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

– 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

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 Basiodiomycotina, Deuteromycotina and Mycoplasma: Basiodiomycotina- *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 Basiodiomycotina, 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 Xanthopyta- *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 *Notothylus* Classification, Structure and reproduction of Bryopsida. *Funaria* and *Polytricum*

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, Stelar 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, Stelar 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 Batracospermum* 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 Pterodophytes- *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, Batracospermum* 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 Pterodophytes- *Rhynia, , Selaginella, Equisetum*

Unit-10- Study of the external features and internal structures of rhizome, leaves, roots, sporangia and strobili of Pterodophytes -*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 hotpots, 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, Draceena, 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, comparision 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 Abscissic acid
Physiology of flowering: Basic concept of flowering, Photoperiodism and Vernalization

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 /or live specimen, T.S. of anther, Study of various types of pollen grains, plancentations, 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, Dracaene, 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 verticellata. Ranunculus sceretus* 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 (comparision 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 /or live specimen

Unit-3-T.S. of anther

Unit-4-Study of various types of pollen grains, plancentations, 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 quadrate 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 interation

Structure and composition of RNA

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

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 Kreb'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 activites of plants

Syllabus- Cell biology, Molecular biology and Biotechnology: To study cell structure from onion/ Tradiscantia leaf peels and Demonstration of stanining 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 Comparision of rate of transpiration using four-leaf method, cobalt chloride pater 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 stanining 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

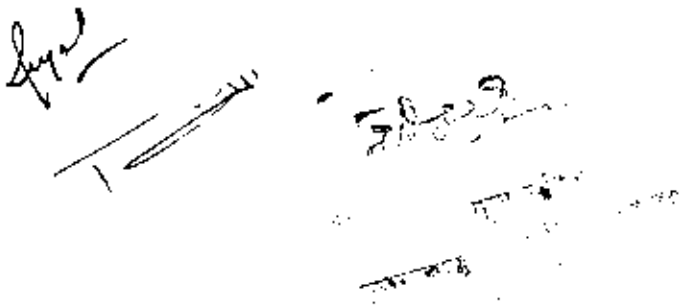
Block-3-Plant Physiology and Biochemistry

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



Subject: Chemistry

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
	FIRST YEAR		
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
	SECOND YEAR		
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
	THIRD YEAR		
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 ψ and ψ^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 NH_3, H_3O^+, SF_4, ClF_3,ICl_2^- and H_2O. 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 intrections- 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. Anomalus behavior of Carbon

XI. Elements of group 15

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

XII. Elements of group 16

General introduction, general charactenstics and uses. Oxides of Sulphur, Oxoacides of Sulphur, Halides of Sulphur and their properties. Anomalus 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 Anomalus 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, clatherates, charge transfer complexes resonance, hyperconjution 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, recapulation of types of reagents.

III. Reaction Intermediate

Reaction intermediates- carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes (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 nomencleature

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

VIII. **Alkenes**

Nomencleature 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 $KMnO_4$ and OSO_4. Polymerization of alkenes. Industrial application of ethylene and propene.

IX. **Cycloalkenes**

Methods of formation, conformation and chemical reactions of cycloalkenes.

X. **Dienes**

Nomencleature 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 atkynes, 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 σ and π 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 tetra chloride.

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. Unites and Dimensions

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

II. Gases State I

Postulates of kinetic theory of gases, deviation from ideal behavivior, 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, collosion number, mean free path and collision diameter Liquification 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

Definitation 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

Definitation 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. Emulsifire.

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. Jule Thomson effect, Jule 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. Enthelpy of neutralization, bond dissociation energy and its calculation forv 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, Degestion, Filtration, Drying and Ignition of precipitation, cooling, weighting;

1.4 Common Laboratory reagents

1.5 Laboratory Safety

Unit 2: Identification of Anion (Known)

1.1 Classification of the anion: Aniob 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 rthe Oxilate ions, Test for the Chloride ions.

Test for the Bromide ions, Testb 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 Identificationof 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

IInd Year

COURSE-V BCH201 INORGANIC CHEMISTRY- II **3 credit**

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, spectrial 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 spectrial properties and stereochemistry.

V. **Chemistry of Lanthanide elements**

Electronic structure, oxidation state and ionic radii and lanthanide contration, 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, nomencleature 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 nomencleature

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- Nomencleature, methods of formation, physical properties and chemical reactions of vicinal glycols trihydric alcohol- nomenclature and methods of formation, chemical reactions of glycerol.

II. **Phenols**

Nomencleature, 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- manasse reaction and Reimer-Tiemann reaction.

III. Ethers and Epoxides

Nomenclature of ethers and methods Nomencleature of ethers and methods of formation, physical properties. Chemical properties. Synthesis of epoxides, Acid and base catalysed ring opeaning 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. Witting reaction Mannich reaction.

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

V. Ketons

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. Carboxilic 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. Stereochemoistry 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. Gabrial- 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 afunction of V and T, entropy as a function of Pand 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 Equillbria**

Introduction. Electrolytes and Non-electrolytes: Aciss, Bases and Salts, ionic product of water, Common Ion Effect. Ionic Equilibna in weak Acids and Bases including Multistage Equilibria. pH Scale Exact treatment of Calculation of H^+ ions andc pH for HA and BOH. Hydrolysis- Salt hydrolysis, hydrolysis constant, pH calculation, Degree of hydrolysis, Titrations Acid- Base Titration Curve. Buffer solution. Buffer capacity, Handersion 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 equilibnum. 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. Results 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, Freindlich'sand Langmuir's absorption isotherm and their , charg 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 Ka 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, metable 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 quantition of cell reaction (ΔG, ΔH 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 Ttrimetric 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-Hydroxyquinolinate
- Determination of Copper as Copper (I) Thiocynate
- 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 givin Iron Filings solution by Permanganatometry
- Determination of the percentage of iron in givin Iron Filings solution by Chromatometry
- Determination of the percentage of iron in givin Iron Filings solution by Idometric 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 Trioxilatoferrate(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 $(CH_3CO)_2O$ Otherwise use CH_3COCl
- Nitroacetanilide
- Napthyl Benzoate
- Asprin 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 Asprin

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 CCl_4/ Toluene/ Chloroform
- Benzoic acid in to H_2O & 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 [Fe^{++}/Fe^{+++})/ Dichromate] Titration

Unit 16: Kinetics

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

IIIrd 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 ansd 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 theelectronic spectrum of $[Ti(H_2O)_6]^{+3}$ 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 planner 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-ethylenic complexes. Alkyl and Aryl derivatives of alkali and alkaline earth metal.

VII. Boinorganic 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 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 (Bathopchromic, 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 (1H 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 a 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. Organometalic Compounds

Organomagnsium compounds, the Grignard reagents, formation, structure and chemical reactions.Organozinc compounds; formation and chemical reaction.

III. Organisulphur 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 phridine, methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution reaction in pyridine derivatives. Comparision 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 Bischer 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 osozone 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 deoxynbose.

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, alkyal and aryl sulphonates.

X. **Fats Oils and Detergents**

Natural fates 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. nicotein, cocaine.

COURSE-X I BCH303 PHYSICAL CHEMISTRY- III 3 **credit**

I. **Elementary Quantum Mechanics**

Black body radiation, Planck's radiation law, photoelectric effect, Bohr's modes of hydrogen atom (no derivation) and its defects. Compton Effect. de-Brogli Hypothesis, the Heisenberg's uncertainty principles. Harmiltonian 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**

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 polarizavility, 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 photochemcal processes. Laws of photochemistry. Grothus - Drapper law, Stark-Einstein law, Jabtonsiki 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 solutionand colligative properties**

Ideal and non ideal solution, methods of expressing consecrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Roult's law, relative lowering of vaper pressure, molecular weight determination Osmosis, law of osmotic pressure, and itsmeasurement, determination of molecular weight from osmotic pressureand 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 Nornst 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 trioxilato ferrate (III), $Na_3 [C_2O_4] SO4$ and determination of its composition by permaganometery.

- Preparation of Ni-DMG complex, $[Ni(DMG)_2]$
- Preparation of copper tetraamine complex $[Cu(NH_3)_4]SO_4$
- Preparation of *cis* and *trans*-bioxilato diaque chromate (III) ion.

Unit3: 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, $NaHCO_3$, NaOH for separation and preparation of suitable derivatives.

Unit 5: Synthesis of Organic Compounds (Any two)

- Acetylation of salicylic acid. aniline, glucose and hydroquinine Benzoylation of aniline and phenol
- Preparation of idoform 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/ Backmann freezing point method.
- Determination of the apparent degree of dissociation of an electrolyte (e.g. 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 determination the ionization constant of weak acid conductometrically.

Subject: Forestry

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
	FIRST YEAR		
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
	SECOND YEAR		
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
	THIRD YEAR		
I	Natural resource management (Forest and Wildlife Management) (प्राकृतिक संसाधन प्रबंधन (वन एवं वन्य जीव प्रबंधन)	FR 09	3
II	Wood Science & Technology (वुड साइन्स एवं प्रौद्योगिकी)	FR 10	3
III	Forest mensuration and biostatistics (वन मेंसमिनि 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. Prunning 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

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, Rauvolfia, 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 ree 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 dendropththoe, 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

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 soild 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 solid 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 contact. 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

SUBJECT : GEOGRAPHY

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
	FIRST YEAR		
1.	Fundamentals of Physical Geography	GE-101	04
2.	Geography of India	GE-102	04
3.	Practical Geography	GE-103	04
	SECOND YEAR		
5.	Human Geography	GE-201	04
6.	Geography of Asia	GE-202	04
7.	Practical	GE-203	04
	THIRD YEAR		
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-1Fundamental 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 & Thornwell
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-4Biosphere
Unit-13 Elements of biosphere, Habitat & Plant- Animal association
Unit-14 Ecology & Ecosystem
Unit-15 Bio-diversity & its deptetion
Unit-16 Conservation of biotic resources

GE-102 GEOGRAPHY OF INDIA

UNIT SCHEDULE

Block-1 Physical Aspects

Unit-1 Geology & Structure

Unit-2 Physiographic regions

Unit-3 Drainage Systems

Unit-4 Climate, Soils & Natural Vegetation

Block-2 Resources

Unit-5 Forest Resources

Unit-6 Water Resources & River Valley Projects

Unit-7 Mineral & Power Resources

Block-3 Population

Unit-8 Population Growth, distribution & density

Unit-9 Population Composition

Unit-10 Literacy, Trends of Urbanization

Unit-11 Movement of Population

Block-4 Indian Economy

Unit-12 Agriculture – Spatial pattern of Agriculture

Unit-13 Industries - Spatial pattern region & IRD Complexes

Unit 14 Tourism in India : Past and Present

Block-5 Transport and Trade

Unit-15 Development of Transport Net-work

Unit-16 Special Pattern of Major Transport Net-work

Unit-17 Foreign trade

GE-103 PRACTICAL

UNIT SCHEDULE

Block-1 Scale and Maps

Unit-1 Scale: Plain, Comparative, Diagonal Scale

Unit-2 Elements and types of maps

Unit-3 Enlargement and reduction of maps

Block-2 Representation of Physical Data

Unit-4 Methods of showing relief

Unit-5 Profiles and their relevance in landform mapping and analysis

Unit-6 Representation of Weather data

Block-3 Weather maps and Indian Toposheets

Unit-7 Weather instruments

Unit-8 Interpretation of Indian weather maps

Unit-9 Classification of topographical maps

Unit-10 Interpretation of SOI topo-sheets (53G/16 53L/1 73D/15. 53F/13) of India

GE-201 Human Geography

UNIT SCHEDULE

Block-1 Concept and Nature

Unit-1 Nature, Scope and Elements of Human Geography

Unit-2 Man and Environment relationship-Determinism, Possibilism, Neo determinism, Probabilism

Unit-3 Basic principles and Approaches in Human Geography

Block-2Human Habitation

Unit-4 Population: Growth, distribution & density

Unit-5 Population Migration- National & International, Causes & Consequences

Unit-6 Settlement: Rural & Urban; Types & Patterns

Block-3 Economy

Unit-7 Evolution of Human Economy
Unit-8 Types of Human Activities: Primary. Secondary.
Unit-9 Types of Human Activities: Territory & Qurtnery
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-1Physical Aspects
Unit-1 Introduction. Structure and Relief
Unit-2 Drainage and Climate
Unit 3 Natural Vegetation and soil
Block-2Resources
Unit-4 Power Resources
Unit-5 Mineral Resources
Unit 6 Forest Resources
Block-3Population and Settlement
Unit-7 Population: Growth, Distribution &Density
Unit-8 Movement of Population
Unit-9 Settlement Types and Pattern
Block-4Economy
Unit-10 Agriculture
Unit-11 Industries
Unit-12 Trade
Unit-13 Transport, Port, Herbour
Block-5Regional 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 Isoplethe, Choropleth & Flow charts
Block-2 Statistical Methods
Unit-4 Measurement of Central tendency: Mean, Median & Mode,
Unit 5 Standard Devration . Measures of variability
Unit-6 Regression & Correlation
Block-3 Surveying
Unit-7 Principals 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 Seoctors 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 Whietlsey
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.

GE-303 PRACTICAL GEOGRAPHY

UNIT SCHEDULE

Block-1Map projections

Unit-1 Definitation & 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 & limitations of Conical with 2 standard parallel, Bones . Mercator ,cylindrical, equal area. Zenithal. Polar . Gnomonic, Stereographic, Conventional, Molwide. Sinusoidal & 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	विवित्त गणित	MT-01	04
2.	कलन अवं अवकल समीकरण	MT-02	04
3.	निर्देशांक ज्यामिति अवं गणितीय प्रग्रामन समस्याएँ	MT-03	04
	SECOND YEAR		
1.	वश्तविक विश्लेषण अवं दूरीक समष्टि	MT-04	04
2.	अवकलन समीकरण	MT-05	04
3.	संख्यात्मक विश्लेषण अवं सदिश कलन	MT-06	04
	THIRD YEAR		
1.	बीचगणित	MT-07	04
2.	सम्मिश्र विश्लेषण	MT-08	04
3.	यांत्रिकी	MT-09	04

विवित्त गणित (MT-01)

इकाई 1. समुच्चय सिद्धांत

इकाई 2. सम्बन्ध,जालक एवं फलन

इकाई 3. बीचगणितीय संरचना

इकाई 4.गणन प्रविधियाँ

इकाई 5.वर्णमालाएँ,भाषाएँ अवं व्याकरण

इकाई 6.परिमित अवस्था औतोमता अवं परिमित अवस्था मशीन

इकाई 7.बूलीय बीचगणित

इकाई 8.बूलीय व्यंजक एवं फलन

इकाई 9.विवित्त संख्यांक फलन एवं फलन

इकाई 10.पुनरावृत्ति सम्बन्ध

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

इकाई 12.ग्राफ चक्रमण

इकाई 13.समतलीय ग्राफ

इकाई 14.वृक्ष

इकाई 15.विष्टग्राफ

कलन अवं अवकल समीकरण (MT-02)

इकाई 1.श्रेणी

इकाई 2.व्यापकीकृत माध्यमान प्रमेय अवं घात श्रेणी

इकाई 3.वक्र के चाप का अवकलज व् पदिक समीकरण

इकाई 4.वक्रता

इकाई 5.आंशिक अवकलन

इकाई 6.उच्चिष्ट व निम्निष्ट

इकाई 7.अनंतस्पर्शियाँ

इकाई 8.वक्र अनुरेखण

इकाई 9.अन्वालोप

इकाई 10.समतल वक्रों का क्षेत्रफल

इकाई 11.समतल वक्रों की लम्बाई

इकाई 12.परिक्रमण ठोसों के आयतन अवं पृष्ठ

इकाई 13.द्वि समाकल

इकाई 14.त्रि समाकल अवं दिरिचलेट समकल

इकाई 15.गामा तथा बीटा फलन

इकाई 16.अवकल समीकरण

निर्देशांक ज्यामिति अवं गणितीय प्रग्रामन समस्याएँ (MT-03)

इकाई 1.X-Y में व्यापक द्विघाती कातीय समीकरण का उसके मानक रूप में समानयन

इकाई 2.गोला

इकाई 3.ध्रुव अवं ध्रुवीय समतल

इकाई 4.शंकु

इकाई 5.बेलन

इकाई 6.शांकवज

इकाई 7.एक पृष्ठीय अतिपरवलयज की जनक रेखाएं

इकाई 8.त्रिविम में द्विघात का व्यापक समीकरण व उसके मानकरूपों में समानयन

इकाई 9.रैखिक प्रोगामन समस्याएँ

इकाई 10.आधारी हल ,अग्रमुख समुच्चय एवं रैखिक प्रोगामन समस्या का मूल प्रमेय

इकाई 11.सिम्प्लेक्स कलन विधि

इकाई 12.द्वैतता

इकाई 13.द्वैत द्वारा रैखिक प्रोगामन समस्याओं का हल ज्ञात करना

इकाई 14.नियतन अवं परिवहन समस्याएँ

वास्तविक विश्लेषण अवं दूरीक समष्टि (MT-04)

इकाई 1.वास्तविक संख्या निकाय

इकाई 2.वास्तविक संख्याओं के सांस्थितिकी गुणधर्म

इकाई 3.वास्तविक अनुक्रम १

इकाई 4.वास्तविक अनुक्रम २

इकाई 5.सांतत्य

इकाई 6.अवकलज

इकाई 7.डिचर फलां क लिए सीमा अवं सांतत्य

इकाई 8.रीमान समाफालन १

इकाई 9.रीमान समाफालन २

इकाई 10.फलनो के अनुक्रमों का एकसमान अभिसरण -१

इकाई 11.फलनो के अनुक्रमों का एकसमान अभिसरण-२

इकाई 12.दूरीक समिष्टियां

इकाई 13.विवृत अवं संवृत समुच्चय

इकाई 14.उपसमिष्टियाँ, गुणन समिष्टियाँ, संतत प्रतिचित्रण अवं अभिसरण

इकाई 15.संहत समुच्चय, संहत तथा संबद्ध दूरीक समिष्टियां

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 रैखिक अवकल समीकरण

इकाई 7.समघात रैखिक 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 रैखिय अवकल समीकरण-१

इकाई 11.द्वितीय कोटि के रैखिय अवकल समीकरण-२

इकाई 12द्वितीय कोटि के रैखिय 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

इकाई 7.संख्यात्मक अवकलन

इकाई 8.बीजीय तथा अबिजीय 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 अवं आयतन समाकल

बीचगणित (MT-07)

इकाई 1.समूह ,उपसमूह

इकाई 2.क्रमचय,समूह,चक्रीय 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.वलय

इकाई 8.पूर्णांकीय प्रान्त एवं छेत्र

इकाई 9.वलय समाकारिता एवं अन्तःस्थापन

इकाई 10.पूर्णांकीय प्रान्त एवं विभाग छेत्र अवं अभाज्य छेत्र

इकाई 11.गुणजावालियाँ एवं विभाग वलय

इकाई 12.सदिश समष्टि ,उपसमष्टि की परिभाषा ,उदहारण अवं इनके गुणधर्म

इकाई 13.सदिशों का एकघात संचय ,एकघाती स्वतंत्रता एवं अश्रीतता

इकाई 14.सदिश समष्टि का आधार ,विमा एवं इनके उदहारण ,परिमित विमीय सदिश समष्टियों के गुणधर्म ,एकघाती विस्तृति एवं इनके जनित उपसमष्टि

इकाई 15.दो उपसमष्टियों का योग, उपसमष्टियों का अनुलोम योग अवं पूरक उपसमष्टि,विभाग उपसमष्टि एवं इनकी विमा

सम्मिश्र विश्लेषण (MT-08)

इकाई 1.सम्मिश्र तल , विस्तृत सम्मिश्र तल अवं त्रिविम प्रक्षेप

इकाई 2.सम्मिश्र संख्याओं के संस्थितिक गुण

इकाई 3. सम्मिश्र चर का फलन –सीमा , सांतत्य एवं अवकलनीयता

इकाई 4.विश्लेषिक फलन

इकाई 5.फलनों की श्रेणी का एकसमान अभिसरण एवं घात श्रेणी

इकाई 6.अनुकोण प्रतिचित्रण

इकाई 7.द्विरैखिक 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 अवं इनके अनुप्रयोग

इकाई 14.परिरेखा समाकलन

इकाई 15.विश्लेषित सांतत्य

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.कैटनरी

इकाई 6.वेग एवं त्वरण

इकाई 7.सरल आवर्त गति

इकाई 8.हुक का नियम तथा प्रत्यास्थ डोरियाँ

इकाई 9.प्रतिरोधी माध्यम में सरल रेखीय गति

इकाई 10.कार्य एवं ऊर्जा

इकाई 11.प्रतिबंधित गति

इकाई 12.केंद्रीय बल

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

इकाई 14.जड़त्व आघूर्ण १

इकाई 15.जड़त्व आघूर्ण २

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

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 B, Vector potential, Magnetic flux, Calculation of 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 **B**, **H**, and **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:

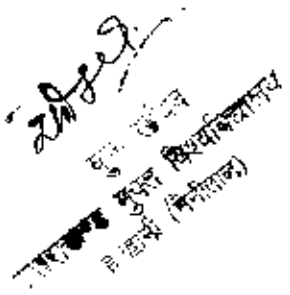
Unit–8: Wave Motion: Formation of a Wave; Graphical Representation of Wave Motion, Relation between Wave Velocity, Frequency and Wavelength; Mathematical Description of Wave Motion:

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.



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 'I' FOR A COMPOUND PENDULUM (BAR PENDULUM) AND THEN TO DETERMINE THE VALUE OF 'g' K and I 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 μ 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 $NiSO_4$

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, stem 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, Nernest 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 Cp and Cv, 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

Credit:3

Course code: BSCPHY202

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

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 thrmal 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 expenment), 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 **Credit: 3**

Course code: BSCPH204

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, Plank'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 megneton, Larmer'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, α and β 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 π 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

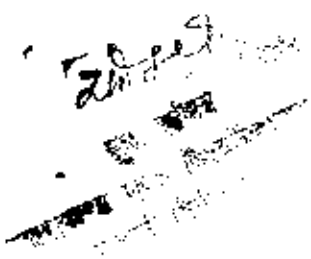
Unit –16: simplifying Boolean expressions; arithmetic circuits (adders, subtractor)

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.



11. To draw characteristics of a triode valve.
12. To draw characteristics of a pentode valve.
13. To draw characteristics of a tetrode valve.
14. To draw characteristics of a photoelectric cell.
15. To determine the value of Planck's constant by a photo cell.
16. To find out the value of energy band gap in PN junction diode.

SUBJECT: ZOOLOGY

COURSE	NAME OF COURSE	COURSE CODE	CREDITS
	FIRST YEAR		
1.	Non-Chordate	BSCZO101	03
2.	Cell and Molecular Biology	BSCZO102	03
3.	Genetics, Taxonomy and Evolution	BSCZO103	03
4.	Laboratory Course (Practical Zoology)	BSCZO104	03
	SECOND YEAR		
5.	Chordates	BSCZO201	03
6.	Environmental Biology & Animal Behavior	BSCZO202	03
7.	Developmental Biology and Applied Zoology	BSCZO203	03
8.	Laboratory Course	BSCZO204	03
	THIRD YEAR		
9.	Physiology and Biochemistry	BSCZO301	03
10.	Microbiology and Immunology	BSCZO302	03
11.	Biostatistics, Instrumentation and Techniques	BSCZO303	03
12.	Laboratory Course	BSCZO304	03

Course 1: Non-Chordate **Credit: 3**
Course Code-(BSCZO101)

Syllabus

General characters classification up to order. Study of Paramecium with particular reference to locomotion, nutrition, osmoregulation and reproduction. Germ layers, diploblatics and triploblastics organization. Theories on the origin of Metazoans. General characters and classification up to order level. *Sycon* with special reference to structure, reproduction and development. Canal systems, affinities and economic importance of Porifera. General characters and classification up to order level. Aurelia with special reference to structure, reproduction, development and polymorphism. A brief account of corals and coral reefs and their importance. General characters and Classification up to order level. Study of *Fasciola* with reference to structure, reproduction and parasitic adaptations. General characters and classification up to order level. Study of *Ascaris* with special reference to structure, reproduction and development. General characters and classification up to order level. *Nereis* with special reference to structure, reproduction and development. Metamerism and Parasitic adaptations in *Hirundinaria*. General characters and classification up to order level. *Paleomon* with special reference to structure, reproduction and development. Zoological importance of *Peripatus*. Types of mouth parts in insects. Social insects and their economic impotance. General characters and classification up to order level. Pila with special reference to structure, reproduction and development. General characters and classification up to order level. Asterias with special reference to structure, locomotion, mode of feeding and reproduction.

UNIT SCHEDULE

Block I: Lower Non chordate

Unit 1: Phylum Protozoa
Unit 2: Metazoa
Unit 3: Phylum Porifera
Unit 4: Phylum Coelenterate
Unit 5: Phylum Platyhelminthes
Unit 6: Phylum Nemathelminthes
Unit 7: Phyllum Annelida

Block II: Higher Non Chordata

Unit 8: Phylum Arthropoda
Unit 9: Phylum Mollusca
Unit 10. Phylum Echinodermata

Course II: Cell and Molecular Biology (BSCZO102)

Syllabus

History and origin. Prokaryotic and Eukaryotic cell. Difference between Prokaryotic and Eukaryotic cell. History Ultra structure, and chemical composition of plasma membrane (Lamellar-models, micellar models and fluid mosaic model). Functions of plasma membrane. History and structure, biogenesis and functions of mitochondria (Respiratory chain complex and Electron transport mechanism).History, structure, functions and importance Endoplasmic reticulum, Ribosome and Golgi bodies. History, structure, functions and importance of Lysosome, centriole and microtubules. History, structure, function and importance of Nucleus. History, types & functions of chromosomes. Giant chromosomes, Polytene chromosome and Lampbrush chromosome. Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synoptonemal complex, recombination nodules) and comparison between meiosis and mitosis Structure, functions and type of DNA, Watson and Crick's structural model of DNA, chemical composition of DNA, replication of DNA and recombinant DNA. Structure of RNA (primary, secondary and tertiary structure) and types of RNA (transfer RNA, messenger RNA, ribosomal RNA). Biosynthesis of m- RNA, t-RNA. Function and importance of RNA Protein Synthesis and regulation: Protein Synthesis, mechanism (initiation, elongation and termination) of protein synthesis Gene regulation (Operon hypothesis: regulator gene, promoter gene, operator gene, structural gene, repressor gene, co-repressor gene and inducer gene). regulation at transcription, regulation by gene arrangement and reversible phosphorylation, types of control mechanisms, regulation of gene activity in eukaryotes. Genetic Code: Properties of genetic code, codon and anti codon, The Wobble Hypothesis, Mutation and the triplet code.

UNIT SCHEDULE

Block I: Cell biology or Cytology

Unit 1: Cell type
Unit 2: Plasma membrane
Unit 3: Mitrochondria
Unit 4: Endoplasmic reticulum, Ribosome, Golgi bodies
Unit 5: Lysosome, centriole, microtubules
Unit 6: Nucleus
Unit 7: Chromosmes
Unit 8: Cell division

Block II: Molecular Biology

Unit 9: Structure and type of DNA
Unit 10: Structure of RNA
Unit 11: Protein Synthesis and regulation
Unit 12: Genetic Code

Course 3: Genetics, Taxonomy and Evolution (BSCZO103)

Syllabus

Elements of heredity and variation, Mendel's principles of heredity. linkage (Coupling and repulsion), crossing-over (mechanism, theories and importance). Chromosomal mapping (Three point cross). Chromosomal Mutation: Classification Translocation. Inversion, Deletion, Duplication, Euploidy, Aneuploidy and Polysomy. Genetic interaction: Gene structure and

functionMethods to study the human inheritance. Recessive inherited disorder, dominant inherited disorder, inborn errors of metabolism, sickle cell anaemia and syndromes. Taxonomy and Systematics: Historical resume of systematic. Introduction to taxonomy and its relationship with systematics. Importance and applications of biosystematics. International Code of Zoological Nomenclature, Bionomial, Trinomial components of classification and formation of scientific names of various taxa. Taxonomic characters: Morphological, Embryological, Cytogenetical, Biochemical and Numerical. Components of classification and Linnaean hierarchy. Concept of species: Species category, different species concept, Sub species and other infra species. Nature, types and potential modes of speciation. Special creation theory, theories of spontaneous generation, cosmozoic theory, theory of chemical evolution and spontaneous origin of life at molecular level. Concept of organic evolution: evidences from paleontology (types of fossils and determination of age of rocks and fossils), taxonomy, comparative anatomy, comparative embryology, physiology and biochemistry and cytology. Theories of organic evolution: Lamarckism, Darwinism, Mutation theory and modern synthetic theory.Modern evolutionary Concept and details of micro. macro and mega evolution. Major Zoo-geographical realms and distribution patterns of animals in different zoogeographical realms. Biogeographical regions in India.

UNIT SCHEDULE
Block I: Genetics
Unit 1: Mendalism and Elements of heredity
Unit 2: Chromosomal Mutation
Unit 3: Genetic interaction
Unit 4: Human genetics
Block II: Taxomomic concept
Unit 5: Taxonomy and Systematics
Unit 6: Zoological Nomenclature
Unit 7: Kinds of taxonomic characters and classification
Unit 8: Concepts of Species
Block III. Evolution
Unit 9: Origin of life
Unit 10: Concept of organic evolution
Unit 11: Theory of organic evolution
Unit 12: Evolutionary concept
Unit 13: Zoogeographical relams

Course IV: Laboratory Course (Practical Zoology)
Syllabus:

Museum Specimens study of Porifera, Coelentrata, Ctenophora, Platyhelminthes, Nemathelminthes, Annelida, Arthropoda, Mollusca and Echinodermata. Dissection study including general anatomy of leech, Pila, Unio, Prawan and cockroach. Study of permanent slides/ museum specimens/ models belonging to following phyla: Protozoa, Annelida, Arthropoda, Mollusca and Echinodermata. Larval stages study of different non chordate groups using whole mount slides: Annelida, Mollusca, Arthropda and Echinodermata. Permanent preparation of obelia colony; Ovary, pharyneal and septal nephidium earthworm, parapodia of Nereis and Heteronereis; gill, radula and osphradium of Pila, salivary glands, mouth parts and trachea of cockroach, gill lamina of Unio, staocyst and hastate plate of prawn. Study of mitosis and meiosis using available material. Experimentation on Mendalian and non Mendalian inheritance.

UNIT SCHEDULE
Block I: Museum Specimen study
Unit1: Protozoa (study of Permanent slides)
Unit2: Porifera (Study of permanent slides and Museum specimens)
Unit3: Coelentrata (Study of museum specimens and permanent slides)
Unit4: Platyhelminthes
Unit5: Nematoda
Unit6: Annelida (Study of museum specimens, permanent slide and slide preparation and study)
Unit7: Arthropoda (Museum specimens, whole mount and slide preparation)
Unit8: Mollusca(Museum specimens, whole mount/slides and slide preparation)
Unit9: Echinodermata (Museum specimens, whole mount/slides and slide preparation)
Block II: Experimentation ata. Dissection study including general anatomy of leech, Pila, Unio, Prawan and cockroach.

Unit10: Dissection
Unit11: Permanent slide preparation
Unit12: Cytological study
Unit13: Genetics experiment

Course V: Chordates (BSCZO201)

Syllabus

Origin, ancestry, introduction and charterers of chordates. Classification of chordates upto order level. General characters and classification upto order level. Study of *Balanoglossus* and its affinities. General characters and classification upto order level. Study of *Herdmania* and its affinities.General characters and classification upto order level. study of *Branchiostoma (Amphioxus)* and its affinities. General characters and classification upto order level. Study of *Petromyzon* and its affinities. General characters and classification upto order level. Types of scales and fins of fishes. *Scoliodon* as type study. migration and parental care in fishes. General characters and classification upto order level. *Rana tigrina* as type study parental care, neoteny and paedogenesis. Adaptive features of Anura, Urodela & Apoda.General characters and classification upto order level, extinct reptiles. Study of *Uromastix* , Identification of poisonous and non-poisonous snakes and biting mechanism of snakes. General characters and classification upto order level. Study of *Columba* (Pigeon) and Characters of Archaeopterx. Flight adaptations, migration, ratitae and economic importance of birds. General characters and classification upto order level, affinities of Prototheria, Metatheria and Eutheria. Study of rabbit *(Oryctolagus)* and dentition in mammals. Economic importance of Mammals.

UNIT SCHEDULE
Block I (Primitive chordates)
Unit 1: Origin of chordates
Unit 2: Hemichordata
Unit 3: Urochordata
Unit 4: Cephalochordata
Unit 5: Cyclostomata (Agnatha)
Block II (Lower chordates)
Unit 6: Fishes
Unit 7: Amphiba
Unit 8: Reptilia

Block III (Higher chordates)
Unit 9: Aves
Unit 10: Mammalia

Course VI: Environmental Biology & Animal Behavior (BSCZO202)

Syllabus:

Basic concept of ecology, definition, types of ecology, significance. concepts of habitat and ecological niche. Abiotic and biotic factors. Factors affecting environment (light intensity. temperature, humidity, topography, edaphic factors) Producer, consumer and decomposer. Primary and secondary productivity. Major ecosystems (Freshwater, marine. forest and desert). Concept, component and their function, energy flows, food chain, food web. trophic structures, ecological pyramids. Introduction of law of limiting factors. Biosphere: Hydrosphere, Lithosphere and Atmosphere. Biogeochemical cycles (nitrogen, carbon. and hydrogen and oxygen cycle). Biodiversity - Definition - genetic. species and ecosystem diversity Importance of biodiversity. Hotspots, threats to biodiversity - conservation of biodiversity. Principles of wildlife management, Protected Areas & Wildlife habitat in India. wildlife sanctuaries, National Parks and Biosphere reserves in India. endangered and threatened animals species in India. Wildlife Protection Acts 1972 and Biodiversity Act (2001). Protected area network initiative in Uttrakhand · Wildlife Sanctuaries. National Park, Biosphere Reserves Major endangered fauna representing to PA's of Uttarakhand State. Air pollution.water pollution, noise pollution and soil pollution Biodegradable and non degradable pollutants and Biomagnifications and Bioremediations. Drsaster Management - Floods, Earth quake. Cyclone and Landslides.Biomagnifications and Bioremediation. Types of behavior, behavioral equipments (senses, organs), Individual behavior pattern and homing behavior.Courtship and ritual behavior, mating, parental care in Amphibia and Primates. Social life in termites, dance language of the honey bees, Biological clocks. Migration in birds and fishes.

UNIT SCHEDULE
Block I: Environmental Biology
Unit 1: Ecological concept
Unit 2: Environment
Unit 3: Ecosystems
Unit 4: Biosphere
Unit 5: Biogeochemical Cycles
Block II: Biodiversity Conservation and Management
Unit 6: The concept of Biodiversity, Conservation and Management
Unit 7: Protected Area Network in Uttrakhand
Unit8: Environmental Pollution and Management
Unit 9: Policies and Regulation
Block III: Animal Behavior
Unit 10: Concepts and patterns of behavior
Unit11: Social organization

Course VII: Developmental Biology and Applied Zoology (BSCZO203)

Syllabus
Types of egg, Spermatogenesis and Oogenesis. Chemical and metabolic events during gamete formation. Approximation of gametes, Capacitation, Acrosome reaction. formation of fertilization membrane, egg activation, prevention of polyspermy. Patterns of cleavage , control of cleavage patterns, chemical changes during cleavage and significance of cleavage. Embryonic induction and concept of organizer. Formation of Fate maps and Foetal membrane in frog and chick. Significances of Fate and Foetal membrane. General principles of aquaculture: Induced Breeding, Composite fish culture, Lay out of fish farm and its management and by-products of fishing industry. Prawn culture and Pearl culture. Different kinds of silk producing insects. Host plants of silk insects. Grainage, rearing. breeding and diseases of silkworm. Reeling and fiber technology. Honey bee found in India and, different kinds of hives Management of bee colonies, bee enemies and their control. Extraction and processing of honey. Role of Honey bees in pollination management of agro-horticultural crops. Different kinds of Lac producing insects. Host plants, life cycle and diseases of lac insects. Types of poultry breeds, poultry housing, farm and farm management. Grading, handling and marketing of eggs. Poultry diseases and their control. Economic Importance of mammals in agriculture, horticulture, dairy, leather. wool and fur industry. Store grains pests: Their systematic positions, habits, life cycle, nature of damage and control measures. Biological and Chemical control: Elementary knowledge of pesticides and integrated pest management. General characters and Classification up to order level, morphology (including adaptations), life cycle, pathogenecity, diseases and control measures of parasitic animals.

UNIT SCHEDULE
Block I: Developmental Biology
Unit 1: Gametogenesis
Unit 2: Fertilization
Unit 3: Cleavage and Embryonic Induction
Unit 4: Blastulation and Gastrulation in Frog and Chick
Block II. Applied Zoology
Unit 5: Aquaculture
Unit 6: Sericulture
Unit 7: Apiculture
Unit 8: Lac Culture
Unit 9: Poultry
Unit 10: Economic importance of Mammals
Unit 11: Store grain pests
Unit 12: Pest Management
Unit 13: Parasitology

Course VIII: Laboratory Course (BSCZO204)

Syllabus: Museum Specimens study of Protochordat, Pisces, Amphibia, Reptilia, Aves and Mammalia Dissection study including general anatomy of Fish, Frog and available species of mammals. Study of skeleton of Frog, Varanus, Fowl and Rabbit. Permanent slides preparation of the body parts of pisces, Amphibia, Aves. Study permanent slides of protochordata, Amphiabia, Aves and Mammalia. Study water quality and pollution. Study of wild animals and effect of pollutants on animals. Embryological slides of chick and frog showing the different developmental stages. Specimens, picture and slide study of economically important anima

UNIT SCHEDULE

Block I: Chordata

Unit1: Protochordata (study of Permanent slides & Museum specimens)
Unit 2. Pisces (Dissection including general anatomy, Preparation of permanent slides, study of slides. museum specimens).
Unit 3: Amphibia (study dissection, skeleton, histology and museum specimens)
Unit 4: Reptilia (Study of varanus skeleton & Museum specimens)
Unit 5: Aves (Study of: Permanent slides. Skeleton and Museum specimens)
Unit 6: Mammalia (Study of animal dissection, skeleton, permanent slides and museum specimens)

Block II: Ecology Experiments & Environmental Biology

Unit 7. Ecology Experiments& Environmental Biology Water quality and polluents & Study of wild animals. pollutants)

Block III: Applied and Developmental Biology

Unit 9: Developmental biology (Permanent slides of chick & Frog embryology)
Unit 10: Applied Zoology (Specimens, picture and slide study of economically important animals)

Course IX: Physiology and Biochemistry (BSCZO301)

Syllabus

Intracellular and extracellular digestion. Intestinal digestion - Pancreatic secretion, bile juices and digestion in small intestine, digestion and absorption in large intestine. Digestion and absorption of carbohydrate, fat and protein and regulation of enzyme action Types of respiration. Breathing mechanism, pulmonary ventilation, respiratory pigments, gaseous transport and respiratory quotient. Composition and functions of blood, Blood groups. Rh factor. Mechanism of blood clotting. Types of heart. Cardiac cycle and its regulation (Heart beat). Homeostasis. Blood pressure and ECG. Structure of kidney Mode of excretion of nitrogenous wastes in animals: ammonotelism, ureotelism, uricotelism and guanotelism. Myelinated and non-myelinated nerve fibres. Neurotransmitters Synapses: - Ultra structure and function Resting and action potential of nerves, synapse and transmision of nerve impulse. Ultra structure of smooth, striated and cardiac muscles. Muscle contraction and its mechanism and simple twitch and fatigue. General characteristics of endocrine system. Structure and functions endocrine system and its dysfunctions and diseases. Bimolecular structure, classification and properties of peptide bond. Definition, Classification, Metabolism. - Glucogenesis, Gluconeogenesis, Glycolysis, TCA. & oxidative phosphoration of Carbohydrates. Definition, classification, simple, compound and derived lipids. Source, significance & deficiencies diseases of Carbohydrates and Lipids. Classification, structure, occurrence and functions of fat and water soluble vitamins. Source, significance & deficiencies diseases of vitamins. Definition, classification, structure and metabolism of proteins. Source, significance and deficiencies of Proteins. Definition, properties, classification, mechanism of enzyme action and factors affecting enzyme action. Source, significance & deficiencies of Enzymes.

UNIT SCHEDULE

Block I. Physiology

Unit 1: Digestive System
Unit 2: Respiratory System
Unit 3: Blood Vascular System
Unit 4: Excretory System
Unit 5: Nervous System
Unit 6: Muscular System

Block II. Endocrinology

Unit 7: Endocrine system
Unit 8: Hormonal Dysfunction and Diseases

Block III Bio-chemistry

Unit 9: Amino Acids and Peptides.
Unit 10: Carbohydrates and Lipids

Unit 11: Vitamins
Unit 12: Proteins
Unit 13: Enzymes

Course X: Microbiology and Immunology (BSCZO302)
Syllabus
Introduction to microbiology: Kinds of Microbes, Viruses. Archaea, Bacteria, Eukaryotic microorganisms and typical structure of bacterium and a virus. Culture and growth of microorganisms, classification of bacteria based on staining of microbes.Bacteria of medical importance – Gram positive and Gram Negative, Mycobecterium, Rickettsia and Actinomycetes. A brief knowledge of Mycoplasma and Aids. Useful microbial products: antibiotics, Food production, Dairy products. Alcoholic beverages, microbial spoilage and food preservation. Environmental use of microorganism: Metal recovery, petroleum recovery, waste treatment. Innate, Adaptive (cell mediated and humoral), Active and Passive immunity (Artificial and Natural). Organs of immune system: Primary and secondary lymphoid organs and lymphatic system. Antigen: Antigenicity , Adjuvants and Haptens. Immunoglobulins: types structure and function. Complement system (antigen – antibody reactions). Structural organization of MHC complex, Antigen processing and presentation. Functions of T-cells. Brief introduction to Vaccines, Immunodiagnosis and Immunotherapy.

UNIT SCHEDULE
Block I: Microbiology
Unit 1: Diversity of Microbes
Unit 2: Techniques in culture of microbes
Unit 3: Applied microbiology
Block II: Immunology
Unit 4: Overview of Immune System
Unit 5: Cells and organs of immune system
Unit 6: Humoral immunity
Unit 7: Cell mediated immunity
Unit 8: Applications of Immunology
Block III: Toxicology
Unit 9: Toxin
Unit10: Analytical toxicology

Course 11: Biostatistics, Instrumentation and Techniques (BSCZO303)

Syllabus:
Biostatistics as a tool in research and scope, Statistical symbols, Scope & Applications. Collection (Random and non random sampling), Organization and representation of data (Graph, Histogram, Scatter diagram). Mean Mode and Median, Measures of Variability: Mean deviation, Standard deviation, Variance and coefficient of variation. pH meter, UV-visible spectrophotometer, Centrifuges (clinical, high-speed and ultra- centrifuge). Geiger Muller and scintillation counters Tissue preparation, Fixation, Block preparation, Microtomy (paraffin and frozen tissue sectioning).Types of Microscopes: Bright field, Dark-field, Phase contrast, Fluorescence, Confocal and Scanning and transmission electron microscopes Chromatography, Electrophoresis and cryopreservation.

UNIT SCHEDULE
Block I: Biostatistics
Unit 1: Data collection and presentation
Unit 2: Measures of central tendency
Unit 3: Variability/ Dispersion
Block II: Instrumentation and techniques
Unit 4: Principles and uses of analytical instruments
Unit 5: Microtomy and Microscopy
Unit 6: Separation techniques and cryopreservation

Course 12: Laboratory Course (BSCZO304)

Syllabus

Measurement of action of salivary amylase, invertase enzyme and pepsin, trypsin. Blood physiology of the mammals i.e. hemoglobin % RBC & WBC, Haematin crystal and blood groups, Rh factor etc. Biochemistry exercises relevant to human beings i.e., Chemical test of urine for the presence of urea, sugar, proteins and ketone bodies and color test for carbohydrates, proteins and lipids. Bio-techniques: uses of various instrument i.e. Microscopes, electrophoresis, spectrophotometer etc. Bioinformatics: Data search engines, Data search tools for bioinloramtics, computer peripherals etc. Biostatistics study i.e., mean median, mode, standard deviation, standard error from the data provided.

Unit Details
Unit 1: Hematology Exercise
Unit 2: Physiology Experiment 2 (Slide study & reflex action)
Unit 3: Bio-chemistry Experiments
Unit 4: Immunology Experiment/study
Unit 5: Microbiology
Unit 6: Biotechniques (exercise based on chart / picture or sample instrument)
Unit 7: Biotechnology Exercise (I)
Unit 8 Biotechnology Exercise (II)
Unit 9: Bioinformatics
Unit 10: Biostatistics Exercise

iii) **Duration of the programme:** Minimum duration of programme is three (03) years and maximum duration if six (06) years

iv) **Faculty and support staff requirement:** At present there are four (04) regular faculty members and 05 academic associates are available in the School to run the programme. However, need is to have one Associate Professor and One Assistant Professor in each Department.

v) **Instructional delivery mechanism:** The programme will be offered in the Open and Distance Learning (ODL) mode. Guided self study material using print (SLM) and electronic media, lecture/ counseling sessions; special counseling sessions and group interactions in Workshop at cluster level; debate on key environmental issues, self-reliant study activities: individual / group work assignment; Project work; Lab sessions and excursion. The delivery material will include printed SLM, assignment, Face to face counseling at the designated study centres during Saturday and Sundays. Laboratory workshop will be conducted for 10 days at designated Study Centres.

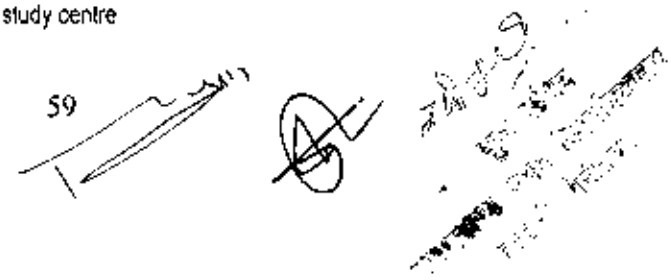
f) **Proceedure for admission, curriculum transaction and evaluation**

Eligibility: 10+2 Science subjects

Fee Structure: 15650 per year and Total Fees for three years Rs. 46800/-

Evaluation norms: A learner will be evaluated through continuous evaluation (Assignments) and term end evaluation (Term end examination) at the end of semester. Continuous evaluation will carry 20% weightage whereas term end evaluation will carry 80% weightage.

g) **Requirement of the laboratory support and Library Resources:** In order to carry out laboratory exercises, laboratory is compulsory requirement of the programme and in order to meet this requirement, the laboratory facilities of study centres will be utilized. S/he will be provided laboratory manual as per the need of the programme. Similarly for library, a learner may utilize the resources available at the designated study centre



h) **Cost estimates for development of the programme:** In order to develop our own study material for each subject financial assistance is required as per details given below:

Subject	Units	Amount (Rs.)
Botany	142	710000.00
Chemistry	118	590000.00
Forestry	114	490000.00
Geography	124	620000.00
Mathematics	132	670000.00
Physics	124	620000.00
Zoology	140	700000.00
	GRAND TOTAL (A+B+C)	4400000.00

i) **Quality assurance mechanism and expected programme outcomes:**

The programme will be implemented through only those Government Degree Colleges/ Universities / Institutions which have facilities for conducting laboratory counseling. In addition to this University will organize Laboratory workshop in designated places once (year/semester) for additional back up to the students so that competent and skilled human resource is produced. Further, the Programme and SLM developed will be continuously upgraded and necessarily be revised after a period of 5 years.

Programme outcomes:

- Learners residing in far flung rural hilly areas will be benefitted
- Marginalysed and economically backward communities will get opportunity to learn science education.
- In-service learners will have opportunity to enhance their science education.