032	SHINDE DIPALI SUNIL	Mr Holkar P. D.	
32	2033	HIRAVE RUTUJA DILIP		
33	2034	GOPHANE SATYAJIT LAXAMANRAO		

34	2035	ATPADKAR PRAJAKTA BALU	Mr Holkar P. D.	
35	2036	MOTE GOURI BALASAHEB		
36	2037	PHARANDE RUTIK SATISH	Mr.Bhong N.N.	
37	2038	DHUMAL PRAGATI LAXMAN		
38	2039	SHEWALE SANGRAM RAMCHANDRA		
39	2040	JADHAV POOJA SANJAY		
40	2041	NIMBALKAR PRATIK MAHADEV		
41	2042	THOPATE PAYAL MARUTI	Miss.Pandit R.A.	
42	2043	PHADTARE AKASH BALASO		
43	2044	SHINDE SHITAL DATTATRAYA		
44	2045	KHANDAGALE ANKITA MAHENDRA		
45	2046	RASKAR ANJALI GULAB		
46	2047	KARE UJWALA SANJAY	Miss.Dhumal K.R.	
47	2048	GARDI SHUBHAM SURESH		
48	2049	GAWADE KIRAN PANDURANG		
49	2050	GARDI AKSHAY RAVINDRA		
50	2052	MOTE MANISHA MAHADEV		
51	2053	GADHAVE VRUSHALI DIPAK	Miss.Doiphode S.D.	
52	2054	DAGADE KALYANI ANIL		
53	2055	RANANAWARE DINESH MADHUKAR		
54	2056	BHOITE AKASH BAPURAO		
55	2057	SALUNKHE KIRTI SANDIP		
56	2058	SONAWANE MANISH BALASO	Miss .Bhosale J.M.	
57	2059	GORGAL MINAKSHI MAHADEV		
58	2060	TAWARE KAILAS SATISH		
59	2061	SHINDE RUSHIKESH YASHWANT		
60	2062	MALSHIKARE APEKSHA SANJAY		
61	2063	GHADGE SARANG DHANYAKUMAR	Mr. Yadav N.J.	
62	2064	NIGADE POOJA DATTATRAY		
63	2065	SHINDE KUNAL KANTILAL		
64	2066	SHINDE MAYUR RAJENDRA		
65	2067	SHIVTARE MAYUR BHAGWAN		
66	2069	TODKAR SHIVANI HANUMANT	Miss. Raut P.N	
67	2070	JAGTAP BHAGYASHRI RAMDAS		
68	2071	BHANDWALKAR RUTUJA ANANT		
69	2072	SANKPAL SAYALI SATISH		
70	2073	JADHAV SWEETY APPASAHEB		
71	2074	BHOSALE RUTUJA GOPICHAND	Mr. Attar K.C.	

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Notice

(Environmental Awareness)

All the staff of S.Y.B.Sc and S.Y.B.Sc (Comp. Sci.) informed that **"Environmental Awareness"** lecture will be conducted from 4th March to 9th March on Thursday to Tuesday at 10.00 am to 12.00 pm.

(Co-ordinator)

Principal

Someshwar Science College,Someshwarnagar

Someshwar Science College COLLEGE CODE 827

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness, 2020-21

Time Table

Sr.No.	Date	Time	Unit	Name of Staff
1	4/03/2021	10.00am-10.40am	Unit:1 (Multidisciplinary nature of Environmental Studies)	Miss. Chachar R.B.
		10.40am-11.20pm	Unit 1(Scope And Importance; Concept of sustainable development)	Mr. Bhong N.N.
		11.20 pm-12.00pm	Unit 2(Ecosystem -Concept , Structure and function)	Miss. Pandit R.A.
2	5/03/2021	10.00am-10.40am	Unit 2(Case studies of following ecosystem-Forest ecosystem, Grassland ecosystem)	Mr. Attar K.C.
		10.40am-11.20pm	Unit 2(Case studies of following ecosystem-Desert ecosystem, Aquatic ecosystem)	Miss. Kare P.N.
		11.20 pm-12.00pm	Unit3(Natural Resources –Land resources ;land degradation ,soil erosion & desertification)	Miss .Bhosale J.M.
3	6/03/2021	10.00am-10.40am	Unit 3 (Natural Resources – Deforestation ;Causes and impact due to mining dam building on environment, forests, biodiversity and tribal populations)	Mr. Nikalje R.S.
		10.40am-11.20pm	Unit 3 (Natural Resources – Water : Use and over – exploitation of surface and ground water ,floods, droughts conflicts over water international & interstate).	Miss. Adsul P.S.
		11.20 pm-12.00pm	Unit 3 Natural Resources (Energy resources: Renewable and non - renewable energy resources, use of alternate energy sources, growing energy need, case studies.)	Mr. Phalke D.B.
4	8/03/2021	10.00am-10.40am	Unit 4 Biodiversity & Conservation (Levels of biological diversity : genetic species and ecosystem diversity; Biogeographic zones of India; biodiversity patterns & global biodiversity hot spots)	Mrs. Thamane A.B
		10.40am-11.20pm	Unit 4 Biodiversity & Conservation (India as mega- Biodiversity nation; Endangered and endemic species of India)	Mr. Yadav N.J.
		11.20 pm-12.00pm	Unit 4 Biodiversity & Conservation (Threats to Biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity)	Miss. Raut P.N.
5	9/03/2021	10.00am-11.00 am	Unit 4 Biodiversity & Conservation (Ecosystem & Biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value).	Mr. Devmalkar V.S.

NOTE:- After Evs. Lecture, remaining lectures should be conducted as per time table. After Conducting Evs. Lecture every staff must be submit student attendance and 10 mcqs related to the given topic to the co-coordinator.

Patel

Co-ordinator (EVS)

03/03/2021

Principal

Principal

Savitribai Phule Pune University

Examination Session 2020

Marks Inward System for Colleges

2104050201483

4/5/2021

College Name	CAAP012890 - SOMESHWAR SCIENCE COLLEGE,BARAMATI		
Pattern Name	11719 - B.Sc.(REGULAR) 2019 Credit Pattern	**Batch No**	202010031322
Subject Name	23361 - AECC-I ENVIRONMENTAL AWARENESS	**Exam Type**	INTERNAL OUT OF 15
Teacher Name	More Pratiksha Kishor (Mob. No.: 8805521098) - Internal Examiner		

Total Students	Present Students	Absent Students	Not Applicable	CopyCase	Detained
86	86	0	0	0	0

Seat No	Marks/Grade	Seat No	Marks/Grade	Seat No	Marks/Grade	Seat No	Marks/Grade
63983	10	64008	9	64033	7	64058	7
63984	7	64009	14	64034	7	64059	10
63985	7	64010	12	64035	11	64060	11
63986	9	64011	13	64036	8	64061	7
63987	12	64012	10	64037	10	64062	10
63988	11	64013	11	64038	13	64063	10
63989	10	64014	7	64039	13	64064	9
63990	13	64015	11	64040	10	64065	7
63991	7	64016	13	64041	12	64066	12
63992	10	64017	12	64042	12	64067	12
63993	9	64018	13	64043	11	64068	12
63994	12	64019	13	64044	8		
63995	10	64020	11	64045	7		
63996	9	64021	12	64046	13		
63997	7	64022	12	64047	12		
63998	7	64023	10	64048	12		
63999	12	64024	8	64049	10		
64000	13	64025	11	64050	12		
64001	14	64026	9	64051	10		
64002	10	64027	11	64052	11		
64003	7	64028	13	64053	11		
64004	8	64029	12	64054	11		
64005	11	64030	7	64055	11		
64006	10	64031	10	64056	7		
64007	10	64032	12	64057	13		

Patil

(More P.K.)

08/04/2021

Principal

Someshwar Science College,Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College,

Someshwarnagar

Environmental Awareness cell

2020-21

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College

Environmental Awareness cell 2020-21

Sr.no.	Name of person	Designation	Mobile no.	Signature
1	Prof . D.V. Bansode	Principal	8605546297	
2	Mrs. P.K. More	Co-ordinator	8805521098	
3	Asst.Prof.N.N.Bhong	Member	9561334010	
4	Mr. R.S. Nikalje	Member	8999392530	
5	Miss. J.M. Bhosale	Member	9689525302	
6	Miss. R.A. Pandit	Member	8796945991	
7	Mr. K.G. Salunke	Member	9665506722	
8	Miss. P. P .Holkar	Student representative	9309985828	
9	Mr. S.V. Shinde	Student representative	9352189485	
10	Mr.S. J. Jagadale	Non-Teaching	9730586352	

Co-ordinator

Principal
Someshwar Science College,Someshwarnagar

Someshwar Science College
COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Objectives

- To sensitize the student teachers about the problems of pollution.
- To inculcate the sense of responsibility towards the development of planet Earth and appreciation of its beauty.
- To providing opportunities to acquire knowledge, skills, attitude, commitment to preserve the environment.
- To make them understand the interdependence of economic, social and ecological factors.
- To train the student teachers to impart environmental education to college students through curricular and co-curricular activities.

Patel.
(Co-ordinator)

Principal
Someshwar Science College, Someshwarnagar

Someshwar Science College
COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Notice

(Environmental Awareness)

All the students of S.Y.B.Sc and S.Y.B.Sc (Comp. Sci.) informed that **"Environmental Awareness"** lecture will be starting from 6th May 2022, according to the given time table.

Patel

(Co-ordinator)

(More. P. K.)

05/05/2022

Principal

Someshwar Science College, Someshwarnagar

Someshwar Science College COLLEGE CODE 827

Principal

Someshwar Science College, Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness, 2021-22

Time Table (Sem - II)

Date	Time	Unit	Name of Staff	Sign
6/05/2022 Friday	12.50pm-1.20 pm	Unit 5 Environmental Pollution:-Types, Causes, Effect & Controls(Air & Water Pollution)	Miss. Kambale S.B	05/05/22
7/05/2022 Saturday	10.00am-10.30am	Unit 5 Environmental Pollution:-Types, Causes, Effect & Controls(Soil & Noise Pollution)	Miss. Kadam .P. G.	
	10.30 am-11.00am	Unit 5 Nuclear Hazards & Human health Risks,	Miss. Adsul P.S.	
	11.00 pm-11.30pm	Unit 5 Solid waste management : control measures of urban & industrial waste	Miss. Chavan M.B.	
	11.30pm- 12.00 pm	Unit 6 Environmental Policies & Practices: Climate change, global warming, ozone layer depletion, acid rain & impact on human communities & agriculture.	Miss. Pawar S.B.	
13/05/2022 Friday	12.50pm-1.20 pm	Unit 6 Environmental Policies & Practices: Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act, Water(Prevention & Control of Pollution) Act.	Miss. Gaikwad M.R.	
14/05/2022 Saturday	10.00am-10.30am	Unit 6 Environmental Policies & Practices: Environment Laws: Wildlife Protection Act; Forest Conservation Act, International agreement: Montreal & Kyoto protocols & conservation on Biological Diversity(CBD)	Mr. Holkar P. D.	
	10.30 am-11.00am	Unit 6 Environmental Policies & Practices: Nature reserves, tribal populations &right, & human wildlife conflicts in India context	Mr. Thopate V.D.	
	11.00 am-11.30am	Unit 7 Human communities & the Environment: i) Human population growth: Impacts on environment, human health & welfare ii) Resettlement & rehabilitation of project affected persons; case studies.	Miss. Jagtap R.S.	
	11.30 pm-12.00pm	Unit 7 Human communities & the Environment: i) Disaster Management:- Floods, Earthquake, Cyclones & Landslides.ii) Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. iii) Environmental ethics: Role of Indian other religions & cultures in environmental conservation.	Mrs. Bhandwalkar M.S.	

Co-ordinator (EVS)
(More. P.K.)

05/05/22
Principal
Someshwar Science College,Someshwarnagar

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College,Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness Attendance 21-22 Sem-II

S.Y.BSc

Sr.No	Roll No.	Name Of Student	6/5	7/5	7/5	7/5	7/5	13/5	14/5	14/5	14/5	14/5	TOTAL
1	2001	SALUNKHE GAURAV KISAN	E	P	P	Ab	Ab	E	Ab	P	P	Ab	06
2	2002	MORE SAKSHI SATISH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
3	2003	TAMBE KISHOR MAHADEV	Kishor	P	P	P	P	Ab	Ab	Ab	P	P	07
4	2004	TILEKAR PRIYANKA TATYABA	Ab	P	P	P	P	Ab	P	P	P	P	08
5	2005	MANDHARE AVISHKAR SANJAY	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
6	2006	BHOITE GANESH NANDKUMAR	G.N.Bhoite	Ab	P	P	P	Ab	P	P	P	P	08
7	2007	SHINDE AKANKSHA SUNIL	Shinde	Ab	Ab	P	Ab	Ab	P	P	P	P	06
8	2008	GAIKWAD TEJASWINI SANTAJI	Ab	Ab	Ab	Ab	Ab	T.S.Gaikwad	P	P	Ab	Ab	03
9	2009	KHARADE PRAGATI POPAT	Ab	P	P	P	Ab	Ab	Ab	Ab	Ab	Ab	03
10	2010	JADHAV RUTURAJ HEMANT	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
11	2011	JAGTAP PRADNYA VISHNU	Ab	Ab	Ab	Ab	Ab	Ab	Ab	P	Ab	Ab	01
12	2012	JAGDALE RUTIK DADASO	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
13	2013	BHAPKAR APURVA HITESH	A.Bhapkar	P	P	P	Ab	Ab	P	P	P	P	08
14	2014	NIGADE NIKITA DATTATRAYA	Nigade	P	P	Ab	Ab	Nigade	Ab	Ab	Ab	P	05
15	2015	THOPATE ABHIJEET ANIL	Thopate	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
16	2016	SURYAWANSHI DISHA MARUTI	Suryawanshi	P	P	P	Ab	Ab	P	P	Ab	Ab	06
17	2017	AMRALE SANJANA SHANKAR	Amrale	P	P	P	P	Amrale	P	P	Ab	P	08
18	2018	SHINDE VRUSHALI NANASO	V.N.Shinde	Ab	Ab	Ab	P	V.N.Shinde	P	P	P	P	07
19	2019	MADANE BHUSHAN NILESH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
20	2020	YADAV ADITYA NANDKUMAR	A.N.Yadav	Ab	P	P	Ab	A.N.Yadav	Ab	Ab	Ab	Ab	04
21	2021	SALVE SANJANA YUVRAJ	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
22	2022	NAYKUDE VAISHNAVI SANTOSH	V.N.Naykude	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
23	2023	YADAV POURNIMA RAJENDRA	R.Yadav	P	P	Ab	Ab	R.Yadav	P	P	P	P	08
24	2024	GAIKWAD SHITAL BALASO	S.B.Gaikwad	P	P	Ab	P	Ab	Ab	Ab	P	P	06
25	2025	SORATE SHUBHANGI MAULI	Sorate	P	P	P	P	Ab	Ab	Ab	Ab	Ab	05
26	2026	SHINDE PRIYANKA BHANUDAS	Ab	P	Ab	P	Ab	P.Shinde	P	P	P	P	06
27	2027	VIRKAR VAISHNAVI NANDKUMAR	Ab	P	P	Ab	Ab	Vaishnavi	P	Ab	Ab	Ab	04
28	2028	BHARGUDE ISHWARI PRAKASH	I.P.Bhargude	Ab	P	Ab	P	Ab	P	P	P	P	07
29	2029	SUL PAYAL MOHAN	P.M.Sul	P	P	Ab	Ab	Ab	Ab	Ab	P	P	05
30	2030	KALBHOR ANJALI SANTOSH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
31	2031	SALUNKHE MANASI SANDIP	Ab	P	P	P	P	Ab	Ab	P	Ab	Ab	05

Someshwar Science College COLLEGE CODE

			6/5	7/5	7/5	7/5	7/5	13/5	14/5	14/5	14/5	14/5	Total
32	2032	GAIKWAD SHREYASI SUDAM	Ab	Ab	P	Ab	P	Ab	Ab	Ab	Ab	Ab	02
33	2033	BACHKAR PU[illegible]M SHANTARAM	Ab	Ab	Ab	Ab	Ab	P.S.B	P	P	P	P	05
34	2034	SASTE SHIVAM RAMESH	Ab	Ab	Ab	Ab	Ab	Saste	Ab	Ab	Ab	P	02
35	2035	GAIKWAD SOHAM MAHENDRA	Ab	Ab	P	Ab	Ab	Gaikwad	Ab	P	Ab	Ab	03
36	2036	BANKAR GAURAV SHASHIKANT	Ab	Ab	Ab	Ab	Ab	[illegible]	Ab	P	Ab	P	03
37	2037	JAGTAP VISHIVJEET YUVRAJ	Jagtap	Ab	Ab	Ab	Ab	Jagtap	P	P	Ab	P	05
38	2038	JAGTAP MONIKA SUDAM	[illegible]	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
39	2039	GOPHANE ANIKET RAMCHANDRA	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
40	2040	SALUNKE TEJAS VILAS	Salve	Ab	P	P	P	Salve	Ab	P	Ab	P	07
41	2041	JAGTAP ABHIJIT SUBHASH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
42	2042	KAZI RIHAN JAFAR	Rihan	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
43	2043	SHENDKAR SAKSHI SHIVAJI	Sakshi	Ab	Ab	Ab	Ab	Sakshi	Ab	Ab	Ab	Ab	02
44	2044	SHENDKAR AKANKSHA GORAKH	Shendkar	Ab	P	P	P	Shendkar	P	P	P	P	09
45	2045	KHARADE NEHA UJJWAL	Kharade	P	P	P	P	Ab	P	P	P	P	09
46	2046	KHARADE NIKITA UJJWAL	Kharade	P	P	P	P	Ab	P	P	P	P	09
47	2047	KHARAT RUTUJA SATISH	Bharat	P	P	Ab	Ab	Bharat	Ab	P	P	Ab	06
48	2048	MALSHIKARE SANIKA SANDEEP	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
49	2049	MALSHIKARE SHRAVANI SATISH	Ab	P	P	P	P	Ab	P	P	Ab	Ab	06
50	2050	GHADAGE DARSHAN HANUMANT	[illegible]	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
51	2051	DHURVE ROHINI MALHARI	Ab	Ab	P	P	P	Rohini	P	Ab	Ab	P	06
52	2052	GAIKWAD ADITYA DHANAJI	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
53	2053	THOPATE SHWETA SANJAY	Thopate	Ab	Ab	Ab	Ab	Thopate	P	P	P	P	06
54	2054	ATOLE SHUBHAM PANDURANG	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
55	2055	KARE SAGAR BAPURAO	[illegible]	P	P	P	P	[illegible]	Ab	Ab	P	Ab	07
56	2056	LAKADE OMKAR SANJAY	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
57	2057	SHAIKH RAFIK RAJU	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
58	2058	PAWAR HARSHAL MACHHINDRA	[illegible]	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	01
59	2059	BHAPKAR PRACHI VIJAY	Bhapkar	P	P	P	Ab	Ab	P	P	P	P	08
60	2060	SURVE AAKASH SURESH	[illegible]	Ab	Ab	Ab	Ab	Ab	Ab	Ab	P	Ab	02
61	2061	THORAT KOMAL	Thorat	Ab	Ab	Ab	Ab	Thorat	Ab	P	P	P	05
62	2062	LAKADE LALITA	Lakade	Ab	Ab	P	Ab	Ab	Ab	Ab	Ab	Ab	02
63	2063	BHANDALKAR NANDINI	[illegible]	P	P	Ab	Ab	[illegible]	Ab	P	P	P	07
64	2064	BHOSALE DIPTI TANAJI	Ab	P	P	P	P	Ab	P	P	P	P	08
65	2065	HAKE MONESH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
66	2066	JAGADALE SHUBHAM	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College, Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Science College, Someshwarnagar

Environmental Awareness Attendance 21-22 Sem-II

S.Y.BSc(Computer Sci.)

Sr.No	Roll No.	Name Of Student	6/5	7/5	7/5	7/5	7/5	13/5	14/5	14/5	14/5	14/5	TOTAL
1	7001	ADSUL ARPITA GANESH		Ab	Ab	Ab	Ab		Ab	Ab	Ab	Ab	02
2	7002	PINGALE VAIBHAV ASHOK		Ab	P	P	P		P	P	Ab	P	08
3	7003	JAGTAP MANASI RAJENDRAKUMAR		P	P	P	P		P	P	P	Ab	09
4	7004	PHADATARE ASAWARI ASHOK	Ab	P	P	Ab	P		P	Ab	P	P	07
5	7005	MANDKE ATHARV PRADIP		P	P	Ab	P		P	P	P	P	09
6	7006	KOLATE NEHA DATTATRAYA		P	P	P	P		P	P	P	P	10
7	7007	SHINDE ABHISHEK ANKUSH	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
8	7008	SAHIL BHAIRU PADALKAR	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
9	7009	GHADGE PRAGATI BHIMRAO		Ab	Ab	Ab	P	Ab	P	P	P	P	06
10	7010	GADHAVE SAKSHI ANIL		P	P	Ab	P	Ab	P	Ab	P	P	07
11	7011	JADHAV RIYA TANAJI		Ab	Ab	P	P		P	Ab	P	Ab	06
12	7012	KUMBHAR KALYANI BHARAT		P	P	Ab	P		P	P	P	P	09
13	7013	SALUNKHE DIPTI JAYAVANT	Ab	P	Ab	P	P		P	P	P	P	08
14	7014	KONDE YOGINI RAVINDRA		P	P	P	P		P	P	P	P	10
15	7015	KHENGARE TEJAS H.		P	P	Ab	P		P	P	P	Ab	08
16	7016	BHOJ KAVERI GANESH		P	P	P	P		P	P	P	P	10
17	7017	SURYAWANSHI PRATIKSHA G.		P	P	P	P		P	P	P	P	10
18	7018	SHAIKH SAHIL MAHAMMAD		P	P	P	Ab		P	Ab	P	Ab	07
19	7019	KHALATE ATISH SANTOSH		P	P	Ab	P		P	P	P	Ab	08
20	7020	WABALE OMKAR MAHESH		P	P	P	P		P	P	P	Ab	08
21	7021	DHANGEKAR SHUBHAM SURESH	Ab	Ab	Ab	P	Ab	Ab	Ab	P	P	Ab	03
22	7022	SAWANT SHRUNGALI SOMNATH		P	P	Ab	P		P	Ab	P	Ab	07
23	7023	VIR ABHIMANYU HRIDAYANATH		P	P	Ab	Ab	Ab	P	P	P	Ab	06
24	7024	CHAVAN ROHAN RAJU		P	P	P	Ab	Ab	P	P	P	P	08
25	7025	JAGTAP SAKSHI SANJAYRAO		P	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	02
26	7026	MANE PRIYANKA		P	P	P	P	Ab	P	P	P	P	09
27	7027	ADAGALE DNYANDEEP		Ab	Ab	P	P	Ab	P	P	P	Ab	06
28	7028	PAWAR GAYATRI		P	P	P	P	Ab	Ab	Ab	Ab	P	06
29	7029	PATOLE KOMAL SHIVAJI	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
30	7030	DURGUDE SAGAR RAJKUMAR	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00
31	7031	PILANE PRADNYA PANDURANG	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	00

Someshwar Science College COLLEGE CODE 827

Principal
Someshwar Science College Someshwarnagar

ENVIRONMENT PROJECT

WATER POLLUTION

Name - Suryawanshi Divya Sambhaji

collage Name - Someshwar science college
Someshwarnagar.

Standard - S.Y. Bsc.

Division - 'B' group Roll No. 2031

Address - At post Wanewadi, Tal- Baramati
Dist Pune.

Project Name - Water Pollution

Guidance Teacher - Asst. Prof. Chavan M.B.

CERTIFICATE

Shri someshwar shikshan prasarak Mandal
Someshwar vidnyan Mahavidyalya someshwarnagar.

This is to certify that Miss suryawanshi Divya sambhaji (Roll No. 20311) SY BSC (B. group) has satisfactorily carried out requried project work according to syllabus prescribed by the savitribai phule pune university in environmental Awarness and this project represents his bonafined work in the yeae 2019-2020.

Guide Teacher

Incharge Teacher
24/02/2020

Examiner

Principal
02/03/2020

Industrial Causes

- The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc)

Pathogens. coliform bacteria are a commonly used bacterial indicator of water pollution, although not an actual cause of disease. other micro-organisms sometimes found in surface waters which have caused human health problems include. High levels of pathogens may result from inadequately treated sewage discharges. this can be caused by a sewage plant designed with less than secondary treatment.

Types of water pollution

① Nutrients pollution- some waste water. fertilizers and sewage. contain high level of nutrients if the end up in water bodies they encorage algae and weed growth in the water.

② Surface water pollution- surface water includes natural water found on the earth's surfaces like rivers, lakes, and oceans. Hazardous substances coming into contact with this surfaces water dissolving or physically.

③ Oxygen Depleting- water bodies have micro-organisms. these include aerobic and anaerobic organisms when too much biodegradeble matter (things that easily decay) end up in water, it encourage) more micro-organisms.

Name- Miss. Todkar
Ashwini Hanumant.

College Name -
Someshwar Science
College,
Someshwarnagar.

Project Name -

Bird Conservation

Guide Teacher -

Nikalge Sir

Certificate

This is to certify that Miss. Todkar Ashwini Hanumant from S.Y. Bsc (B group) has satisfactory carried out required project work according to the syllabus prescribed by the Savitribai Phule Pune University in Zoology pro Environment Project and this project represent her bonafide work in the year 2019 - 2020.

Roll. No :- 2001 Exam Seat No :-

25/02/2020 27/04/2020 27/04/2020

Batch Incharge Guide Incharge

Principal

Index

24/25

Sr. No	Name	Page No.	Sign
1]	Bird Conservation	1 to 2	
2]	Threats to birds	2 to 3	
3]	Introduced Species	3 to 4	
4]	Hunting and exploitation	4 to 5	
5]	Hybridisation	5 to 6	
6]	Other threats	6 to 7	
7]	Conservat^ Techniques	7 to 8	
8]	About the convetion on Migratory species	8 to 9	

Revise

Bird Conservation

Bird conservation is a field in the science of conservation biology related to threatened birds. Humans have a profound effect on many bird species. Over one hundred species have gone extinct in historical times, although the most dramatic human-caused extinctions occured in the Pacific Ocean as humans colonised the islands of Melanesia, Polynesia and Micronesia, during which an estimated 750-1800 species of bird