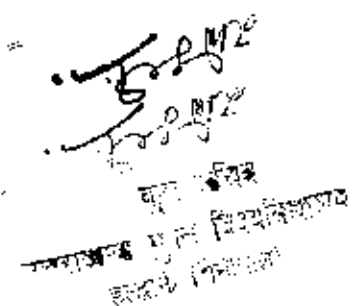


## Programme Project Report (PPR)

Name of Programme: Bachelor of Science (B.Sc.)

- a) **Programme mission and objectives:** The mission of the programme is to take Science education to the doorsteps of the communities residing in far –flung difficult and remote areas. Further, the economic condition of the majority of the hill communities does not allow them to afford the higher cost involve in science education for which they have to send their children to cities. Therefore, the main objective of the programme is to provide opportunity for science education to the door steps of aspirants and to enhance their skills to enhance employability or entrepreneurship.
- b) **Relevance of the program with HEIs Mission and Goals:** One of the mission of higher education particularly Open and Distance Learning Institutions is to provide greater opportunities of access to Higher Education with equity to all the eligible persons and in particular to the vulnerable sections.
- c) **Nature of prospective target group of learners:** Those learner who wish to opt career in science and related disciplines in various government organizations, non-governmental organizations, scientific organizations, laboratories, will be the target group of learners.
- d) **Appropriateness of programme to be conducted in Open and Distance Learning mode to acquire specific skills and competence:** In the light of Science Education being limited to selected colleges and Universities of the State, much of the aspirants remain devoid of science education. Conducting the programme in ODL mode will provide them opportunity for this programme. It will help in catering to the needs and aspirations of larger section of hilly society particularly representing to marginalized and deprived sections of the society. Further, it will prove to be excellent opportunity for those learners who are in job and wish to enhance their science education and skills. In order to communicate effectively with the learners University has adopted the following tools:
- self-instructional printed material
  - audio / video cassettes and CDs
  - audio-video programmes transmitted through FM Radio and EduSat
  - face-to- face counselling at study centres by academic counselors
  - reference library at study centre
  - web based academic support
  - assignments

  
The stamp contains the text: 'UNIVERSITY OF JAMMU' and 'JAMMU'.

- practical

e) **Instructional design:**

**i) Curriculum design:** Bachelor of Science (B.Sc.) is a three year degree programme with 108 credits. A learner shall have to take 36 credits in three subjects in one year. Each course in mathematics and Geography discipline will be of 4 credits whereas in other subjects each course will be of 3 credits. Following subject combinations are available for students in B.Sc. Programme. Student will have to opt one of the above mentioned combinations and once opted a combination will remain same for the next two years.

Physics	Chemistry	Mathematics
Physics	Mathematics	Geography
Botany	Zoology	Chemistry
Botany	Zoology	Forestry
Botany	Zoology	Geography

**Subject: Botany**

**B.Sc.-I year**

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
FIRST YEAR			
1.	Microbiology, Mycology and Plant Pathology	BO-101	03
2.	Phycology and Bryology	BO-102	03
3.	Pteridology, Gymnosperms and Paleobotany	BO-103	03
4.	Laboratory Course-I	BO-104	03
SECOND YEAR			
5.	Taxonomy of Angiosperms	BO-201	03
6.	Anatomy, Embryology and Elementary Morphogenesis	BO-202	03
7.	Plant Ecology and Biostatistics	BO-203	03
8.	Laboratory Course-II	BO-204	03
THIRD YEAR			
9.	Cell Biology, Molecular Biology and Biotechnology	BO-301	03
10.	Economic Botany, Genetics and Plant Breeding	BO-302	03
11.	Plant Physiology and Biochemistry	BO-303	03
12.	Laboratory Course-III	BO-304	03

**SYLLABUS**

**COURSE-MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY (BO-101)**

**Objectives:** To understand the nature of Microorganisms, Fungi and Lichens and their economic importance with particular reference to plants diseases caused by them

**Syllabus-General Account, distribution, reproduction, and classification of Viruses, Fungi, Bacteria, Major microbes of food, water, and soil**

**Isolation and cultivation of microorganisms, Instruments used in microbiological studies**

**Structure, Classification, Nutrition, Reproduction and Economic importance of Bacteria**

**General account, Classification, Structure, Reproduction and Economic importance of Viruses**

**Characters, Economic importance, Classification and General account of major classes of Fungi**

*Handwritten signature and stamp*

General account, Habit, Structure and Methods of reproduction in Mastigomycotina, Zygomycotina, Ascomycotina: Mastigomycotina- *Phytophthora*, Zygomycotina- *Mucor*, Ascomycotina- *Saccharomyces*, *Erysiphe*  
General account, Habit, Structure and Methods of Reproduction in Basidiomycotina, Deuteromycotina and Mycoplasma: Basidiomycotina- *Puccinia* and *Agaricus*, Deuteromycotina – *Alternaria*, Mycoplasma- General Account  
Occurrence, General structure, Nutrition, Reproduction, Economic and Ecological importance of Lichens  
Infection, Disease resistance and General Symptoms  
Symptoms, Morphology of the causal organism, Diseases cycle and control measures-I. Mosaic diseases of tobacco, citrus canker, Wart diseases of potato, Late blight of potato  
Symptoms, Morphology of the causal organism, Diseases cycle and control measures-II. Red rot of sugarcane, Loose smut of wheat, Early blight of Potato.  
Plant Protection and Control measures of Plant Diseases

### Unit Schedule

#### Block-1-General Microbiology

Unit-1-General account, distribution and classification of microorganisms, Major microbes of food, water and soil  
 Unit-2-Isolation and Cultivation of Microorganisms, Instruments used in Microbiological studies  
 Unit-3-Structure, Classification, Nutrition, Reproduction and Economic importance of Bacteria  
 Unit-4-General account, Classification, Structure, Reproduction and Economic importance of Viruses

#### Block-2- Fungi and Lichens

Unit-5- Characters, Economic importance, Classification and General account of major classes of Fungi  
 Unit-6- General account, Habit, Structure and Methods of reproduction in Mastigomycotina, Zygomycotina, Ascomycotina  
 Unit-7-General account, Habit, Structure and Methods of Reproduction in Basidiomycotina, Deuteromycotina and Mycoplasma  
 Unit-8- Occurrence, General structure, Nutrition, Reproduction, Economic and Ecological importance of Lichens

#### Block-3- Plant Pathology

Unit-9-Infection, Disease resistance and General Symptoms  
 Unit-10-Symptoms, Morphology of the causal organism, Diseases cycle and Control measures-I  
 Unit-11-Symptoms, Morphology of the causal organism, Diseases cycle and Control measures-II  
 Unit-12-Plant Protection and Control measures of Plant Diseases

### COURSE- PHYCOLOGY AND BRYOLOGY (BO-102)

**Objectives:** To study the important group of Algae and bryophytes with their distribution, structure, reproduction and economic importance

#### Syllabus- General Characters and Life cycles in Algae

Important Classifications of Algae (Any three)

Range of Vegetative Structure

Ecological and Economic importance of Algae

Occurrence, Structure of thallus and Mode of reproduction in Cyanophyta and Bacillariophyta: Cyanophyta- *Oscillatoria*

*Nostoc*, Bacillariophyta- General Account

Occurrence, Structure of thallus and Mode of reproduction in Chlorophyta and Xanthophyta:

Chlorophyta – *Chlamydomonas*, *Volvox*, *Oedogonium*, and Xanthophyta- *Vaucheria*, Occurrence, Structure of thallus and

Mode of reproduction in Phaeophyta: *Ectocarpus*, *Sargassum*

Occurrence, Structure of thallus and Mode of reproduction in Rhodophyta: *Polysiphonia*, *Batracospermum*

History, Distribution, Economic and Ecological importance and Classification: (In Bryophytes) in accordance with the International Code of Botanical Nomenclature.

Classification, Structure and reproduction of Hepaticopsida: *Riccia* and *Marchantia* Classification, Structure and

reproduction of Anthocerotopsida: *Anthoceros* and *Notothylium* Classification, Structure and reproduction of Bryopsida.

*Funaria* and *Polytricum*

*[Handwritten signature]*

*[Handwritten signature]*  
 [Stamp: UNIVERSITY OF ...]  
 [Stamp: ...]

### Unit Schedule

#### Block-1- Algae: General Account

- Unit-1-General Characters and Life cycles in Algae
- Unit-2-Important Classifications of Algae (Any three)
- Unit-3-Range of Vegetative structure
- Unit-4-Ecological and Economic importance of Algae

#### Block-2- Algae: Major Groups

- Unit-5-Occurrence, Structure of thallus and Mode of reproduction in Cyanophyta and Bacillariophyta
- Unit-6-Occurrence, Structure of thallus and Mode of reproduction in Chlorophyta and Xanthophyta
- Unit-7-Occurrence, Structure of thallus and Mode of reproduction in Phaeophyta
- Unit-8-Occurrence, Structure of thallus and Mode of reproduction in Rhodophyta

#### Block-3- Bryophytes

- Unit-9-Habit, Distribution, Economic importance and Classification
- Unit-10-Classification, Structure and Reproduction in Hepaticopsida
- Unit-11-Classification, Structure and Reproduction in Anthocerotopsida
- Unit-12-Classification, Structure and Reproduction in Bryopsida

### COURSE: PTERIDOLOGY, GYMNOSPERMS AND PALAEOBOTANY (BO-103)

**Objectives-** To study the distribution structure and reproduction in Pteridophytes and Gymnosperms along with their evolutionary history, their phylogenetic relationships and fossil wealth

**Syllabus-** General Features and Classification of Pteridophytes, Telome theory, Stellar system Heterospory, Life cycle

Structure and Reproduction: Selaginella and Rhynia

Structure and Reproduction: Equisetum and Adiantum

Structure and Reproduction: Marsilea and Azolla

General Characters, Classification, Economic importance and Distribution of Gymnosperms in India

Structure and Life History: Cycas

Structure and Life History: Pinus

Structure and Life History: Ephedra

Geological time scale

Types of Plant fossils

Process of fossilization

Important fossils in India: Birbal Sahani Institute of Palaeobotany

### Unit Schedule

#### Block-1- Pteridophytes

- Unit-1-General features, Classification, Telome theory, Stellar system, Heterospory and Life cycle
- Unit-2-Structure and Reproduction in Rhynia and Selaginella
- Unit-3- Structure and Reproduction in Equisetum and Adiantum
- Unit-4- Structure and Reproduction in Marsilea and Azolla

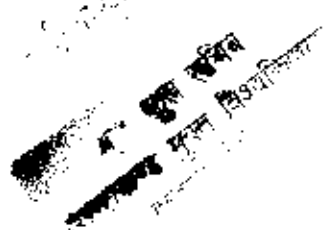
#### Block-2- Gymnosperms

- Unit-5-General Characters, Classification, Economic importance and Distribution of Gymnosperms in India
- Unit-6-Structure and Life History of Cycas
- Unit-7-Structure and Life History of Pinus
- Unit-8 -Structure and Life History of Ephedra

#### Block-3- Elementary Palaeobotany

- Unit-9-Geological Time Scale
- Unit-10-Types of Plant fossils
- Unit-11- Process of Fossilization
- Unit-12- Important Fossils in India





## COURSE-LABORATORY PRACTICAL (BO-104)

**Objective-** To get the knowledge through whole mount cutting sections and making suitable preparations and description based identification of the plant materials

**Syllabus- Microbiology, Mycology and Plant Pathology:** A study of the following types of Fungi: *Albugo*, *Phytophthora*, *Puccinia*, *Agaricus*, *Alternaria*, *Erysiphe*, *Saccharomyces*, *Mucor*. Study of morphology and structure of different types of lichens. Symptoms, morphology of pathogen and host-parasite relationship of plant diseases- citrus canker, Wart disease of potato, Loose smut of wheat, Black rust of wheat, Red rot of sugarcane, Late blight of Potato, Early blight of Potato. Different methods of cultivation and isolation of microbes. **Diversity of Algae and Bryophytes:** Study of algae- *Oscillatoria*, *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Vaucheria*, *Ectocarpus*, *Sargassum*, *Polysiphonia* and *Batrachospermum* by preparing temporary slides. Study of the external features, internal structure and reproductive structures with the help of permanent and /or temporary preparations of Bryophytes- *Riccia*, *Marchantia*, *Anthoceros*, *Notothylus*, *Funaria* and *Polytrichum*.

**Pteridophytes, Gymnosperms and Paleobotany:** Study of the external features and internal structures of rhizome leaves, roots, sporangia and strobili of Pteridophytes- *Rhynia*, *Selaginella*, *Equisetum*, *Adiantum*, *Marsilea* and *Azolla*. Study of the morphology and anatomy of vegetative and reproductive parts of Gymnosperms -*Cycas*, *Pinus* and *Ephedra*. Study of fossil specimens: impressions, casts and petrifications

### **Unit Schedule**

#### **Block-1- Microbiology, Mycology and Plant Pathology**

Unit-1-Study of Fungi

Unit-2-Study of Morphology and Structure of different types of Lichens

Unit-3-Symptoms, Morphology of pathogen and host-parasite relationship of plant diseases Unit-4-Different methods of Cultivation and Isolation of Microbes

#### **Block-2- Diversity of Algae and Bryophytes**

Unit-5-Study of the Algae types -*Oscillatoria*, *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, by preparing temporary slides

Unit-6-Study of the Algae types- *Vaucheria*, *Ectocarpus*, *Sargassum*, *Polysiphonia*, *Batrachospermum* by preparing temporary slides.

Unit-7-Study of external features, internal structure and reproductive structures of *Riccia*, *Marchantia*, *Anthoceros*, with the help of permanent and /or temporary preparations.

Unit-8- Study of external features internal structure and reproductive structures of *Notothylus*, *Funaria* and *Polytrichum* with the help of permanent and /or temporary preparations.

#### **Block-3- Pteridophytes, Gymnosperms and Paleobotany**

Unit-9-Study of the external features and internal structures of rhizome, leaves, roots, sporangia and strobili of Pteridophytes- *Rhynia*, *Selaginella*, *Equisetum*

Unit-10- Study of the external features and internal structures of rhizome, leaves, roots, sporangia and strobili of Pteridophytes -*Adiantum*, *Marsilea* and *Azolla*

Unit-11-Study of the morphology and anatomy of vegetative and reproductive parts of Gymnosperms -*Cycas*, *Pinus* and *Ephedra*

Unit-12-Study of fossil specimens. Impressions, Casts and Petrifications

### **B.Sc.-II year**

## COURSE- TAXONOMY OF ANGIOSPERMS AND BIODIVERSITY (BO-201)

**Objectives-** To understand the habitat, collection, identification, nomenclature, systematic position, phylogeny and salient features of important families of Angiosperms and to study the variations and conservation of biodiversity

**Syllabus- Historical background and Evolution of Classifications:** Classification proposed by Bentham and Hooker, Engler and Prantl and Hutchinson of Angiosperms

**Basic principles, plant nomenclature and International code of Botanical nomenclature (ICBN) - History, Principles and Applications**

**Tools and techniques in Collection and Preservation of specimens:** For herbarium and Museum

Botanical gardens and Herbaria: A brief idea of Botanical Survey of India (BSI)  
Systematics, Distinguishing Characters, Important genera and Economic importance of the Families: Ranunculaceae, Caryophyllaceae, Rutaceae  
Systematics, Distinguishing Characters, Important genera and Economic importance of the Families: Rosaceae, Fabaceae and Asclepiadaceae  
Systematics, Distinguishing Characters, Important genera and Economic importance of the Families: Solanaceae, Acanthaceae and Lamiaceae  
Systematics, Distinguishing Characters, Important genera and Economic importance of the Families: Orchidaceae, Liliaceae, and Poaceae  
Biodiversity-Basic concept: Biodiversity at Global and National level, Threats to Biodiversity  
Biodiversity Conservations: *In situ* (Biosphere Reserves, National Parks and Sanctuaries) and *Ex situ*, Gene bank, NBPGR  
Biodiversity- Hotspots and Megabiodiversity Countries: Global biodiversity hotspots, India as mega-biodiversity countries  
Floristic diversity of India and Endemism: Floristic Regions of India, Flora and Vegetation, Endemism.

### Unit Schedule

#### Block-1- Angiosperms: General Consideration

Unit-1- Historical background and Evolution of classification of Angiosperms  
 Unit-2- Basic principles, Plant nomenclature and ICBN  
 Unit-3- Tools and techniques in collection and Preservation of specimens  
 Unit-4- Botanical Gardens and Herbaria

#### Block-2- Families

Unit-5- Ranunculaceae, Caryophyllaceae and Rutaceae  
 Unit-6- Rosaceae, Fabaceae and Asclepiadaceae  
 Unit-7- Solanaceae, Acanthaceae and Lamiaceae  
 Unit-8- Orchidaceae, Liliaceae and Poaceae

#### Block-3- Biodiversity and Conservation

Unit-9- Biodiversity- Basic concepts  
 Unit-10- Biodiversity Conservation - *In situ* and *Ex situ*, Gene bank, NBPGR  
 Unit-11- Biodiversity - Hotspots and Megabiodiversity countries  
 Unit-12- Floristic diversity of India and Endemism

### COURSE-ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS (BO-202)

Objectives- To study the cell structure, tissues (meristems, permanent tissue) normal and abnormal activity of cambium and development of male, female gamete including development of embryo and development of organs

#### Syllabus- Tools and techniques in Plant Anatomy

Types of Tissues and Anatomy of Root, Shoot and Leaf: Types of tissues (Meristematic, permanent and specialised tissue).

A brief account of root, shoot and leaf anatomy

Structure of Vascular tissues: Structure of xylem and phloem. Origin, structure and function of vascular cambium and its normal activity, Cork cambium, its activity and products

Normal and Anomalous growth: With special reference to the taxa: *Bougainvillea*, *Nyctanthes*, *Dracaena*, *Ficus*, *Tinospora* and Orchids

Male gametophytes- Structure of anther, microsporogenesis and development of male gametophytes in angiosperms

Female gametophytes: Structure of ovule, megasporogenesis and development of the female gametophytes with particular reference to polygonum type, comparison with Biosporic and Tetrasporic types

Fertilization and Post fertilization: Apomixes, Adventives embryony, Polyembryony and Parthenocarpy

Plant Morphogenesis and Morphogenetic factors: Basic idea Morphogenesis and Concept of Differentiation, Polarity,

Totipotency

Plant growth regulators: Auxins, Gibberellins, Cytokinins and Abscisic acid

Physiology of flowering: Basic concept of flowering, Photoperiodism and Vernalization

*[Handwritten signature]*

6

*[Handwritten signature]*  
 10/10/2020  
 31/10/2020  
 10/10/2020

### Unit Schedule

#### Block-1- General Anatomy

- Unit-1-Tools and Techniques in Plant Anatomy
- Unit-2-Types of Tissues and Anatomy of Root, Shoot and Leaf
- Unit-3-Structure of Vascular tissues
- Unit-4-Normal and Anomalous growth

#### Block-2- Embryology

- Unit-5- Male Gametophytes
- Unit-6- Female Gametophytes
- Unit-7- Fertilization and Post Fertilization

#### Block-3- Morphogenesis

- Unit-8- Plant Morphogenesis and Morphogenetic factors
- Unit-9- Plant Growth Regulators
- Unit-10-Physiology of Flowering

### COURSE-PLANT ECOLOGY AND BIOSTATISTICS (BO-203)

**Objectives-** To study the structure and function of hydrosphere, atmosphere, lithosphere and biosphere, Applications and techniques used in remote sensing and elementary knowledge of Biostatistics

**Syllabus-** Definition, Branches and Scope of ecology

**Ecosystem Ecology-I:** Types, Structure, Abiotic and Biotic components, Food chain, Food web, Ecological pyramids, Population ecology

**Ecosystem Ecology-II:** Energy flow, Productivity, Biogeochemical cycles –water, sulphur, carbon, and nitrogen cycles, Ecological succession and Community ecology

**Ecological factors:** Climatic, Edaphic, Physiographic, Biotic,

**Pollution Ecology:** Air, Noise, Water and Soil

**Biogeographical regions of India, Vegetation types of Uttarakhand:** Forests and grasslands **Remote sensing- Tools and techniques:** Application, Physical basis of remote sensing

**Aerial and space platforms, Aerial photography and photo-interpretation**

**Methods graphic and non-graphic presentation of data**

**Measurements of Central tendencies-** Mean, Median, Mode

**Measures of Dispersions and Deviations:** Measures of dispersion- range, Mean deviation and Standard deviation

**Correlation, Statutory test:** Coefficient of correlation, chi-square test, t test

### Unit Schedule

#### Block-1-General Ecology and Ecosystem

- Unit-1-Definition, Branches and Scope of Ecology
- Unit-2- Ecosystem Ecology-I
- Unit-3- Ecosystem Ecology-II
- Unit-4- Ecological Factors
- Unit-5- Pollution Ecology
- Unit-6 -Biogeographical regions of India, Vegetation types of Uttarakhand.

#### Block-2- Applied Ecology & Remote Sensing

- Unit-7- Remote sensing- Tools and Techniques
- Unit-8 -Aerial and Space platforms, Aerial photography and Photo-interpretation

#### Block-3- Biostatistics

- Unit-9-Methods Graphic and Non-graphic presentation of data
- Unit-10-Measurements of Central tendencies
- Unit-11-Measures of Dispersions and Deviations
- Unit-12-Correlation, Statutory test

### COURSE- LABORATORY PRACTICAL (BO-204)



**Objective-** To identify the plant based on the bases of semi-technical description and to identify the anatomical, embryological materials on preparation based description of the plant material.

**Syllabus- Diversity of Angiosperms:** Identification of locality available plants belonging to the families mentioned in the syllabus (Ranunculaceae, Caryophyllaceae, Rutaceae, Rosaceae, Fabaceae, Asclepiadaceae, Solanaceae, Acanthaceae, Lamiaceae, Orchidaceae, Liliaceae, and Poaceae), their description in semi technical language. Collection of plant specimens-herbarium and for live specimen, T.S. of anther. Study of various types of pollen grains, placentations, ovules development using temporary and permanent preparations **Embryology, Anatomy and Morphogenesis:** Demonstration of usual techniques of Plant anatomy, section cutting, T.S., L.S. of leaf, stem and root. Normal and abnormal secondary growth in *Bougainvillea*, *Nyctanthes*, *Dracaena*, *Tinospora* and Orchids. Influence of Growth regulators on root formations, senescence and pollen germination (hanging drop method). Structure and organization of the shoot apex (*Hydrilla verticillata*, *Ranunculus sceleratus* and *Euphorbia hirta*)

**Plant Ecology and Biostatistics:** To determine the minimum size of quadrat by species area curve method and to be laid down for the vegetational analysis of the given area. Determine frequency (comparison of frequency diagram with Ruankiaer's normal frequency diagram), density and abundance of each species in a community by quadrat method. Determine the mean basal cover and total basal cover. Statistical problems of central tendencies- mean, median, mode and Standard deviation and Chi-square test

#### Unit Schedule

##### Block-1- Diversity of Angiosperms

Unit-1-Identification of locality available plants belonging to the families mentioned in the syllabus, their description in semi technical language.

Unit-2- Collection of plant specimens-herbarium and for live specimen

Unit-3-T.S. of anther

Unit-4-Study of various types of pollen grains, placentations, ovules development using temporary and permanent preparations

##### Block-2- Embryology, Anatomy and Morphogenesis

Unit-5-Demonstration of usual techniques of plant anatomy, section cutting, T.S., L.S. of leaf, stem and root

Unit-6- Normal and abnormal secondary growth

Unit-7- Influence of growth regulators on root formations, senescence and pollen germination (hanging drop method).

Unit-8- Structure and organization of the shoot apex

##### Block-3- Plant Ecology and Biostatistics

Unit-9- Determine the minimum size and number of quadrat by species area curve method for the vegetational analysis of the given area.

Unit-10- Determine frequency, density and abundance of each species in a community by quadrat method.

Unit-11-Determine the mean basal cover and total basal cover.

Unit-12- Statistical problems on central tendencies and Chi-square test.

#### B.Sc.-III year

#### COURSE-CELL BIOLOGY, MOLECULAR BIOLOGY AND BIOTECHNOLOGY (BO-301)

**Objectives-** To provide knowledge about the intricacies of life processes at the molecular and cellular level. To describe the cell structure, function, morphology and to study the biotechnological techniques and tools of genetic engineering

**Syllabus- The Cell:** Historical background, Cell theory, Cell size and Structure, Comparative account of prokaryotic and eukaryotic cell

**Structures and Functions of Cell Organelles:** Nucleus, Ribosomes, Nucleoplasm, Mitochondria and Chloroplast, Types of plastids, Golgi complex, Endoplasmic Reticulum, Lysosomes, Peroxisomes

**Structure and Types of Chromosomes**

**Cell division:** Mitosis, Meiosis, their significance

**Structure and composition of DNA:** DNA the genetic material, DNA structure, replication, DNA- protein interaction

**Structure and composition of RNA**

Handwritten signature and scribbles.

Handwritten text and stamp.



Modern concept of Gene and Genetic code: Operon concept

Protein synthesis and Gene regulation of Protein synthesis: Protein synthesis. Structure and properties of polysaccharides

Recombinant DNA

Genetic Engineering: Tools and techniques in Genetic Engineering

Biotechnology: Biotechnology and its applications in Health, Agriculture and Industries

Plant Tissue Culture: Methods of gene transfer, Transgenic plants, Gene bank, Nif gene, Nod gene and Mycoprotein

### Unit Schedule

#### Block-1-Cell biology

Unit-1-The Cell

Unit-2-Structures and Functions of Cell Organelles

Unit-3-Structure and Types of Chromosomes

Unit-4-Cell Division

#### Block-2-Molecular Biology

Unit-5-Structure and Composition of DNA

Unit-6- Structure and Composition of RNA

Unit-7-Modern Concept of Gene and Genetic code

Unit-8- Protein synthesis and Gene regulation of Protein synthesis

#### Block-3-Biotechnology

Unit-9-Recombinant DNA

Unit-10-Genetic Engineering

Unit-11- Biotechnology

Unit-12-Plant Tissue Culture

### COURSE-ECONOMIC BOTANY, GENETICS AND PLANT BREEDING (BO-302)

**Objective-** To discuss genetic material, genetics and breeding for improvement of selected economically-important plants

**Syllabus- Cereals, Millets and Legumes:** Cultivation, production and uses of Cereals and Millets-Wheat, paddy, maize,

bajra and jowar; and Legumes-Pea, Gram, Lentil, Pigeon pea, Black gram, Green gram, Rajmash

**Fruits, Vegetables, Fibre-yielding and Timber-yielding plants:** General account of Fruits- Mango, apple, banana, citrus and

litchi, Vegetables: Root vegetables, stem vegetables, leafy vegetables and fruit vegetables, Fibres- Cotton, jute and coir,

Timber- Teak, Shisham, Sal, Chir-pine, Deodar

**Medicinal plants, Oils and Beverages:** Medicinal plants- *Aconitum*, *Atropa*, *Cinchona*, *Rauwolfia* and *Ephedra*. Oil- Castor,

coconut, linseed, groundnut and mustard, and Beverages- Tea, coffee, cocoa

**Ethnobotany:** Concept and history of ethnobotany. Ethnic groups of India. their food and food products, Ethnobotany and

conservation of natural resources, Plants of ethnobotanical importance, Ethnomedicinal plants Narcotic plants

**Genetic Inheritance:** Mendel's experiment and Law of inheritance- Principal of segregation. Principal of independent

assortment, Incomplete dominance

**Linkage and Crossing over:** Complete and incomplete linkage, Linkage group

**Polyploidy and Mutation:** Spontaneous, Induced

**Sex determination and Sex-linked inheritance**

**Aims, Objectives and Basics techniques:** Plant breeding

**Crop Improvement**

**Mutational breeding:** Mutational breeding and Breeding for disease resistance

**Centres of origin of crop plants:** Centres of Origin of important crop plants. Domestication and introduction of crops

### Unit Schedule

#### Block-1-Economic Botany

Unit-1 -Cereals, Millets and Legumes

Unit-2-Fruits, Vegetables, Fibre-yielding and Timber-yielding forest species

Unit-3-Medicinal plants, Oils and Beverages

Unit-4- Ethnobotany

  
1/2/21

## **Block-2-Genetics**

Unit-5-Genetic Inheritance

Unit-6- Linkage and Crossing over

Unit-7- Polyploidy and Mutations

Unit-8-Sex determination and Sex-linked inheritance

## **Block-3- Plant Breeding**

Unit-9- Aims, Objectives and Basic techniques of plant breeding

Unit-10-Crop improvement

Unit-11-Mutational Breeding

Unit-12-Centres of Origin of crop plants

## **COURSE- PLANT PHYSIOLOGY AND BIOCHEMISTRY (BO-303)**

**Objectives-** To study the plant in relation to water metabolites and various growth hormones

**Syllabus- Absorption of water and Ascent of Sap:** Importance of water to plant life; physical properties of water, diffusion and osmosis; absorption of water, ascent of sap

**Loss of Water from Plants:** Transport of water, transpiration. Physiology of stomata

**Mineral nutrition and absorption of mineral salt:** Essential macro- and micro-elements and their role, deficiency symptoms, toxicity symptoms, absorption of mineral salt, mineral uptake

**Organic substances- their Transport and Translocation:** Mechanism of Phloem transport, source-sink relationship, factors affecting translocation

**Photosynthesis:** Significance, historical aspects, photosynthetic pigments, Concept of two photosystems, Photophosphorylation, Calvin cycle, C4 pathway, CAM plants photorespiration

**Respiration:** ATP -the biological energy currency, aerobic and anaerobic respiration, Krebs's cycle, Electron transport mechanism (chemiosmotic theory), pentose phosphate pathway

**Nitrogen metabolism:** Atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation **Growth and Phases of development:** Definitions, Concept of photoperiodism, physiology of flowering, Biological clocks, Physiology of senescence, Fruit ripening, Seed dormancy, Seed germination

**Carbohydrates and Lipids:** Classification, Properties and Biological role

**Protein, Amino acids and Vitamins:** Classification, properties and biological role **Enzymology:** Discovery, Nomenclature, Characteristics of enzymes, Concept of holoenzyme, apoenzyme, Coenzyme and cofactors

### **Biochemical techniques**

#### **Unit Schedule**

#### **Block -1- Plant water relationship**

Unit-1- Absorption of water and Ascent of sap

Unit-2- Loss of water from plants

Unit-3- Mineral nutrition and Absorption of mineral salts

Unit-4- Organic substances- their Transport and Translocation

#### **Block -2- Metabolism**

Unit-5- Photosynthesis

Unit-6- Respiration

Unit-7- Nitrogen metabolism

Unit-8- Growth and Phases of development

#### **Block-3-Biochemistry**

Unit-9-Carbohydrates and Lipids

Unit-10-Proteins, Amino acids and Vitamins

Unit-11-Enzymology

Unit-12-Biochemical techniques

## **COURSE- LABORATORY PRACTICAL (BO-304)**

**Objective-** To study the cell, cell-organelles, cell division, their chemical composition, various genetical aspects, the economic uses of plants and experiments to demonstrate various physiological activities of plants





**Syllabus- Cell biology, Molecular biology and Biotechnology:** To study cell structure from onion/ Tradescantia leaf peels and Demonstration of staining and mounting methods. Estimation and relationship between nucleus and cell volume at shoot/ root apices by camera lucida/micrometer method. Chromosome study during cell division. Biotechnology exercise.

**Economic botany, Genetics and Plant Breeding:** Identification, collection and maintenance of economically important plants and plant product mentioned in the syllabus. Exercises on genetical problems-To work out the laws of inheritance, to work out the mode of inheritance linked genes. Floral biology of some of the locally available crops such as wheat, pea, mustard, brinjal, tomato etc. Emasculation techniques in the field along with bagging and labelling

**Plant Physiology and Biochemistry:** To perform endosmosis and exosmosis using potato tuber and egg osmoscope, Demonstration of imbibitions, plasmolysis and deplasmolysis. To study the effects of temperature on the permeability of plasma membrane. Study the Structure of stomata, their opening and closing, stomatal frequency and Comparison of rate of transpiration using four-leaf method, cobalt chloride paper or by different types of photometers under different climatic condition. To study the effect of intensity and quality of light on the rate of photosynthesis by wilmott's bubbler. Study of R.Q. by Ganong's respirometer in different seeds. Demonstration of colour tests and micro chemical tests for carbohydrates, proteins and lipids

#### **Unit Schedule**

#### **Block-1- Cell biology, Molecular biology and Biotechnology**

Unit-1- Study cell structure from onion/ tradescantia leaf peels, and Demonstration of staining and mounting methods

Unit-2- Estimation and relationship between nucleus and cell volume at shoot/ root apices by camera lucida/micrometer method.

Unit-3- Chromosome study during cell division

Unit-4- Biotechnology exercise

#### **Block-2-Economic botany, Genetics and Plant Breeding**

Unit-5-Identification, collection and maintenance of economically important plants and plant product mentioned in the syllabus

Unit-6- Exercises on genetic problems

Unit-7-Study of the floral biology of some of the locally available crops plants

Unit-8-Emasculation techniques in the field along with bagging and labelling

#### **Block-3-Plant Physiology and Biochemistry**

Unit-9- To perform endosmosis and exosmosis and Demonstration of imbibitions, plasmolysis and deplasmolysis and the effects of temperature on the permeability of plasma membrane.

Unit-10- To study structure of stomata, their opening and closing, stomatal frequency and Comparison of rate of transpiration

Unit-11- To study the effect of intensity and quality of light on the rate of photosynthesis by wilmott's bubbler and to study R.Q. by Ganong's respirometer in different seeds

Unit-12- Demonstration of colour tests and micro chemical tests for carbohydrates, proteins and lipids

*Handwritten signature*

*Handwritten signature*

*Handwritten signature*

*Handwritten signature*

## Subject: Chemistry

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
<b>FIRST YEAR</b>			
1.	Inorganic Chemistry I	BSCH 101	03
2.	Organic Chemistry I	BSCH 102	03
3.	Physical Chemistry I	BSCH 103	03
4.	Laboratory Course I	BSCH 104	03
<b>SECOND YEAR</b>			
1.	Inorganic Chemistry II	BSCH 201	03
2.	Organic Chemistry II	BSCH 202	03
3.	Physical Chemistry II	BSCH 203	03
4.	Laboratory Course II	BSCH 204	03
<b>THIRD YEAR</b>			
1.	Inorganic Chemistry III	BSCH 301	03
2.	Organic Chemistry III	BSCH 302	03
3.	Physical Chemistry III	BSCH 303	03
4.	Laboratory Course III	BSCH 304	03

### **COURSE-I BCH 101 INORGANIC CHEMISTRY- I**

**3 credit**

#### **I. Atomic Structure**

Idea of de Broglie matter wave, Heisenberg uncertainty principle, Schrodinger wave equation, significance of  $\psi$  and  $\psi^2$ , quantum numbers, radial and angular wave functions and probability distribution curve, shape of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configuration of the elements, effecting nuclear charge.

#### **II. The Periodic Table**

History of Periodic Table, Description of Mendeleev Periodic Table, Old and Modern Concept of Mendeleev Periodic Table.

#### **III. Periodic Properties**

Atomic and ionic radii, ionization energy, electron affinity and electronegative- definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior

#### **IV. Chemical bonding I**

Covalent bond- Valence bond theory and its limitation, directional characteristics of covalent bond, types of hybridization and shape of simple inorganic molecule and ion. Valence shell electron pair repulsion theory (VSEPR) theory to  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{ICl}_2^-$  and  $\text{H}_2\text{O}$ . MO theory, homonuclear and heteronuclear (CO and MO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

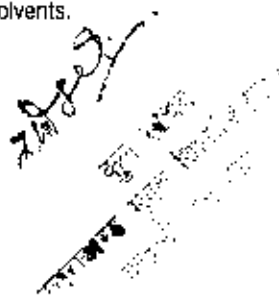
#### **V. Chemical bonding II**

Ionic solid- Ionic characters, radius ratio effect and coordination number, limitations of radius ratio rule, lattice defect, semiconductors lattice energy and Born-Haber cycle, Fajan's rule. Weak interactions- hydrogen bonding, van der Waal forces.

#### **VI. Hydrogen's**

Introduction, Solvent Properties, Protic and Aprotic Solvents. Reactions in Non-aqueous Solvents.

#### **VII. Alkali metals**



General introduction, general characteristics and use (Flame Colouration), Oxides and Hydroxides, solubility and hydration  
Complexation of alkali metal ions. Anomalous Behavior of Lithium.

#### **VIII. Alkaline earth metals**

General introduction, general characteristics and uses, Halides and Hydrides of Beryllium, complexation behavior. Anomalous Behavior of Beryllium.

#### **IX. Elements of group 13**

Introduction, general characteristics and uses. Hydrides of Boron (Properties, preparation and structure of diborane and Borazine). Halides of Boron and Aluminium, Oxides of Boron and Borates. Anomalous behavior of Boron.

#### **X. Elements of group 14**

Introduction, general characteristics and uses. Oxides of carbon and Silicon, halides, Organosilicon Compounds. Anomalous behavior of Carbon

#### **XI. Elements of group 15**

General introduction, general characteristics and uses. Hydrides, halides. Oxides and Oxoacids (Properties and structure). Anomalous behavior of Nitrogen.

#### **XII. Elements of group 16**

General introduction, general characteristics and uses. Oxides of Sulphur, Oxoacides of Sulphur, Halides of Sulphur and their properties. Anomalous behavior of Oxygen.

#### **XIII. Elements of group 17**

General introduction, general characteristics and uses. Halides, Halogen oxides and oxoacides of halogens. Interhalogen compounds, polyhalides. Basic properties of halogens. Anomalous behavior of Fluorine.

#### **XIV. Chemistry of noble gases elements**

General introduction, general characteristics and uses. Compounds of Noble gases- Preparation, Properties and structures

### **COURSE-II BCH102 ORGANIC CHEMISTRY- I**

**3 credit**

#### **I. Structure and bonding**

Hybridization, Bond length and bond angles, bond energy, localized and delocalized chemical bond, van der Waal interactions  
Inclusion compounds, clathrates, charge transfer complexes resonance, hyperconjugation aromaticity, Steric effect (Inductive resonance/mesomeric, electromeric and field effect) hydrogen bonding.

#### **II. Mechanism of Organic reactions**

Curve arrow notation, drawing electron movements with arrows, half-headed and double headed arrows, homolytic and heterolytic bond cleavage. Types of reagents, recapitulation of types of reagents.

#### **III. Reaction Intermediate**

Reaction intermediates- carbocations, carbanions, free radicals, carbenes, nitrenes and benzyne (with examples). Assigning formal charge on intermediates and other ionic species.

#### **IV. Stereochemistry-I**

Concept of isomerism. Types of isomerism. Optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogenic centres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres,

diastereomers threo and erythro diastereomers, meso compound, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rule. D & L and R & S system of nomenclature

#### V. Stereochemistry-II

Geometrical isomerism- determination of configuration of geometrical isomers. E & Z system of nomenclature, geometrical isomerism in oximes and acyclic compounds.

Conformational analysis of ethane and n-butane, conformation of cyclohexane, axial and equatorial bond, conformation of mono substituted cyclohexane. Newman projection and Sawhorse formula, Fischer and flying wedge formula. Difference between configuration and conformation.

#### VI. Alkanes

IUPAC nomenclature of branch and unbranched alkanes, classification of carbon atoms in alkanes. Isomerism of alkanes, sources, methods of formation (with special reactions, Kolbe's reaction, Corey-House reaction of alkanes).

Mechanism of free radical halogenations of alkanes: orientation, reactivity and selectivity.

#### VII. Cycloalkanes

Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations.

#### VIII. Alkenes

Nomenclature of alkenes, isomerism of alkenes, methods of preparation, Physical properties of alkenes. Chemical reaction of alkenes, mechanism involved in hydrogenation, electrophilic and free radical addition, Markownikoff's rule. hydroboration oxidation, oxymercuration reduction, ozonolysis and oxidation with  $\text{KMnO}_4$  and  $\text{OsO}_4$ . Polymerization of alkenes. Industrial application of ethylene and propene.

#### IX. Cycloalkenes

Methods of formation, conformation and chemical reactions of cycloalkenes.

#### X. Dienes

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadienes. Methods of formation, polymerization. Chemical reactions -1,2 and 1,4 addition, Diels – Alder reaction.

#### XI. Alkynes

Nomenclature, and classification, structure and bonding in alkynes. Methods of formation. Physical properties. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, oxidation and polymerization.

#### XII. Arenes and Aromaticity

Nomenclatures of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene molecular formula and Kekule structure. Resonance and MO picture

Aromaticity: the Huckel's rule, aromatic ions.

Aromatic electrophilic substitution- general pattern of mechanism, role of  $\sigma$  and  $\pi$  complexes. Mechanism of nitration, halogenations, sulphonation, Friedel Craft reactions. Activating and deactivating substituents, orientation and ortho/para ratio. Reduction of benzene (Birch reduction).

#### XIII. Alkyl halides

Nomenclature and classification of alkyl halides, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN1 and SN2 and SNi reaction with energy profile diagrams. Elimination reactions, types of elimination reactions. Polyhalogen compounds-Chloroform, carbon tetrachloride.

#### XIV. Aryl halides

Nomenclature and classification of aryl halides. Methods of formation of aryl halides, nuclear and side chain reaction. Chemical reactions. Relative reactivity of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

### COURSE III BCH103 PHYSICAL CHEMISTRY-I

3 credit

#### I. Units and Dimensions

Introduction, basic units, derived units, SI Prefixes. Grammatical Rules for Representing the SI Units. Conversion of Non- SI unit to SI units

#### II. Gases State I

Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation state. Critical Phenomena; PV isotherms of real gases, continuity of states, the isotherms of van der Waal equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.

#### III. Gases State II

Molecular velocities; Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule Thomson effect).

#### IV. Liquid state

Intermolecular forces, structure of liquid (a qualitative description).

Structural differences between solid, liquid and gases.

Liquid crystal: difference liquid crystal, solid and liquid. Classification, structure of nematic and cholesterol phases.

#### V. Solid State

Definition of space lattice, unit cell.

Law of crystallography- (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry element in crystals.

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method)

Liquid in solid (gels): Classification, preparation and properties, inhibition, general application of colloid.

#### VI. Chemical kinetics-I

Chemical kinetics and its scope, rate of reaction, factors affecting the rate of reaction- concentration, Pressure, temperature, solvent, light, catalyst. Order of reactions, zero order, first order, second order, third order and pseudo order.

#### VII. Chemical kinetics-II

Integrated rate law equation of zero and first order of reaction. Half life periods. Radioactive decay as a first order phenomenon. Concept of activation energy.

### VIII. Colloids and Macromolecules

Definition of colloids, classification of colloids.

Solid in liquid (sols): properties- kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

Liquid in liquid (emulsion): types of emulsion, preparation. Emulsifier.

### IX. Catalysis

Catalysis, characteristics of catalyzed reactions, Classification of catalysis, miscellaneous examples.

### X. Basic Concepts of Thermodynamics

Definition of thermodynamics terms, system, surroundings, Types of systems, intensive and extensive properties, states and path functions and their differentials, thermodynamic process, concept of heat and work.

### XI. First law of Thermodynamics

Statements, internal energy and enthalpy, Heat capacity- heat capacity at constant volume and pressure, Joule Thomson effect, Joule Thomson coefficient, calculation of  $w$ ,  $q$ ,  $dU$  and  $dH$  for the expansion of ideal gases under isothermal and adiabatic condition for reversible process.

### XII. Thermochemistry

Standard state, standard enthalpy of formation- Hess law and its applications, heat of reaction at constant pressure and constant volume, Enthalpy of neutralization, bond dissociation energy and its calculation for thermochemical data, temperature dependence of enthalpy, Kirchoff's equation.

## COURSE IV BCH104 LABORATORY COURSES I

3 credits

(Inorganic, Organic and Physical)

### Inorganic Chemistry Lab I

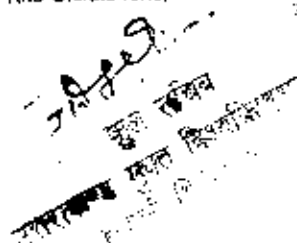
#### Unit 1: Introduction Lab techniques: Inorganic Chemistry

(One session)

- 1.1 Introduction
- 1.2 Laboratory Note book
- 1.3 Laboratory Apparatus and Operation: Heating, Evaporation, Precipitation, Digestion, Filtration, Drying and Ignition of precipitation, cooling, weighing;
- 1.4 Common Laboratory reagents
- 1.5 Laboratory Safety

#### Unit 2: Identification of Anion (Known)

- 1.1 Classification of the anion: Anion of class I, Anion of class II, Anion of class III.
- 1.2 Preliminary Tests for the Anions: Preliminary Tests for the Anions of class I, Preliminary Tests for the Anions class II
- 1.3 Preparation of solution for Identification of the anion. Preparation of water extract, Preparation of Sodium Carbonate extract.
- 1.4 Confirmatory test for the Anion: Test for the Sulphide ions, Test for the Sulphite ions, Test for the Thiosulphate ions, Test for the Nitrile ions, Test for the acetate ions, Test for the Nitrate ions, Test for the Oxalate ions, Test for the Chloride ions.





Test for the Bromide ions, Test for the Iodide ions, Test for the Fluoride ions, Test for the Sulphate ions. Test for the Phosphate ions, Test for the Borate ions; Special test for the mixtures of the anions.

### Unit 3: Identification of cation (Known)

- 3.1 Classification of the cation into Analytical groups
- 3.2 Solubility and solubility product: Relation between Solubility and Solubility products.
- 3.3 The common ion effect; complex formation
- 3.4 The separation of Cations in to analytical Groups: The precipitation of Group I cations, the separation of Group II cation from Group IV Cations, The Precipitation of Group III Cations, The Precipitation of Group V Cations.
- 3.5 Preliminary Investigation of the Sample
- 3.6 Preparation of solution for the analysis of Cations
- 3.7 Separation of cation into Analytical Groups
- 3.8 Analysis of the cations of Analytical Group I: Separation and Identification of the cations of Analytical Group I
- 3.9 Analysis of the cations of analytical Group II: Separation of Analytical Group II in to group IIA and Group IIB, Separation of the Cations of group IIA, Separation of the Cations of group IIB, Identification of the cations of Group II
- 3.10 Analysis of the cations of analytical Group III: Separation and Identification of the cations of analytical Group III.
- 3.11 Analysis of the cations of analytical Group IV: Separation and identification of the cations of Analytical group IV, Analysis of the cations of analytical Group V Separation and identification of the cations of Analytical group V.
- 3.12 Analysis of the Cations of analytical group VI
- 3.13 Analysis of the Cations of analytical group zero

### Organic Chemistry Lab I

#### Unit 1: Introduction Lab techniques: organic Chemistry

- 1.1 Determination of melting point
- 1.2 (Naphthalene, Urea, Benzoic acid, Succinic acid etc.): Any two
- 1.3 Determination of boiling point and Distillation
- 1.4 (Toluene, Ethanol, Propanol, ethyl acetate)
- 1.5 Crystallization
- 1.6 Sublimation (Camphor, Phthalic acid, Succinic acid)

#### Unit 2: Separation Techniques

- 2.1 Simple distillation Methods
- 2.2 Solvent Extraction Method

#### Unit 3: Qualitative Analysis

- 3.1 Detection of N,S, Halogens
- 3.2 Functional group identification with known samples
- 3.3 Identification of known functional group

#### Physical Chemistry Lab I

##### Unit 1: Introduction Lab techniques: Physical Chemistry

Use of Apparatus: Pipette, Burette, Volumetric flask, Balance

###### 1.1 Use of Burner

-Luminous flame

-Non luminous flame

Introduction to Instruments

###### 1.2 Colorimeter

###### 1.3 Conductometer

###### 1.4 Handling of Data

###### 1.5 Data analysis

###### 1.6 Error Calculation

###### 1.7 Plotting of Graph

###### 1.8 Writing of Experiments

###### 1.9 Safety measures and First Aid

##### Unit 2: Determination of Surface Tension ( Any two)

###### 2.1 Organic liquid (alcohol)

###### 2.2 Detergent (Sodium dodecyl sulphate or cetyltrimethyl ammonium borate)

###### 2.3 Determination of composition of solvent mixture

##### Unit 3: Determination of Viscosity

###### 3.1 Cane sugar solution or Glycerol (more than 5%)

###### 3.2 Detergent /Determination of CMS(Critical micelle concentration)

##### Unit 4: pH Measurement

###### 1.1 Measurement of pH of simple solution (aq. Strong acid/ strong base or weak acid / weak base at different dilution)

###### 1.2 pH of extract fruits i.e. orange, lemon, grapes and vinegar

##### Unit 5: Thermochemistry

###### 1.1 Heat capacity

###### 1.2 Enthalpy of solution

###### 1.3 Enthalpy of neutralization for weak acid with strong base or weak base with strong acid

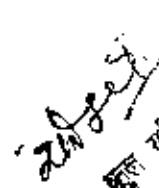
###### 1.4 Enthalpy of ionization

II<sup>nd</sup> Year

COURSE-V BCH201 INORGANIC CHEMISTRY- II

3 credit

  
18

  
18

**II. Chemistry of elements of first transition series**

Characteristic properties of d-block elements. Properties of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation state, coordination number and geometry

**III. Chemistry of elements of second transition series**

General characteristics, comparative study with their 3d-analogues in respect of ionic radii, oxidation state, magnetic behavior, spectral properties and stereochemistry.

**IV. Chemistry of elements of Third Transition series**

General characteristics, comparative study with their 3d-analogues in respect of ionic radii, oxidation state, magnetic behavior, spectral properties and stereochemistry.

**V. Chemistry of Lanthanide elements**

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

**VI. Chemistry of Actinides elements**

General feature and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the latter actinides and the latter lanthanides.

**VII. Coordination compounds**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds.

**VIII. Isomerism of Co-ordination Compounds** isomerism in coordination compounds, valence bond theory of transition metal complex.

**IX. Oxidation and Reduction**

Use of redox potential data- analysis of redox cycles, redox stability in water-Frost, Latimer and Pourbaix. Principles involved in the extraction of the element.

**X. Acids, Base and Salts**

General concept of acid and base. Theory of acid and base- Arrhenius, Bronsted-Lory, the Lux-Flood, Solvent system and Lewis concept of acids and base.

**COURSE-VI BCH 202 ORGANIC CHEMISTRY- II**

**3 credit**

**I. Alcohals**

Classification and nomenclature

**Monohydric alcohols-** nomenclature, method of formation by reduction of aldehydes, ketones, carboxylic acids and esters  
Acidic nature. Physical properties, chemical reactions of alcohols.

**Dihydric alcohols-** Nomenclature, methods of formation, physical properties and chemical reactions of vicinal glycols  
**trihydric alcohol-** nomenclature and methods of formation, chemical reactions of glycerol.

**II. Phenols**

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic character of alcohols and phenols, Chemical reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation.

Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Houben-Hoesch reaction, Lederer-Mannich reaction and Reimer-Tiemann reaction.

### III. Ethers and Epoxides

Nomenclature of ethers and methods of formation, physical properties. Chemical properties. Synthesis of epoxides. Acid and base catalysed ring opening of epoxides. Orientation of epoxide ring opening.

### IV. Aldehydes

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes with particular reference to the synthesis of aldehyde from acid chloride, synthesis of aldehyde using 1,3-dithianes. Physical properties.

Mechanism of nucleophilic addition to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.

Oxidation of aldehydes. Baeyer-Cannizzaro reaction. MPV reaction, Clemmensen reaction.

### V. Ketones

Nomenclature and structure of ketones. Synthesis of ketones, synthesis of ketone from nitriles and carboxylic acid. Physical properties. Chemical reactions of ketone. Villiger oxidation of ketone, Wolff-Kishner reaction. Halogenation of enolizable ketone.

### VI. Carboxylic acid

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids. Effect of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acids: malic, tartaric and citric acids.

### VII. Functional Derivatives of Monocarboxylic Acids

Structure and nomenclature of acid chlorides, esters, amides and acidhydrides. Relative stability of acyl derivative. Physical properties. Preparation of carboxylic acid derivatives, chemical reactions. Mechanism of esterification and hydrolysis (acidic and basic).

VIII. Organic Compounds of Nitrogen (Nitro compounds) Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Picric acid.

### IX. Amino Compounds

Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Preparation of alkyl and aryl amines, reduction amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromination reaction.

### X. Organosulphur and Organo Phosphorus Compounds

Introduction, thioether, preparation of Thiols and Thioethers, properties of Thiols and Thioethers.

### References

1. S. Bahl 'Advanced organic Chemistry', S. Chand. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapters-6,24)
2. Paula Y. Bruice, 'Organic Chemistry' - 3rd Edn. Pearson Education Asia.

COURSE-VII BCH203 PHYSICAL CHEMISTRY-II

3 credit

## I. Thermodynamics II

Second law of thermodynamics: need for the law, different statement of the law. Carnot cycles and its efficiency. Carnot theorem. Thermodynamic scale of temperature.

## II. Concept of entropy

Entropy as a state function, entropy as a function of  $V$  and  $T$ , entropy as a function of  $P$  and  $T$ , entropy change in physical change. Entropy change in ideal gases and mixing of gases. Clausius inequality.

## III. Chemical Equilibria

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore. Clapeyron equation and Clapeyron-Clapeyron equation. applications.

## IV. Ionic Equilibria

Introduction. Electrolytes and Non-electrolytes: Acids, Bases and Salts, ionic product of water, Common Ion Effect. Ionic Equilibria in weak Acids and Bases including Multistage Equilibria. pH Scale Exact treatment of Calculation of  $H^+$  ions and pH for HA and BOH. Hydrolysis- Salt hydrolysis, hydrolysis constant, pH calculation, Degree of hydrolysis, Titrations Acid-Base Titration Curve. Buffer solution. Buffer capacity, Henderson equation. Solubility and solubility product. Indicators. Common ion effect and the Solubility of a Sparingly soluble salt

## V. Phase Equilibrium I

Statement and meaning of the term- phase, component and degree of freedom, derivation of Gibbs phase rule. phase equilibrium of one component system- water,  $CO_2$  and S system. Phase equilibrium of two component system- solid liquid equilibrium. simple eutectic- Bi- Cd, Pb-Ag system. desilverisation of lead.

## VI. Phase Equilibrium II

Solid solution- compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl- $H_2O$ ). ( $FeCl_3$ - $H_2O$ ) and ( $CuSO_4$ - $H_2O$ ) system. Freezing mixtures. acetone-dry ice.

Liquid- liquid mixtures- Ideal liquid mixtures. Raoult's and Henry's law. Non-ideal system- azeotropes- HCl- $H_2O$  and ethanol-water systems.

Partially miscible liquids- Phenol water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Immiscible liquids, Steam distillation.

## VII. Surface Chemistry

Types of absorption, Freundlich's and Langmuir's absorption isotherm and their , charge on the colloidal particle, size of the colloidal particle, Perrin's method of determination of the Avogadro's number.

## VIII. Electrochemistry-I

Electrical transport- conduction in metal and in electrolyte solution, specific conductance and equivalent conductance. measurement of equivalent and specific conductance with dilute.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. weak and strong electrolytes. Ostwald's dilution law its uses and limitations. Debye-Huckel- Onsager's equation for strong electrolytes. Transport number. definition and determination by Hittorf method and moving boundary method.

Application of conductivity measurements: determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of sparingly soluble salt, conductometric titrations

#### IX. Electrochemistry-II

Types of reversible electrodes- gas- metal ion, metal-metal ion, metal insoluble salt- anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode reference electrodes- standard electrode potential, single conventions, electrochemical series and its significance.

#### X. Electrolytic and Galvanic cells

Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reaction ( $\Delta G$ ,  $\Delta H$  and  $K$ ), polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, applications of concentration cells, valency of ions, solubility product and activity coefficient potentiometric titration.

COURSE VIII BCH204 LABORATORY COURSES II

3 credit

(Inorganic, Organic and Physical)

### Inorganic Chemistry Lab - II

#### Block I: Inorganic Quantitative analysis

##### Unit 1: Introduction to Lab Techniques: Inorganic Chemistry

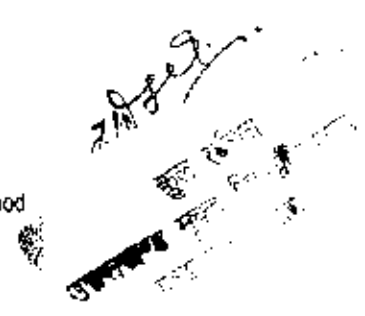
- Introduction
- Laboratory Note Book
- Apparatus commonly used: How to use a Pipette, How to use Burette, How to use a Volumetric Flask, How to use an Analytical balance.
- Heating, Evaporation, Precipitation, Digestion, Filtration, Drying and Ignition of Precipitates, colling.
- Standard Solution; Titration: Types of Indicators, Types of Titration;
- Sample Titrimetric Experiment: Determination of Strength of given Sodium hydroxide solution: Instrumental determination of Equivalence point;
- Lab reagents
- Safety Measures in the Laboratory

##### Unit 2: Gravimetric Analysis (Any two)

- Determination of Aluminium as Aluminium (III) Oxide
- Determination of Aluminium as Aluminium 8-Hydroxyquinolate
- Determination of Copper as Copper (I) Thiocyanate
- Determination of Iron as Iron (III) Oxide
- Determination of Sulphate ions as Barium Sulphate

##### Unit 3: Volumetric Analysis (Any Four)

- Determination of Sodium Carbonate and Sodium hydroxide in a mixture by Indicator method



- Determination of the percentage of Iron in given Iron Filings solution by Permanganometry
- Determination of the percentage of Iron in given Iron Filings solution by Chromatometry
- Determination of the percentage of Iron in given Iron Filings solution by Iodometric method
- Determination of total hardness of water by Complexometry

**Block 2: Inorganic Preparation and separation**

**Unit 4: Inorganic Preparation (Any two)**

- Preparation of Potash Alum
- Preparation of Tetraamminecopper (II) Sulphate Monohydrate
- Preparation of Potassium Trioxalatoferrate(III) Trihydrate

**Unit 5: Separation Method**

- Ion Exchange
- Solvent Extraction

**Organic Chemistry Lab II**

**Unit 6: Introduction to Lab Techniques: Organic Chemistry**

**Unit 7: Organic Preparations**

- Acetanilide (Subject to availability of  $(\text{CH}_3\text{CO})_2\text{O}$  Otherwise use  $\text{CH}_3\text{COCl}$ )
- Nitroacelanilide
- Naphyl Benzoate
- Aspirin to Salicylic acid (Hydrolysis)
- Claisen Condensation (Acetophenone/ethylacetate)
- Isolation of Caffeine from tea leaves
- Isolation of ricinoleic acid from Castor oil (Hydrolysis and then solvent extraction)

**Unit 8: Estimation Methods**

- Sugars
- Amino acid
- Hydroxi group
- Iodine value (Ricinoleic acid)

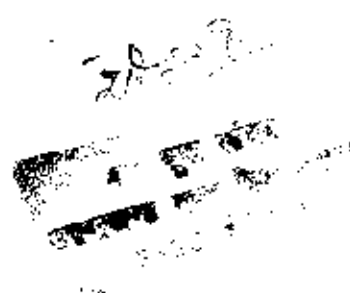
**Unit 9: Multistep Synthesis**

- Adipic acid from cyclohexanol
- Acetanilide to Azodyevia Aniline
- Synthesis of Nylon 6, 6
- Synthesis of Aspirin

**Physical Chemistry Lab - II**

**Unit 10: Phase Equilibria**

- CST: Phenol- Water system
- Effect of NaCl/Succinic acid on CST of Phenol- Water system



#### Unit 11: Partition Coefficient

- Iodine in water and  $\text{CCl}_4$ / Toluene/ Chloroform
- Benzoic acid in to  $\text{H}_2\text{O}$  & Toluene

#### Unit 12: Phase diagram of Simple Eutectic system

- Resorcinol - Benzoic acid
- Naphthalene- Benzoic acid

#### Unit 13: pH Titration

- Acid base Titration

#### Unit 14: Conductometric Titration

- Acid- Base Titration
- Precipitation Titration

#### Unit 15: Potentiometric Titrations

- Acid- base Titration
- Redox P [ $\text{Fe}^{3+}/\text{Fe}^{2+}$ ]/ Dichromate] Titration

#### Unit 16: Kinetics

- Kinetics of Acid catalysed
- Kinetics of base catalysed (Conductometry)
- Clock reaction
- Iodination of acetone by Colorimetry

III<sup>rd</sup> Year

COURSE-IX BCH301 INORGANIC CHEMISTRY- III

3 credit

#### I. Hard and Soft Acid and Base (HSAB)

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

#### II. Metal Ligand bonding in Transition metal Complexes

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planer complexes, factor effecting the crystal field parameter.

#### III. Magnetic properties in Transition metal Complexes

Types of magnetic behavior, Methods of determining magnetic susceptibility-Guyed and Quinckes method, spin only formula. orbital contribution to magnetic moments. application of magnetic moment data of 3d-metal complexes.

#### IV. Electron spectra of Transition metal-Complexes

Types of electronic transitions, selection rule for d-d transition, spectroscopic ground state spectrochemical series. Orgel-energy level diagram for  $d^1$  and  $d^9$  state, discussion of the electronic spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

#### V. Thermodynamic and Kinetic Aspects of metal Complexes

A brief outline of thermodynamic and kinetic stability of metal complexes and factor effecting and stability, substitution, reactions of square planer complexes.



#### VI. Organometallic chemistry

Mononuclear carbonyls and nature of bonding in metal carbonyls. Definition, nomenclature, classification, general methods of preparation of organometallic compounds and a brief account of metal-ethylene complexes. Alkyl and Aryl derivatives of alkali and alkaline earth metal.

#### VII. Bioinorganic Chemistry

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

#### VIII. Silicones and Phosphazenes

Silicones and Phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

#### IX. Electromagnetic Spectrum: Absorption Spectra

Ultraviolet (UV) absorption spectroscopy- Absorption law (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transition, effect of conjugation. Concept of chromophore and auxochrome. Absorption shift (Bathochromic, hypsochromic, hyperchromic and hypochromic shift). Applications of UV spectroscopy.

COURSE-X BCH302 ORGANIC CHEMISTRY- III

3 credit

#### I. Nuclear magnetic resonance (NMR) spectroscopy

Proton magnetic resonance ( $^1\text{H}$  NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

#### II. Organometallic Compounds

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

#### III. Organosulphur Compounds

Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphuric acid, sulphonamides and sulphguanidine.

#### IV. Heterocyclic compounds I

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

#### V. Heterocyclic compounds II

Introduction to condensed five and six numbered heterocycles. Preparation and reactions of quinoline and isoquinoline with special reference to Fisher indol synthesis, Skraup synthesis and Bischler Napieralski synthesis. Mechanism of electrophilic substitution reaction of quinoline and isoquinoline.

#### VI. Amino acids, Peptides and Proteins

Classification, structure and stereochemistry of amino acids. Acid base behavior, isoelectric point and electrophoresis. Structure and nomenclature determination, end group analysis, selective hydrolysis of peptides and proteins. Level of protein structure. Protein denaturation. Enzymes, Coenzymes, Cofactors and Vitamins.

## VII. Carbohydrate

Classification and nomenclature. Monosaccharides, mechanism of osone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldose. Configuration of monosaccharides. Erythro and threo diastereomers conversion of glucose, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+) glucose. Mechanism of mutarotation. General study of disaccharides. General introduction of structure of ribose and deoxyribose.

## VIII. Lipids

Introduction, Classification and Types of Lipids, important Structural features, Industrial features.

## IX. Nucleic acids and Fats

Nucleic acids: introduction. Constituents of nucleic acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA, Genetic code.

Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils, saponification value, iodine value and acid value. Soap, synthetic detergents, alkyl and aryl sulphonates.

## X. Fats Oils and Detergents

Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soap, synthetic detergents, alkali and aryl sulphonate.

## XI. Synthetic Dyes

Colour and constitution (electronic concept) Classification of dyes. Synthesis and use of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.

## XII. Natural products

Classification, extraction and general methods of structure determination of terpenoids: limonene, citral and alkaloids: nicotine, cocaine.

## COURSE-XI BCH303 PHYSICAL CHEMISTRY- III

3 credit

### I. Elementary Quantum Mechanics

Black body radiation, Planck's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects. Compton Effect, de-Broglie Hypothesis, the Heisenberg's uncertainty principles, Hamiltonian operator, Schrödinger wave equation and its importance (with derivation), physical interpretation of the wave function, postulates of quantum mechanics. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance.

### II. Fundamentals of Spectroscopy

Introduction of Spectroscopy, importance of Spectroscopy, The Electromagnetic Radiation, regions of the spectrum, basic features of different spectrometers. Difference between Atomic and molecular Spectroscopy. Absorption and Emission spectra. Born-Oppenheimer Approximation

### III. Rotational Spectrum

Diatomic molecules, energy levels of a rigid rotor (semi classical principles), selection rule, rotational spectra of rigid diatomic molecule, determination of bond length, numerical problems.

### IV. Vibrational Spectrum

Handwritten signature and stamp  
श्री. श्री. श्री.  
श्री. श्री. श्री.  
श्री. श्री. श्री.  
श्री. श्री. श्री.

Infrared spectrum, energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

#### V. Infrared spectrum

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

#### VI. Raman spectrum

Concept of polarizability, selection rules, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

#### VII. Photochemistry

Introduction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry. Grothus - Drapper law, Stark-Einstein law, Jablonski diagram qualitative description of fluorescence, phosphorescence, non-radiative processes (Internal conversion, Intersystem crossing), quantum yield, photosensitized reactions.

#### VIII. Physical properties and molecular structure

Optical activity and its measurement, dipole moment and its measurement by temperature change method, magnetic property and its measurement by Guoy balance method. Applications of optical activity, dipole moment and magnetic property for determination of structure of molecule.

#### IX. Solution, Dilute solution and colligative properties

Ideal and non ideal solution, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapor pressure, molecular weight determination. Osmosis, law of osmotic pressure, and its measurement, determination of molecular weight from osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Abnormal molar mass, degree of dissociation and association of solute.

#### X. Thermodynamics III

Statement and concept of residual entropy and enthalpy, third law of thermodynamics, unattainability of absolute zero. Nernst heat theorem, Evaluation of absolute entropy from heat capacity data.

**COURSE XII BCH 204 LABORATORY COURSES II**

**3 credit**

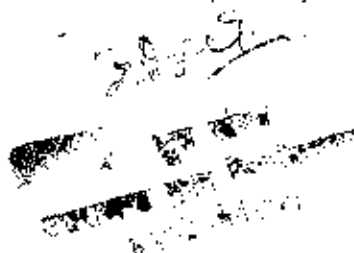
**(Inorganic, Organic and Physical)**

### Inorganic Chemistry

**Unit 1: Introduction Lab Techniques: Inorganic Chemistry**

**Unit 2: Synthesis and Analysis (Any two)**

- Preparation of Sodium trioxalato ferrate (III),  $\text{Na}_3[\text{C}_2\text{O}_4]_3\text{SO}_4$  and determination of its composition by permanganometry.



- Preparation of Ni-DMG complex,  $[\text{Ni}(\text{DMG})_2]$
- Preparation of copper tetraamine complex  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
- Preparation of *cis* and *trans*-bioxalato diaque chromate (III) ion.

#### Unit 3: Solvent Extraction

- Separation and estimation of Mg (II) and Zn (II)

#### Organic Chemistry

#### Unit 4: Qualitative Analysis

- Analysis of an organic mixture containing two solid components using water,  $\text{NaHCO}_3$ ,  $\text{NaOH}$  for separation and preparation of suitable derivatives.

#### Unit 5: Synthesis of Organic Compounds (Any two)

- Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol
- Preparation of iodoform from ethanol and acetone
- Nitration- Preparation of *p*-bromoacetanilide and Preparation of 2,4,6-tribromophenol
- Preparation of benzoic acid from toluene
- Preparation of aniline from nitrobenzene
- Preparation of *m*-nitroaniline from *m*-dinitrobenzene

#### Physical Chemistry

#### Unit 6: Molecular weight determination

- Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g.  $\text{NaCl}$ ) in aqueous solution at different concentrations by ebullioscopy.

#### Unit 7: Electrochemistry

- To determine the strength of the given acid conductometrically using standard alkali solution.
- To study the saponification of ethyl acetate conductometrically.
- To determine the ionization constant of weak acid conductometrically.

Handwritten signature and a stamp. The stamp is from the Department of Chemistry, Government College, Patna, Bihar, India. The text on the stamp includes 'DEPARTMENT OF CHEMISTRY', 'GOVERNMENT COLLEGE', 'PATNA, BIHAR, INDIA', and '2019-2020'.

Handwritten signature and a stamp. The stamp is from the Department of Chemistry, Government College, Patna, Bihar, India. The text on the stamp includes 'DEPARTMENT OF CHEMISTRY', 'GOVERNMENT COLLEGE', 'PATNA, BIHAR, INDIA', and '2019-2020'.

## Subject: Forestry

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
<b>FIRST YEAR</b>			
I	Principles of Silviculture (वन संवर्धन के सिद्धांत)	FR 01	3
II	Forest products & utilization (वन उत्पाद एवं उपयोग)	FR 02	3
III	Forest Protection (वन रक्षण)	FR 03	3
IV	Practical forestry I (प्रायोगिक वानिकी)	FR 04	3
<b>SECOND YEAR</b>			
I	Environment & Ecology (पर्यावरण एवं पारिस्थितिकी)	FR 05	3
II	Social forestry and agro-forestry (सामाजिक वानिकी एवं कृषि वानिकी)	FR 06	3
III	Plantation Forestry (प्लान्टेशन वानिकी)	FR 07	3
IV	Practical forestry II (प्रायोगिक वानिकी II)	FR 08	3
<b>THIRD YEAR</b>			
I	Natural resource management (Forest and Wildlife Management) (प्राकृतिक संसाधन प्रबंधन (वन एवं अन्य जीव प्रबंधन))	FR 09	3
II	Wood Science & Technology (वुड साइंस एवं प्रौद्योगिकी)	FR 10	3
III	Forest mensuration and biostatistics (वन क्षेत्रमिति एवं जैव सांख्यिकी)	FR 11	3
IV	Practical forestry III (प्रायोगिक वानिकी III)	FR 12	3

### FR 01 PRINCIPLES OF SILVICULTURE (Credits 03)

Definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. Definition, objectives and scope of Silviculture. Status of forests in India and their role. History of forestry development in India.

Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Role played by light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimate and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, and topography on the soil formation. Soil profile - physical and chemical properties, mineral nutrient and their role, soil moisture and its influence on forest production. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Impacts of controlled burning and grazing. Influence of forests on environment.

**Growth and development.** Trees and their distinguishing features. Forest reproduction - flowering, fruiting and seeding behaviour. Natural, artificial and mixed regeneration. Natural regeneration - seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. Plant succession, competition and tolerance. Forest types of India and their distribution.

**Silvicultural system:** Definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate and progressive strip systems. Shelterwood system - Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications. Coppice system, Choice of silvicultural system. Dauerwald concept. Culm selection system in Bamboo. Tending operations - weeding, cleaning, thinnings, definitions, objectives and methods, increment felling and improvement felling, Pruning and lopping. Control of climbers and undesirable plants.

**Silviculture of some important Indian Trees:** Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems and economic importance of the following conifer and broadleaved tree species of India. **Conifers:** Abies pindrow, Cedrus deodara, Pinus roxburghii, Pinus gerardiana.

**Broad leaved species:** Tectona grandis, Shorea robusta, Dalbergia sissoo, Quercus spp. Alnus spp. Populus spp, Eucalyptus spp. Terminalia spp., Santalum album, Azardirachta indica, Madhuca indica, Leucaena leucocephala

*[Handwritten signatures and marks]*

and Bamboos.

### FR 02 FOREST PRODUCTS & UTILIZATION (Credits 03)

**Wood Products and Utilization:** Pulp and paper industry. Introduction and raw material; pulping-mechanical, chemical, semichemical and semi-mechanical; pulp bleaching; stock preparation and sheet formation; types of paper; manufacture of rayon and other cellulose derived products. Manufacture, properties and uses of Composite wood- plywood, fiberboard, particleboard and hard board. Adhesives used in manufacture of composite wood. Improved wood-definition, types (impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood). Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast.

**Utilization of Non-Timber Forest Products:** Introduction, methods of collection, management and importance of Non-Timber Forest Products (NTFP). Fodder (grasses and tree leaves), canes and bamboos. Essential Oils - methods of extraction, classification, storage and uses. Non-essential oils - nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees.

Gums and resins -definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants. Dyes - classification and sources of dyes. Beedi leaves - sources, collection and processing. Fibers and flosses. Katha and Cutch - sources, extraction and uses. Drugs, wild fruits, spices, poisons and bio-pesticides;

**Medicinal and aromatic plants:** History, scope, opportunities and constraints in the cultivation and utilisation of medicinal and aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and aftercare, training and pruning, nutritional and water requirements. Plant protection, harvesting, processing and economics of under mentioned important medicinal and aromatic plants.

**Medicinal Plants:** pepper, cardamom, clove, ginger, turmeric, betelvine, periwinkle, Rauwolfia, Dioscorea, isabgol, Ammi majus, belladonna, Cinchona, pyrethrum and other species relevant to local conditions.

**Aromatic Plants:** Citronella grass, khus grass, sweet flag (bach), lavender, geranium, patchouli, bursera, Mentha, muskdana (musk mallow), Ocimum and other species relevant to the local conditions. Endangered medicinal and aromatic plants of India and their conservation. Study of chemical composition of a few important medicinal and aromatic plants, their extraction and use. Therapeutic and pharmaceutical uses of important species.

### FR 03 FOREST PROTECTION (Credits 03)

Definition, role of forests in relation to environment and human welfare, historical evidence of damage, factors effecting forest protection, history of forest protection in India and classification of protection measures.

Man as a source of injury to forests: deforestation, shifting cultivation, encroachment, mining and felling. Forest fire: Classification of forest fire, damage, controlled use of fire, protective and remedial measures, fire control policy and economics of fire protection.

Protection against injuries by animals: grazing and browsing, rotational and controlled grazing, effect of wild animal on forest regeneration. Protection against injuries by diseases: classification of forest tree diseases and their control; common diseases in forests- root rot, heart rot, wilt, stem canker, stem rust, die-back galls, leaf spots, leaf blight, powdery mildew and leaf rust.

Protection against injuries by plants: defoliation, sap suckers and mites, shoot twig and root insects, seed and cone insects, wood boring insects and gall makers.

Methods of control against insects and pests- silvicultural, biological and chemical control.

Diseases caused by phanerogamic plant parasite like dendrophthoe, acanthobium, loranthus.

Protection against adverse climatic factors- Temperature, Rainfall, and winds.

### FR 04 PRATICAL I (Credits 03)

Acquaintance with various technical terms and equipments used in silvicultural practices. Visit to nearest forest area and identification of different forest species. Study of growth and development of forest species (Composition, Measurement of CBH / DBH and calculation of total basal area, frequency, density, abundance and IVI). Study of shoot development, growth rings, crown development, leafing flowering and fruiting Study

Kumar  
T

Handwritten signature and stamp of the institution.

of factors of locality (temperature, moisture content, bulk density, pH, rainfall measurement). Study of morphology and phenology of trees. Study of injury to forest by man in nearby locality. Study of impacts of forest fires in nearby locality and measures carried out by forest department to control it. Identification and uses of important non-wood forest produce with special reference to Uttarakhand Visit to some progressive bee keepers. Study of various bee keeping instruments, bee products and their utilization. Identification and collection of fibres of economic importance. Identification & collection of herbaria of medicinal & aromatic plants and documentation of its uses. Study of different wood products. Study of important tree disease. Study of wood density and gravity. Collection of plants yielding natural dyes.

#### **FR 05 ECOLOGY & ENVIRONMENT (Credits 03)**

Introduction to ecology: division, concept, scope and importance of ecology; Ecosystem: structure & function; Important ecosystems: forest, grassland, desert and pond, Ecological energetics: concept of energy flow, trophic structure, food chain, food web and ecological pyramids; Forest communities, vegetational analysis, biomass, productivity and forest floor mass, litter decomposition, forest soil development and nutrient cycling; Locality factors: climatic factors, topographic factors, edaphic factors & biotic factors; Succession; hydrology of forest ecosystem; forest classification: Champion & Seth's classification, forest types of India, Environment: definition, concept, components; Environmental pollution; Biodiversity and its conservation.

#### **FR 06 SOCIAL FORESTRY & AGRO-FORESTRY (Credits 03)**

Definition, concept and types of social forestry and agroforestry; Social forestry plantations: energy, road side, river bank, coastal, marshy, waterlogged, sand dunes and mountainous regions; Fodder and fuel species in Uttarakhand; Tree crop interactions in agroforestry; Importance of agroforestry; Fodder plants, fuel and medicinal plants in agroforestry; agroforestry for livelihood and soil and water conservation;

**Agroforestry** – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, hortisilvipastoral, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree crop species for agro-forestry. **Agroforestry projects** – national, overseas, MPTS – their management practices, economics of cultivation – nursery and planting (Acacia catechu, Dalbergia sissoo, Tectona, Populus, Morus, Grewia, Eucalyptus, Quercus spp. and bamboo, tamarind, neem etc.); Tree crop interactions in agroforestry; Importance of agroforestry; Fodder plants, fuel and medicinal plants in agroforestry; agroforestry for livelihood and soil and water conservation

#### **FR 07 PLANTATION FORESTRY (Credits 03)**

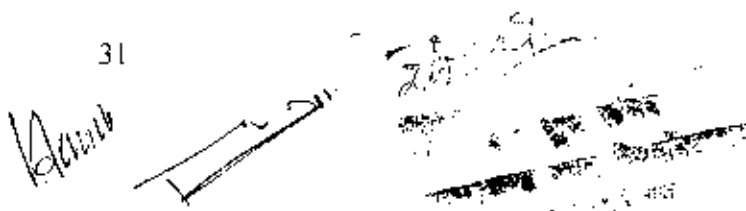
Definition, scope and impediments. Plantation forests - planting plan, plantation records, maps. Plantation establishment - legal title of land, survey, site selection. Site preparation - purpose and methods. Planting - layout, time of planting, planting pattern, spacing, gap filling, planting methods, direct seedling. Choice of species on ecological aspects - afforestation of dry land, wet land, other adverse sites and taungya. Enrichment planting, nurse and cover crops. Intercultural operations. Plantation maintenance - weed control, climber cutting, staking, singling and pruning. Thinning - definition, objectives. Effects of thinning - physiological and mensurational. Effect of methods of thinning on stand development. Energy and industrial plantation - definition, scope, species, establishment, management and impact on environment. Plantation economics.

#### **FR 08 PRATICAL II (Credits 03)**

Knowledge of some important ecological instruments and their applications- Hygrometer, Rain gauge, Anemometer, Altimeter, thermometer; Sampling of vegetation; Quantitative Analysis (density, frequency, abundance, A/F ratio, cover, total basal area); Important Value Index (IVI); Understanding various agroforestry systems; Identification of seeds; identification of timber

#### **FR 09 NATURAL RESOURCE MANAGEMENT (FOREST & WILDLIFE MANAGEMENT) (Credits 03)**

**Forest Management:** Introduction: definition and scope. Peculiarities of forest management. Principles of forest management and their applications. Objects of management, purpose and policy Sustained and progressive yield concept and meaning. General definitions – management and administrative units, felling



cycle, cutting section. Rotations: definition, kinds of rotations, choice of rotations, length of rotations and conversion period. Normal forest: definition and concept. Evenaged and unevenaged models. Estimation of growing stock, density, quantity and increment. Yield regulation - general principles of even aged and unevenaged forest crop. Yield regulation based on area, volume, area and volume, increment and number of trees. Working Plan - definition, objects and necessity

**Wildlife Management:** History of wildlife management and conservation in India; cultural background. Habitat management: Purposes, principles, practices and tools-fire, cutting, grazing. Habitat interspersion and edge effect. Provision of water, saltlicks and food. Zoning - core, buffer, tourism and multiple use in protected areas. Wildlife damage control: Mitigating human - wildlife conflict: fences, trenches, walls, lure crops, repellents, translocation and compensation. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife census: Purpose, techniques. Direct and Indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities. Wildlife (Protection) Act, 1972. Protected areas - Sanctuary, National Park and Biosphere Reserves. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, Red Data Book, Category of threat, CITES. Conservation: Meaning, principles and strategies, in-situ and exsitu conservation, conserving biodiversity. Politics-socioeconomics, role of education and extension.

### FR 10 WOOD SCIENCE & TECHNOLOGY (Credits 03)

Wood as raw material, kinds of woods- hardwood, softwood; bamboos and canes. Merits and demerits of wood as raw material. The physical features of wood. Mechanical properties of wood like tension, compression, bending, shearing cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Electrical and acoustic properties of wood. Wood water relationship - shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning - merits, principles and types - air seasoning, kiln seasoning and chemicals seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control. Wood preservation - principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). Classification of timbers based on durability. General idea about fire retardants and their usage. Non-pressure methods - steeping, dipping, soaking open tank process, Boucherie process. Pressure methods - full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing - techniques, kinds of saws - cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

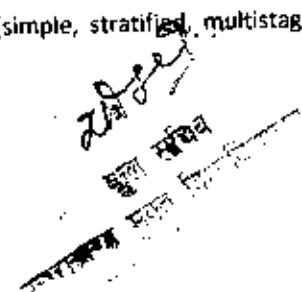
### FR 11 FOREST MENSURATION AND BIostatISTICS (Credits 03)

Introduction, definition, objectives and scope of forest mensuration. Scales of measurement (nominal, ordinal, interval and ratio scale). Units of measurement, standards of accuracy 129, implied in their expression. Measurement of single tree - objectives, standard rules governing measurement at breast height. Measurement of tree diameter and girth using rulers, callipers and tapes. Comparison between tape and calliper measurements. Measurements of upper stem diameter and instruments such as Ruler, Finish Parabolic Calliper, Relaskop, Pentaprism. Bark measurements - objectives, thickness, surface area and volume. Crown measurements - objectives, diameter, height, surface area and volume. Height measurements - direct and indirect methods. Height measurement employing geometric and trigonometric principles, height measuring instruments, errors in height measurement. Measurement of cross sectional area, basal area, bole surface area, leaf area. The tree stem form, taper and classification of form factors and form quotient. Volume estimation of felled and standing trees and formulae involved. Volume tables-definition and their classification, (general, regional and local volume tables), merchantable volume tables. Preparation of volume tables. Stand growth, site quality, site index, stand structure, yield tables and preparation of yield tables. Biomass measurement. Determination of age of trees. Tree growth measurements, objectives increment, determination of increment, stump analysis, stem analysis and increment boring. Measuring tree crops - objectives, diameter, diameter and girth classes, height measurement of crop, crop age and crop volume.

Stand

tables. Forest inventory- definition, objectives, kinds of enumeration.

Sampling - definition, advantages, kinds of sampling, random sampling: (simple, stratified, multistage and





multiphase sampling). Non random sampling (selective, systematic and sequential sampling) sampling design, size and shape of the sampling units. Point sampling - horizontal and vertical point sampling.

**FR 12 PRATICAL III (Credits 03)**

Measurement of tree diameter by measuring tape; Measurement of tree diameter by Calliper; Rules of breast height measurement; Various instruments used in height measurement of trees; Measurement of height of tree; Measurement of leaf area; Measurement of volume of trees; Increment borer; Measurement of increment; Sampling design and kinds of sampling

*Handwritten signature*

**SUBJECT : GEOGRAPHY**

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
<b>FIRST YEAR</b>			
1.	Fundamentals of Physical Geography	GE-101	04
2.	Geography of India	GE-102	04
3.	Practical Geography	GE-103	04
<b>SECOND YEAR</b>			
5.	Human Geography	GE-201	04
6.	Geography of Asia	GE-202	04
7.	Practical	GE-203	04
<b>THIRD YEAR</b>			
8.	Evolution-of Geographical Thought	GE-301	04
9.	Economic Geography	GE-302	04
10.	Practical Geography	GE-304	04

**GE-101 FUNDAMENTALS OF PHYSICAL GEOGRAPHY**

**UNIT SCHEDULE**

**Block-1 Fundamental Concepts of Lithosphere**

**Unit-1** Nature & Scope of Physical Geography

**Unit-2** Origin of the Earth & Earth Interior

**Unit-3** Epirogenetic & Orogenetics ( Isostasy, Volcanism & Seismicity)

**Unit-4** Erosion, Weathering & Evolution of Landforms

**Block-2 Atmosphere**

**Unit-5** Composition and Structure of Atmosphere

**Unit-6** Insolation & Heat Budget (Vertical & Horizontal Temperature Distribution)

**Unit-7** Atmospheric pressure, Winds, Humidity & Rainfall

**Unit-8** Climate & its Classification- Koppen & Thornweit

**Block-3 Hydrosphere**

**Unit-9** Surface Configuration of Ocean bottoms

**Unit-10** Oceanic-temperature & salinity

**Unit-11** Circulation of Ocean water. Currents & Tides

**Unit-12** Ocean deposits & Corals Reefs

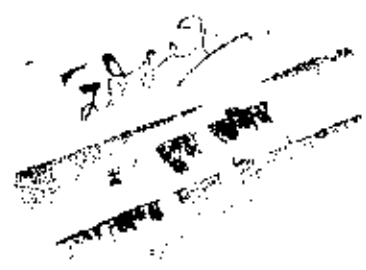
**Block-4 Biosphere**

**Unit-13** Elements of biosphere, Habitat & Plant- Animal association

**Unit-14** Ecology & Ecosystem

**Unit-15** Bio-diversity & its depletion

**Unit-16** Conservation of biotic resources





- Unit-7 Evolution of Human Economy
- Unit-8 Types of Human Activities: Primary, Secondary.
- Unit-9 Types of Human Activities: Territory & Quaternary
- Block-4 Society and Culture**
- Unit-10 Evolution of man
- Unit-11 Cultural Diffusion, Cultural realms
- Unit-12 World Human Races-Classification
- Block-5 Human Tribes**
- Unit-13 Habitat, Economy and Society of World Tribes: Khirgees, Eskimo, Bush, Pigmy
- Unit-14 Habitat, Economy and Society of Indian Tribes: Bheel, Santhal, Toda, Gaddis
- Unit 15 Habitat, Economy and Society of Uttarakhand Tribes: Bhotia, Tharu, Baksa, Gujjar

GE-202

### GEOGRAPHY OF ASIA

#### UNIT SCHEDULE

##### Block-1 Physical Aspects

- Unit-1 Introduction, Structure and Relief
- Unit-2 Drainage and Climate
- Unit 3 Natural Vegetation and soil

##### Block-2 Resources

- Unit-4 Power Resources
- Unit-5 Mineral Resources
- Unit 6 Forest Resources

##### Block-3 Population and Settlement

- Unit-7 Population: Growth, Distribution & Density
- Unit-8 Movement of Population
- Unit-9 Settlement Types and Pattern

##### Block-4 Economy

- Unit-10 Agriculture
- Unit-11 Industries
- Unit-12 Trade
- Unit-13 Transport, Port, Harbour

##### Block-5 Regional Study

- Unit-14 Iraq and Iran
- Unit-15 Pakistan and Sri Lanka
- Unit-16 Indonesia and Myanmar
- Unit-17 China and Japan

GE-203

### PRACTICAL

#### UNIT SCHEDULE

##### Block-1 Methods of Representing Socio-Economic data

- Unit-1 Quantitative and qualitative techniques
- Unit-2 Dots, proportional circles and spheres Methods
- Unit-3 Isopleths, Choropleth & Flow charts

##### Block-2 Statistical Methods

- Unit-4 Measurement of Central tendency: Mean, Median & Mode.
- Unit 5 Standard Deviation, Measures of variability
- Unit-6 Regression & Correlation

##### Block-3 Surveying

- Unit-7 Principles of Surveying
- Unit-8 Plane Table surveying
- Unit-9 Prismatic Compass Survey
- Unit-10 Indian Pattern Clinometer



GE-301

## Geographical Thought and Evolution

### UNIT SCHEDULE

**Block-1 History of Geographical Thought in ancient period**

Unit-1 Contributions of Greek & Romans

Unit-2 Dark Period

Unit-3 Contributions of Arab Geographers

**Block-2 History of Geographical Thought in modern period**

Unit-4 Contributions of France & German

Unit-5 Contributions of American & British

Unit-6 Contributions of Russians

**Block-3 Modern Approaches.**

Unit-7 Quantitative revolution and challenges

Unit-8 Contributions of Blache, Carl Saver, Ratzel, Mackinder, Huntington, Davis

Unit-9 Qualitative paradigm; Behavioral revolution: perception and cognition,

mental maps; Marxism; Postmodernism

Unit-10 Post structuralism and Post colonialism.

**Block-4 Dichotomy in Geography**

Unit-11 Human vs. Physical

Unit-12 Systematic vs. Regional

Unit-13 Applied vs. Quantitative

Unit-14 Ancient Indian Geography and Scientific outlook

Unit-15 Modern Indian Geography

Unit-16 Indian Geography: Problems, Perspectives and Prospects

GE-302

## ECONOMIC GEOGRAPHY

### UNIT SCHEDULE

**Block 1 Nature, Scope and approaches**

Unit1 Meaning and Scope

Unit2 Economy: Definition, classification, local and spatial organization

Unit3 Geographical bases of economic activities: Systematic and spatial

Unit4 Sectors of economy: An Introduction

**Block 2 Primary Activities**

Unit5 Primary activities: Concept, Classification and importance.

Unit6 World view of primary activities- problems and trend of management with reference of forestry, fishing and livestock farming.

Unit7 Critical appreciation of agricultural systems: Intensive agriculture (Rice), Extensive agriculture(Wheat), Plantation farming(Tea) and Mixed farming (NW Europe).

Unit8 Land use and Agricultural models: Von Thunen and Whietsey

**Block3 Secondary Activities**

Unit-9 Secondary activities: Concept, classification and importance

Unit10 Factors of industrial location; industrial location and economic growth models: Weber, Lochs and Gunner Myrdal.

Unit11 Industries – their resource base, distribution, potentials of growth and problems with reference to Iron and steel (UK, Japan, and India), Cotton textile (USA and India), Petrochemicals (USA and India) and Food processing (India).

Unit 12 Industrial association, integration, infrastructure and problems

**Block-4 Tertiary Activities**

Unit-13 Tertiary activities and service: concept, classification and importance

Unit-14 Trade: as an engine and hindrance to growth, determinants, trade strategies- import substitution and export promotion.

Unit-15 International trade Ricardian theory, international trade with reference to GATT and WTO

Unit-16 Transport: Concept of distance, accessibility and connectivity relative cost advantage of different modes of transport.



Handwritten signature and a circular stamp. The stamp contains text in Hindi, including 'भारतीय विश्वविद्यालय' (Indian University) and 'दिल्ली' (Delhi). There is also a date stamp '20/11/2023'.

## UNIT SCHEDULE

## Block-1 Map projections

Unit-1 Definition &amp; Principles of Map Projection

Unit-2 The Earth: shape, size, areas and great circles-coordinate system.

Unit-3 Classification and choice of map projections

Unit-4 Construction merits &amp; limitations of Conical with 2 standard parallel, Bomes . Mercator ,cylindrical, equal area. Zenithal. Polar . Gnomonic, Stereographic, Conventional, Molwide. Sinusoidal &amp; International

## Block-2 Technology and its application in Geography

Unit-5 Aerial Photography: Definition and Interpretation

Unit-6 Remote sensing: Sensors, products and their uses.

Unit-7 GIS: Principles and application

## Block-3 Field work

Unit-8 Geographical study of a region / village

## SUBJECT: MATHEMATICS

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
FIRST YEAR			
1.	विविक्त गणित	MT-01	04
2.	कलन एवं अवकल समीकरण	MT-02	04
3.	निर्देशांक ज्यामिति एवं गणितीय प्रमाणन समस्याएँ	MT-03	04
SECOND YEAR			
1.	घटविक विश्लेषण एवं दूरीक समष्टि	MT-04	04
2.	अवकलन समीकरण	MT-05	04
3.	संख्यात्मक विश्लेषण एवं सदिश कलन	MT-06	04
THIRD YEAR			
1.	बीजगणित	MT-07	04
2.	सम्मिश्र विश्लेषण	MT-08	04
3.	यांत्रिकी	MT-09	04

विविक्त गणित (MT-01)

इकाई 1. समुच्चय सिद्धांत

इकाई 2. सम्बन्ध, जालक एवं फलन

इकाई 3. बीजगणितीय संरचना

इकाई 4. गणन प्रविधियाँ

इकाई 5. वर्णमालाएँ, भाषाएँ एवं व्याकरण

इकाई 6. परिमित अवस्था औत्तमता एवं परिमित अवस्था मशीन

इकाई 7. बूलीय बीजगणित

इकाई 8. बूलीय व्यंजक एवं फलन

इकाई 9. विविक्त संख्यांक फलन एवं फलन

इकाई 10. पुनरावृत्ति सम्बन्ध

इकाई 11. ग्राफ, ग्राफों में सम्बद्धता एवं ग्राफों पर संक्रियाएँ

Swati/3/24/24

2024

- इकाई 12. ग्राफ चक्रमण  
 इकाई 13. समतलीय ग्राफ  
 इकाई 14. वृक्ष  
 इकाई 15. दिष्टग्राफ

कलन एवं अवकल समीकरण (MT-02)

- इकाई 1. श्रेणी  
 इकाई 2. व्यापकीकृत माध्यमान प्रमेय एवं घात श्रेणी  
 इकाई 3. वक्र के चाप का अवकलज व् पदिक समीकरण  
 इकाई 4. वक्रता  
 इकाई 5. आंशिक अवकलन  
 इकाई 6. उच्छिष्ट व विमिश्र  
 इकाई 7. अनंतस्पर्शिणी  
 इकाई 8. वक्र अनुरक्षण  
 इकाई 9. अन्वरोध  
 इकाई 10. समतल वक्रों का क्षेत्रफल  
 इकाई 11. समतल वक्रों की लम्बाई  
 इकाई 12. परिक्रमण वॉर्सों के आयतन एवं पृष्ठ  
 इकाई 13. द्वि समाकल  
 इकाई 14. त्रि समाकल एवं दिरिचलेट समाकल  
 इकाई 15. गामा तथा बीटा फलन  
 इकाई 16. अवकल समीकरण

निर्देशांक ज्यामिति एवं गणितीय प्रमाणन समस्याएँ (MT-03)

- इकाई 1.  $X-Y$  में व्यापक द्विघाती कातीय समीकरण का उसके मानक रूप में समानयन  
 इकाई 2. गोला  
 इकाई 3. प्रुच एवं भुवीय समतल  
 इकाई 4. शंकु  
 इकाई 5. बेलन  
 इकाई 6. शोकवज  
 इकाई 7. एक पृष्ठीय अतिपरबलयज की जनक रेखाएँ  
 इकाई 8. त्रिकोण में द्विघात का व्यापक समीकरण व उसके मानकरूपों में समानयन  
 इकाई 9. रेखिक प्रोगामन समस्याएँ  
 इकाई 10. आधारि हल, अक्षमुख समुच्च्य एवं रेखिक प्रोगामन समस्या का मूल प्रमेय  
 इकाई 11. सिम्प्लेक्स कलन विधि  
 इकाई 12. द्वैतता  
 इकाई 13. द्वैत द्वारा रेखिक प्रोगामन समस्याओं का हल ज्ञात करना  
 इकाई 14. नियतन एवं परिवहन समस्याएँ



Handwritten signature and stamp. The stamp is circular and contains the text 'मुख्य अधिकारी' (Chief Officer) and 'संयोजक' (Coordinator). Below the stamp, there is a handwritten signature and the name 'Suresh Kumar'.

#### वर्तविक विश्लेषण अवं दूरीक समष्टि (MT-04)

- इकाई 1.वर्तविक संख्या निकाय  
इकाई 2.वर्तविक संख्याओं के सांस्थितिकी गुणधर्म  
इकाई 3.वर्तविक अनुक्रम १  
इकाई 4.वर्तविक अनुक्रम २  
इकाई 5.सांतत्य  
इकाई 6.अवकलन  
इकाई 7.द्विचर फलन का लिए सीमा अवं सांतत्य  
इकाई 8.रीमान समाफलन १  
इकाई 9.रीमान समाफलन २  
इकाई 10.फलनो के अनुक्रमों का एकसमान अभिसरण-१  
इकाई 11.फलनो के अनुक्रमों का एकसमान अभिसरण-२  
इकाई 12.दूरीक समष्टियाँ  
इकाई 13.विघृत अवं संघृत समुच्चय  
इकाई 14.उपसमष्टियाँ, गुणन समष्टियाँ, संतत प्रतिचित्रण अवं अभिसरण  
इकाई 15.संघृत समुच्चय, संघृत तथा संघृत दूरीक समष्टियाँ

#### अवकलन समीकरण (MT-05)

- इकाई 1.प्रथम घात अवं प्रथम कोटि के अवकल समीकरण -१  
इकाई 2.प्रथम घात अवं प्रथम कोटि के अवकल समीकरण -२  
इकाई 3.प्रथम घात अवं प्रथम कोटि के अवकल समीकरण -३  
इकाई 4.प्रथम कोटि परन्तु उच्च घात के अवकल समीकरण -१  
इकाई 5.प्रथम कोटि परन्तु उच्च घात के अवकल समीकरण -२  
इकाई 6.आचर गुणांक युक्त रेखिक अवकल समीकरण  
इकाई 7.समघात रेखिक अवकल समीकरण  
इकाई 8.युगपत् अवकल समीकरण  
इकाई 9.  $n$  वें कोटि के यथातथ अवकल समीकरण अस्तित्व अवं अद्वितीयता प्रमेय  
इकाई 10.द्वितीय कोटि के रेखिक अवकल समीकरण-१  
इकाई 11.द्वितीय कोटि के रेखिक अवकल समीकरण-२  
इकाई 12.द्वितीय कोटि के रेखिक अवकल समीकरण-३  
इकाई 13.आंशिक अवकल समीकरण-१  
इकाई 14.आंशिक अवकल समीकरण-२  
इकाई 15.आंशिक अवकल समीकरण-३

#### संख्यात्मक विश्लेषण अवं सदिश कलन (MT-06)

- इकाई 1.परिमित अंतर  
इकाई 2.परिमित अंतर  
इकाई 3.सामान अंतराल द्वारा अंतर्वेशन  
इकाई 4.केंद्रीय अंतर अंतर्वेशन  
इकाई 5.प्रतिलोम अंतर्वेशन  
इकाई 6.संख्यात्मक अवकलन

*[Handwritten signature]*  
*[Handwritten text]*

*[Handwritten signature]*  
*[Handwritten text]*

- इकाई 7.संख्यात्मक अवकलन  
 इकाई 8.बीजीय तथा अविजीय समीकरणों के संख्यात्मक हल  
 इकाई 9.रेखीय बीजीय समीकरण  
 इकाई 10.साधारण अवकल समीकरणों के संख्यात्मक हल  
 इकाई 11.सदिश कलन  
 इकाई 12.अवकल संकारक  
 इकाई 13.अवकल संकारक के अनुप्रयोग  
 इकाई 14.रेखा,प्रष्ठ अथ आपतन समाकल

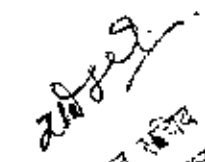
### बीचगणित (MT-07)

- इकाई 1.समूह, उपसमूह  
 इकाई 2.क्रमघय,समूह,घातीय समूह  
 इकाई 3.सहकुलक ,लेग्रेंज प्रमेय  
 इकाई 4.समूह समाकारिता  
 इकाई 5.प्रसामान्य उपसमूह  
 इकाई 6.विभाग समूह एवं समाकारिता की मूलभूत प्रमेय  
 इकाई 7.बलय  
 इकाई 8.पूर्णांकीय प्रान्त एवं क्षेत्र  
 इकाई 9.बलय समाकारिता एवं अन्तःस्थापन  
 इकाई 10.पूर्णांकीय प्रान्त एवं विभाग क्षेत्र एवं अभाज्य क्षेत्र  
 इकाई 11.गुणजावालियाँ एवं विभाग बलय  
 इकाई 12.सदिश समष्टि, उपसमष्टि की परिभाषा ,उदहारण एवं इनके गुणधर्म  
 इकाई 13.सदिशों का एकघात संघय ,एकघाती स्वतंत्रता एवं अश्रीता  
 इकाई 14.सदिश समष्टि का आधार ,विभा एवं इनके उदहारण ,परिमित विधीय सदिश समष्टियों के गुणधर्म ,एकघाती विस्तृति एवं इनके अनित उपसमष्टि  
 इकाई 15.दो उपसमष्टियों का योग, उपसमष्टियों का अनुलोम योग एवं पूरक उपसमष्टि,विभाग उपसमष्टि एवं इनकी विभा

### सम्मिश्र विश्लेषण (MT-08)

- इकाई 1.सम्मिश्र तल , विस्तृत सम्मिश्र तल अथ त्रिविम प्रक्षेप  
 इकाई 2.सम्मिश्र संख्याओं के संस्थितिक गुण  
 इकाई 3. सम्मिश्र चर का फलन -सीमा , सातत्य एवं अवकलनीयता  
 इकाई 4.विश्लेषिक फलन  
 इकाई 5.फलनों की श्रेणी का एकसमान अधिसरण एवं घात श्रेणी  
 इकाई 6.अनुकोण प्रतिचित्रण  
 इकाई 7.द्विदिक्क रूपांतरण एवं इनके गुण  
 इकाई 8.विशेष प्रतिचित्रण  
 इकाई 9.सम्मिश्र समाकलन  
 इकाई 10.कोशी समाकल प्रमेय के अनुप्रयोग  
 इकाई 11.विश्लेषित फलनों का घात श्रेणी के रूप में प्रसार  
 इकाई 12.विचित्र बिंदु  
 इकाई 13.अवशेष प्रमेय एवं इनके अनुप्रयोग



  
 प्रमुख अधिवक्ता  
 राष्ट्रीय विद्यार्थी कल्याण  
 संस्थान (राजस्थान)





इकाई 14.परिखा समाकलन

इकाई 15.विश्लेषित सातत्य

### यांत्रिकी (MT-09)

इकाई 1.स्थिति विज्ञान की मूल संकल्पनाएं

इकाई 2.समतलीय बलों के संतुलन के प्रतिबन्ध

इकाई 3.घर्षण बल

इकाई 4.कल्पित कार्य

इकाई 5.केटनरी

इकाई 6.वेग एवं त्वरण

इकाई 7.सरल आवर्त गति

इकाई 8.हुक का नियम तथा प्रत्यास्थ डोरिपां

इकाई 9.प्रतिरोधी माध्यम में सरल रेखीय गति

इकाई 10.कार्य एवं ऊर्जा

इकाई 11.प्रतिबन्धित गति

इकाई 12.केंद्रीय बल

इकाई 13.स्ताविकता,संकेन्द्र कक्षा में समय व केपलर नियम

इकाई 14.जड़त्व आघूर्ण १

इकाई 15.जड़त्व आघूर्ण २

*Signature*

### **SUBJECT: PHYSICS**

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
FIRST YEAR			
1.	Mechanics	BSCPH 101	03
2.	Electricity and Magnetism	BSCPH 102	03
3.	Oscillations and Waves	BSCPH 103	03
4.	Practical Physics	BSCPH 104	03
SECOND YEAR			
5.	Thermodynamics and Statistical Mechanics	BSCPH 201	03
6.	Optics	BSCPH 202	03
7.	Elementary Solid State Physics	BSCPH 203	03
8.	Practical Physics	BSCPH 204	03
THIRD YEAR			
9.	Elements of Quantum mechanics	BSCPH 301	03
10.	Modern Physics	BSCPH 302	03
11.	Basic Electronics	BSCPH 303	03
12.	Practical Physics	BSCPH 304	03

Course 1: Mechanics

Course code: BSCPH101

Credit: 3

BLOCK 1 Vector Analysis

Unit -1: Vector: Types of vectors, vector representation. dot product and cross product scalar triple product and vector triple product

*Signature*  
41

*Signature*

Unit –2: Vector Calculus: Differentiation of vector, Del operator, scalar and vector fields, gradient, divergence and curl

Unit –3: Gauss, Stoke and Green's theorem: Gauss divergence theorem, Stokes' theorem. Greens theorem

#### BLOCK 2 Mechanics of a Particle

Unit –4: Newton's laws and Conservation principles: Newton's laws of motion. principle of conservation of linear momentum

Unit –5: Principles of conservation of energy and angular momentum: Conservation of energy. principle of conservation of angular momentum

Unit –6: Rotational motion: Rotational motion, angular velocity, angular acceleration, angular momentum, torque

Unit –7: Motion of Charged particle: Motion of Charged particle in Crossed electrical and magnetic field

#### BLOCK 3 Dynamics of Rigid Bodies:

Unit –8: Moment of inertia: Equation of motion, angular momentum vector, Moment of inertia and radius of gyration Physical significance of MI, theorems of parallel and perpendicular axes, Rotational kinetic energy

Unit –9: Formulation of moment of inertia: Formulation and derivation of moment of inertia for some simple symmetric systems (rod, rectangular lamina, circular lamina, solid sphere, cylinder)

Unit –10: Pendulums: Compound pendulum, Kater's pendulum, and applications.

#### BLOCK 4 : Gravitation and Properties of matter

Unit –11: Gravitation: law of Gravitation, Gravitational field and potential, Gravitational potential energy

Unit –12: Escape velocity and gravitational potential: Escape velocity, Gravitational field, Gravitational potential and intensity due to thin uniform spherical shell and solid sphere of uniform density

Unit –13: Conservative forces and inverse square law: Conservative and non-conservative forces. Force as gradient of potential energy. Particle collisions. Centre of mass frame and laboratory frame, Inverse square law, Kepler's laws

Unit –14: Elasticity and elastic constants: Hook's law, elastic constants, relation between elastic constants.

Unit –15: Torsion of cylinder and bending of beam: Torsion of cylinder, bending of beam cantilever, shape of girder.

#### Course 2: Electricity and Magnetism

Course code: BSCPH102

Credit: 3

#### BLOCK 1 Electrostatics

Unit –1: **Electrostatics:** Quantization of charge and Millikan's oil-drop experiment, Coulomb's law application

Unit –2: **Electric field and Potential:** Intensity and potential, Gauss' theorem, simple applications.

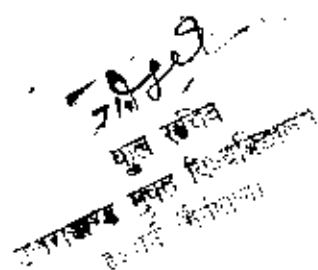
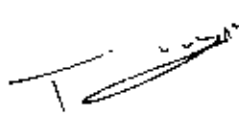
Unit –3: **Electric field and Potential II:** Potential and field due to an arbitrary charge, long charged wire, sphere, disc, electric dipole, and energy stored in an electric field

#### BLOCK 2 Dielectric properties of matter

Unit –4: **Polarization:** Dielectric polarization and polarization charges, Gauss's law in dielectrics

Unit –5: **Dielectric:** Vectors D and E and their boundary conditions, capacitors filled with dielectrics.

Unit –6: **Dielectric Susceptibility** Dielectric Susceptibility and permittivity. Clausius-Mossotti relation. Langevin theory of polar dielectric



### BLOCK 3: Magnetism

Unit -7: **Basic Magnetism:** Lorentz force, Bio-Saverts law, Magnetic force between current elements, Ampere's circuital law, Maxwell correction in Ampere's law

Unit -8: **Vector potential and Magnetic flux:** Curl and divergence of  $\mathbf{B}$ , Vector potential, Magnetic flux, Calculation of  $\mathbf{B}$  for circular and solenoidal currents. Torque on a current loop in a uniform magnetic field. Magnetic dipole

Unit -9: **Magnetic dipole:** Torque on a current loop in a uniform magnetic field, Magnetic dipole, Energy stored in a magnetic field, Ballistic galvanometer

Unit -10: **Magnetization:** Intensity of magnetization, relation between  $\mathbf{B}$ ,  $\mathbf{H}$ , and  $\mathbf{M}$ , illustration in the case of bar magnet.

Unit -11: **Magnetic susceptibility:** Magnetic susceptibility, dia, para and ferromagnetic materials. Curie's law. Hysteresis in a ferromagnetic material.

### BLOCK 4: Electricity

Unit -12: **Steady Current:** Electric Current, Drift Velocity, Current density, equation of continuity, electric Resistivity and conductivity, Wiedemann-Frenz law

Unit -13: **Alternative current:** Mean and r.m.s. values of current and emf with sinusoidal wave form, Reactance, impedance, phase-angle, power dissipation in AC circuit, power factor, vector diagram, series LR, CR and LCR circuits Resonance in a series LCR circuit, Q-factor, principle of ideal Transformer

### Course 3: Oscillations and Waves

Course code: BSCPH103

Credit: 3

#### BLOCK 1 Simple Harmonic Motion:

Unit -1: **Simple Harmonic Motion I:** Basic Characteristics of Simple Harmonic Motion, Oscillations of a Spring-Mass System; Differential Equation of SHM and its Solution

Unit -2: **Simple Harmonic Motion II:** Phase of an oscillator executing SHM, Velocity and Acceleration, Transformation of Energy in Oscillating Systems, Kinetic and Potential Energies.

Unit-3: **Physical Systems and Pendulums:** Examples of Physical Systems Executing SHM; Simple Pendulum, Compound Pendulum, Torsional Pendulum.

Unit-4: **Superposition of harmonic oscillations:** LC circuit, principle of superposition, Superposition of two collinear harmonic oscillations of same/different frequencies, Oscillations in two dimensions

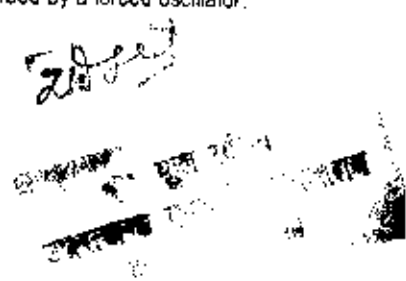
Unit-5: **Superposition of two mutually perpendicular harmonic oscillations:** Superposition of two mutually perpendicular harmonic oscillations of the same/different frequencies; Lissajous Figures.

#### BLOCK 2: Damped and Forced Oscillations:

Unit-6: **Damped Oscillations:** Differential equation of a damped oscillator and its solutions, heavy damping, critical damping, weak damping; characterising weak damping; logarithmic decrement; relaxation time, quality factor

Example of a weakly damped system - LCR circuit: differential equation of an undamped oscillator and its solution;

Unit-7: **Forced Oscillations and Resonance:** differential equation of a weakly damped forced harmonic oscillator and its solutions, steady state solution, resonance. Examples of forced vibrations and resonance, power absorbed by a forced oscillator, quality factor



**BLOCK 3 Basic Concepts of Wave Motion:**

Unit-8: Wave Motion: Formation of a Wave: Graphical Representation of Wave Motion, Relation between Wave Velocity, Frequency and Wavelength; Mathematical Description of Wave Motion:

Unit-9: Phase, Energy and Intensity of wave: Transported Phase and Phase Difference. Phase Velocity, Energy Transported by Progressive Waves, Intensity and the Inverse Square Law:

Unit-10: One-dimensional Wave Equation: One-dimensional Wave Equation Waves on a Stretched String, Waves in a Field, Waves in a Uniform Rod; Waves in Two and Three Dimensions;

Unit-11: The Doppler Effect: Source in Motion and Observer Stationary. Source Stationary and Observer in Motion, Source and Observer both in Motion; Shock Waves.

Unit -12: Principle of Superposition and types of waves: Principle of Superposition of Waves; Stationary Waves, Properties of stationary waves, Velocity of a Particle at any Point in a Stationary Wave, Harmonics in Stationary Waves.

*Handwritten signature*  
मुख्य शिक्षक  
भारतीय विज्ञान संस्थान  
पुणे (महाराष्ट्र)



**Course 4: Practical Physics**

**Course code: BSCPH104**

**Credit:3**

At least 12 experiments out of this list are to be performed by the student.

1. TO DETERMINE THE RESTORING FORCE PER UNIT EXTENSION OF A SPIRAL SPRING BY STATISTICAL AND DYNAMICAL METHODS AND ALSO DETERMINE THE MASS OF THE SPRING.
2. TO STUDY THE OSCILLATIONS OF A SPRING.
3. TO DETERMINE THE COEFFICIENT OF DAMPING, RELAXATION TIME AND QUALITY FACTOR OF A DAMPED SIMPLE HARMONIC MOTION USING A SIMPLE PENDULUM.
4. TO DETERMINE THE YOUNG'S MODULUS, MODULUS OF RIGIDITY AND POISSON'S RATIO OF A GIVEN WIRE BY SEARLE'S DYNAMICAL METHOD.
5. TO DETERMINE THE MOMENT OF INERTIA OF A IRREGULAR BODY ABOUT AN AXIS PASSING THROUGH ITS CENTRE OF GRAVITY AND PERPENDICULAR TO ITS PLANE BY DYNAMICAL METHOD.
6. TO DETERMINE THE MOMENT OF INERTIA OF FLYWHEEL
7. TO STUDY THE VARIATION OF 'T' WITH 'l' FOR A COMPOUND PENDULUM (BAR PENDULUM) AND THEN TO DETERMINE THE VALUE OF 'g' K and J IN THE LABORATORY.
8. TO DETERMINE THE VALUE OF 'g' BY MEANS OF A KATER'S PENDULUM.
9. TO CONVERT WESTON GALVANOMETER INTO AN AMMETER OF 3 AMP./1 AMP./100  $\mu$  AMP. RANGE.
10. TO CONVERT WESTON GALVANOMETER INTO A VOLTMETER OF 50 VOLT/3 VOLT RANGE.
11. TO DETERMINE THE YOUNG'S MODULUS OF THE MATERIAL OF A GIVEN BEAM SUPPORTED ON TWO KNIFE-EDGES AND LOADED AT THE MIDDLE POINT.
12. TO DETERMINE THE ELECTROCHEMICAL EQUIVALENT OF COPPER AND REDUCTION FACTOR OF A HELMHOLTZ GALVANOMETER.
13. TO STUDY THE RESONANCE IN SERIES LCR CIRCUIT WITH A SOURCE OF GIVEN FREQUENCY (AC MAINS).
14. STUDY OF PARALLEL AND PERPENDICULAR AXIS THEOREMS
15. STUDY OF AIR FLOW THROUGH A CAPILLARY.
16. TO DETERMINE THE MASS SUSCEPTIBILITY OF NiSO<sub>4</sub>

**Course 5: Thermodynamics and Statistical Mechanics**

**Course code: BSCPH201**

**Credit:3**

**Block 1:- Basic concepts and Laws of thermodynamics**

Unit 1: **Basic concepts:** Temperature, internal energy, Quasistatic process, isothermal and adiabatic process, zeroth law of thermodynamics



Unit 2: **First law of thermodynamics:** First law of thermodynamics: thermodynamic equilibrium, differential form of first law. Application of first law, Insufficiency of first law

unit 3 : **Second law of thermodynamics:** Reversible and irreversible process. work and heat energy, work done during isothermal and adiabatic process Heat engines, Carnot cycle, Carnot engine and its efficiency, Carnot theorem, Second law of thermodynamics, steam engine, internal combustion engine, petrol engine.

Unit 4: **Entropy:** Entropy, Physical concept of entropy, entropy change in reversible and irreversible process. principle of increase of entropy, Clausius theorem, temperature entropy TS diagram, entropy of perfect gas, Kelvin Scale of temperature, Absolute zero temperature, unattainability of absolute zero, Nernst theorem(third law of thermodynamics)

#### **Block 2:- Thermodynamic Relationship, potentials and applications**

Unit 5 : **Thermodynamic Relationship:** Extensive and intensive thermodynamic variables, Maxwell thermodynamic Relations: derivation and Applications, specific heat of a substance. relation between  $C_p$  and  $C_v$ , its relation, Clausius Clapeyron equation, energy equation, Joule Thomson effect and coefficient, Temperature inversion

Unit 6 : **Thermodynamic Potentials and applications:** Thermodynamic potentials U, H, F and G, relations of thermodynamic potentials and variables, TdS equations, stretching of wire, basic idea about phase transitions, cooling due to adiabatic magnetization, Approach to Absolute zero.

#### **Block 3:- Black Body radiations and related laws**

Unit 7: Black body radiation, Kirchoff's Law, energy distribution in Black Body radiation, Nearest example of Black Body

Unit 8: Wein's radiation law, Rayleigh Jeans law, Stefan Boltzmann Law and Wein's Displacement law, ultraviolet catastrophe

Unit 9: deduction of Planck's law of Black Body Radiation, deduction of Wein's law, Rayleigh law and wein's displacement law from Planck's law

#### **BLOCK 4: Statistical basis**

Unit -10: Probability and thermodynamical probability, Classical description in terms of phase space and quantum description in terms of wave functions

Unit -11: Hypothesis of equal *a priori* probability for microstates of an isolated system in equilibrium. Interactions between two systems – thermal, mechanical and diffusive

Unit -12: Statistical definition of temperature, pressure, entropy and chemical potential. Partition function of a system in thermal equilibrium with a heat bath

Unit -13: Gibbs' paradox. Identical particle and symmetry requirement. Derivation of MB, FD and BE statistics

#### **Course 6: Optics**

Course code: BSCPHY202

Credit:3

#### **BLOCK 1 Geometrical optics**

Unit -1: **Fermat's principle:** Fermat's principle and its application to deduce law of reflection and refraction, Gauss's general theory of image formation.

Unit -2: **Image formation:** Coaxial symmetrical system, cardinal points of an optical system, general relation

Unit -3: **Thick lens and lens combination:** Thick lens and lens combination, telescope.

#### **BLOCK 2 Interference of light waves**



Handwritten signature and a circular official stamp of a university or institution.

Unit-4: **Interference:** Introduction to Interference of light, principle of superposition, Young's experiment, coherence, spatial and temporal coherence, intensity distribution, biprism and Fresnel's biprism

Unit -5: **Interference in thin film and Newton's rings :** Introduction, interference by division of amplitude, interference in thin film, wedge shaped film, Newton's rings in reflected and refracted light, determination of refractive index by Newton's rings experiment

Unit -6: **Haidinger Fringes:** Haidinger Fringes, Fringes of equal inclination and equal thickness, Michelson's interferometer, Multiple beam interference – reflected and transmitted pattern. Fabry-Perot interferometer.

### **BLOCK3 Diffraction of light waves**

Unit -7: **Diffraction:** Introduction, types of diffraction. Fresnel and Fraunhofer class, Fresnel's half period zones: explanation of rectilinear propagation of light; zone plate, comparison of zone plate with lens, wave front, diffraction at a straight edge

Unit -8: **Fraunhofer diffraction:** Introduction, condition for Fraunhofer diffraction, Fraunhofer diffraction due to a single slit, Fraunhofer diffraction due to double slit, Fraunhofer diffraction at circular aperture (qualitative), Plane diffraction grating (transmission), diffraction due to a grating of N parallel slits, Maximum number of order available in a grating, missing orders.

Unit -9: **Resolution and resolving power:** Introduction, resolving power. Rayleigh criterion of resolution, resolving power of transmission grating, resolving power of prism, resolving power of telescope, resolving power of microscope.

### **BLOCK 4: Polarization of light waves**

Unit -10: **Polarization:** Introduction, Concept of plane polarized light, circularly and elliptically polarized light, Malus law, Brewster law.

Unit -11: **Double refraction:** Introduction, double refraction, Huygen's construction for uniaxial crystals; polaroids and their uses

Unit -12: **Production of Polarized light:** Introduction, Production and analysis of plane, circularly and elliptically polarized light by retardation plates and rotatory polarization

Unit -13: **Optical activity:** Introduction, rotatory polarization, optical activity; Fresnel's explanation of optical activity; Biquartz and half shade polarimeter

### **BLOCK 5: Optical Instruments and Aberration in images:**

Unit -14: **Optical Instruments:** introduction, Human eye, field of view, need of multiple lens eyepieces, Ramsden's eyepiece, Huygen's eyepiece, Gaussian eyepiece, comparisons of eye pieces, Astronomical refracting telescope, Spectrometer, electron microscope.

Unit -15 **Aberration In Images:** Introduction, Aberration in images, chromatic aberration of lens, achromatic combination of lenses, monochromatic aberration, spherical mirrors, Schmidt corrector plate, oil immersion lens.

### **Course 7: Elementary Solid State Physics**

Course code: BSCPHY203

Credit: 3

### **BLOCK 1 Crystal Structure**

Unit -1: **Crystal structure :** Crystalline and amorphous solids, single crystal and poly crystal, elementary ideas about crystal structure, lattice and bases, unit cell, Bravais lattices, s.c., f.c.c. and b.c.c. lattices, characteristics of lattices cell, some crystal structures.

Unit -2: **Crystal symmetry:** Miller indices, lattice planes, spacing of planes in crystal lattices, symmetry operation, translational symmetry, basic idea about liquid crystal.

Unit -3: **Reciprocal lattice :** X ray diffraction, Bragg equations, Determination of crystal structure with X-rays, Laue and Powder method, Reciprocal lattice system, Ewald's construction.



Unit -4: **Crystal bonding** : Crystal bonding, ionic crystal, potential and lattice energy of ionic crystal, Madelung constant, covalent bonding, Van der wall bonding, Lenard Jones potential, hydrogen bond, metallic bond.

### BLOCK 2 Band theory of solids

Unit -5: **Free Electron theory** :Free electron theory of metals, Lorentz Drude theory, electrical conductivity, thermal conductivity, Wiedemann-Franz law

Unit -6: **Band theory of solids** : Band formation in solids, Band structure in conductors, Periodic potential and Bloch theorem, Kronig-Penny model, origin of band gap

Unit -7: **Semiconductors** : Semiconductors, effect of impurity on semiconductor. Fermi level, Electron and hole concentration, drift current, mobility and conductivity, Effective mass, Hall effect.

### BLOCK3 Lattice vibrations and Specific heat

Unit -8: **Lattice vibrations**: Elastic and atomic force constants, quantization of lattice vibrations, Dynamics of a chain of monoatomic lattice, optical and acoustic modes, dispersion relation, concept of phonon, comparison of phonon and photons.

Unit -9: **Specific heat**: Specific heat of solids, Dulong and Petit's law, lattice heat capacity, Einstein theory of specific heat. Debye's theory of specific heat. Density of state, lattice thermal conductivity, normal and umklapp processes, paramagnetism of free electrons.

### BLOCK 4: Dielectric and Magnetic properties of materials

Unit -10: **Dielectric properties**: Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization, molecular field in a dielectric; Clausius-Mosotti relation.

Unit -11: **Magnetic properties**: magnetization, magnetic materials, Dia, para and ferro-magnetic properties of solids, magnetic moment, spin angular moment, Langevin's theory of diamagnetism and paramagnetism, Quantum theory of paramagnetism, Curie's law,

Unit -12: **Ferromagnetism**: Ferromagnetism, hysteresis and hysteresis loss, permanent magnet, spontaneous magnetization and domain structure, Weiss theory of ferromagnetism, anti- Ferromagnetism, ferrites, use of ferrites.

### BLOCK 5: Superconductivity

Unit -13: **Introduction**: (Kamerlingh-Onnes experiment), effect of magnetic field, Type-I and type-II superconductors, Isotope effect, Meissner effect, Heat capacity, Energy gap.

Unit -14: **Quantum theory of superconductivity**: Quantum theory, superconductor tunneling, BCS theory, Basic Ideas about High-Tc superconductors, application.

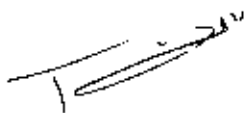
### Course 8: Practical Physics

Course code: BSCPH204

Credit: 3

At least 12 experiments out of this list are to be performed by the student.

1. Study of Malus law.
2. To draw the characteristics of a photo electric cell.
3. To determine the value of Planck's constant by a photo cell.
4. To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula  $1/f = 1/f_1 + 1/f_2 - x/f_1f_2$ .





5. To locate the cardinal points of a system of two thin convergent lenses separated by a distance and then to verify the formulae  $L_1H_1 = +xF/f_2$  and  $L_2H_2 = -xF/f_1$ .
6. To determine the wavelength of sodium light by Newton's Ring method.
7. To determine the wavelength of prominent lines of mercury by plane diffraction grating.
8. To verify Hartmann's formula using a prism spectrometer.
9. To determine the refractive index of a material of the prism for the given colours of mercury light with the help of a spectrometer.
10. To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula.
11. To determine the dispersive power of the material of the prism for violet and yellow colours of mercury light with the help of a spectrometer.
12. To determine the dispersive power of a plane transmission diffraction grating.
13. Zone plate experiment.
14. To verify Stefan's law.
15. Thermal conductivity of a bad conductor by Lee's method.
16. Mechanical equivalent of heat by Searle's method.
17. Thermal conductivity of good conductor by Searle's method.
18. Study of Platinum resistance thermometer.
19. Newton's law of cooling.

#### Course 9: Elements of Quantum mechanics

Course code: BSCPH301

Credit:3

#### BLOCK 1 Basic quantum mechanics

Unit -1: Origin of quantum mechanics, failure of classical mechanics, Photoelectric effect. Bohr atom and quantization of energy levels

Unit -2: Einstein's explanation, Planck's constant, particle nature of light. Compton Effect

Unit -3: de Broglie hypothesis. Electron double-slit experiment, Davisson-Germer experiment

Unit -4: Heisenberg's uncertainty principle (statement) with illustrations.

Unit -5: Group and phase velocities, classical velocity of a particle and the group velocity of the wave representing the particle

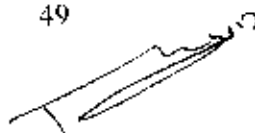
#### BLOCK 2 Schrodinger Wave Equation

Unit -6: Schrodinger time dependent and independent equation, Probabilistic interpretation. wave function. Boundary conditions on the wave function.

Unit -7: Postulate of quantum mechanics, operators, expectation value, Dynamical variables as linear operators and eigenvalue equations,

Unit -8: Momentum, energy and angular momentum operators. Commutation relations between operators, Ehrenfest theorem

#### BLOCK3 Application of Schrodinger Equation



Unit -9: One dimensional potential well and barrier, boundary conditions, bound and unbound states

Unit -10: Reflection and transmission coefficients for a rectangular barrier in one dimension – explanation of alpha decay

Unit -11: Free particle in one dimensional box, box normalization, momentum eigenfunctions of a free particle

Unit -12: Linear harmonic oscillator

Unit -13: Hydrogen atom

#### **BLOCK 4: Relativity**

Unit -14: Inertial and non inertial frame of reference, Michelson-Morley experiment and its outcome, Postulates of special theory of relativity.

Unit -15: Lorentz Transformations, length contraction, time dilation, relativistic transformation of velocity

Unit -16: Velocity dependence of mass, equivalence of mass and energy, Relativistic Doppler Effect.

### **Course 10: Modern Physics**

**Course code: BSCPH302**

**Credit: 3**

#### **BLOCK 1 Atomic Models**

Unit -1: specific charge  $e/m$ , Thomson model, Rutherford's atomic model,

Unit -2: Bohr model and spectra of hydrogen atom, fine structure and shortcoming,

Unit -3: Stern Gerlach experiment, Bohr magneton, Larmor's precession,

Unit -4: Magnetic moment of the electron, Lande g factor, Vector model – space quantization

#### **BLOCK 2 Optical Spectra**

Unit -5: Pauli Exclusion Principle, spectroscopic terms of many electron atoms in the ground state, spectral notations.

Unit -6: L-S, J-J coupling, selection rules and intensity rules

Unit -7: Explanation of fine structure of sodium D line, Normal Zeeman effect

Unit -8: X ray spectra, characteristic and continuous, Moseley's rule

#### **BLOCK3 Laser Physics**

Unit -9: Spontaneous and induced emission, metastable states, Einstein's A and B coefficients

Unit -10: spatial and temporal coherence, optical pumping, Population inversion, laser action.

Unit -11: Ruby and He-Ne laser, applications of Laser.

#### **BLOCK 4: Nuclear physics**

Unit -12: Nuclear mass, charge, size, binding energy, spin and magnetic moment, Isobars, isotopes and isotones;

Unit -13: Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model (descriptive) and the Bethe-Weizsacker mass formula.

Unit -14: Nuclear reaction, Conservation principles in nuclear reactions, Q-values and thresholds, examples of different types of reactions and their characteristics

Unit -15: Nuclear fission and fusion.

Unit -16: Four basic interactions in nature and their relative strengths, examples of different types of interactions.

Unit -17: Classifications of elementary particles, hadrons and leptons, baryons and mesons, elementary ideas about quark structure of hadrons.



**Course 11: Basic Electronics**

**Course code: BSCPH303**

**Credit:3**

**BLOCK 1 Network theorem and solid state device**

Unit -1: Network theorems. Superposition, Thevenins theorem, Norton's maximum power

Unit -2: Low pass and high pass filters, four terminal network, CRT

Unit -3: P-N junction diode, Zener diode, tunnel diode, photo diode, LED

Unit -4 Transistors operation, characteristic curves, common base, common collector, common emitter configuration,  $\alpha$  and  $\beta$  and their interrelations.

**BLOCK 2 Rectifier and Power supply**

Unit -6: Half wave full wave and bridge rectifier.

Unit -7: Filter circuits, L- section, C- section and  $\pi$  section

Unit -8: Unregulated power supply, voltage regulated power supply, Zener diode as power regulation.

**BLOCK3 Applications**

Unit -9: FET, MOSFETS

Unit -5: Single stage CE amplifier, approximate expressions of current and voltage gain with the help of 'Load Line'.

Unit -10: R.C. Coupled transistor amplifier, noise and distortion in amplifier

Unit -11: Feedback amplifier, classification, negative feedback and its advantages.

Unit -12: Oscillators and multivibrators, Schmitt trigger.

**BLOCK 4: Digital Electronics**

Unit -13: Binary systems, binary numbers, Decimal to binary and reverse conversions; binary addition and subtraction

Unit -14: Hexa decimal, octal system and interconnection, BCD, GREY code.

Unit -15: Logic gates, OR, AND, NOT gates, truth tables. Statement of de Morgan's theorem. NOR and NAND universal gates

Unit -16: simplifying Boolean expressions; arithmetic circuits (adders, subtractor)

**Course 12: Practical Physics**

**Course code: BSCPH304**

**Credit:3**

At least 12 experiments out of this list are to be performed by the student.

1. To plot the characteristics of a Zener diode.
2. To plot output characteristics of FET and measure pinch off voltage.
3. To study the logic gates.
4. To draw the characteristics of PN junction diode.
5. To draw output characteristics of NPN transistor.
6. To draw output characteristics of PNP transistor.
7. To draw the characteristics of a vacuum diode valve.
8. To measure  $e/m$  by Helical method.
9. To verify Child-Langmuir's law of space charge limited current using a diode valve.
10. To verify Thevenin's theorem.

