UNIVERSITY OF DELHI

CNC-II/093/1(22)/2022-23/212
Dated: 06.10.2022

N O T I F I C A T I O N

Sub: Amendment to Ordinance V

[E.C Resolution No. 18-1-3 dated 18.08.2022]

Following addition be made to Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University;

Add the following:

Syllabi of Semester-I of the following departments under Faculty of Science based on Under Graduate Curriculum Framework -2022 to be implemented from the Academic Year 2022-23.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany
Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1: Plant Diversity and Evolution

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Diversity and Evolution	**DSC-1**	**2**	0	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/Biotechnology**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students aware about the diversity of plants and microbes present on the planet and how are they possibly related to each other in light of evolution.

Learning outcomes

The Learning Outcomes of this course are as follows:

By studying this course students will gain basic knowledge on

- The diversity of plants and microbes
- Their general characteristics
- Various groups of plants and their evolutionary relationships
- Basic principles and concepts of evolution that contribute to plant diversity

SYLLABUS OF DSC-1

Unit1: Origin of life **Hours: 6**

Principles and concepts of evolution, Tree of Life, and classification (upto six kingdoms)

Unit2: Bacteria **Hours: 4**

General characteristic features, cell structure, asexual reproduction and modes of gene transfer (conjugation, transformation and transduction), brief introduction to Archaebacteria.

Unit3: Viruses **Hours: 4**

General characteristic features, replication, RNA virus (structure ofTMV), DNA virus (structure of T-phage), Lytic and Lysogenic life cycle (Lambda phage).

Unit4: Algae **Hours: 6**

General characteristic features, cell structure, range of thallus, methods of reproduction and evolutionary classification (only upto groups). Brief account of *Spirogyra*, *Sargassum*.

Unit5: Fungi **Hours: 8**

General characteristic features, reproduction and broad classification. Myxomycetes and their similarities with fungi, plants and animals, Brief account of *Rhizopus*, *Agaricus*. Introduction to lichens.

Unit6: Bryophytes **Hours: 8**

General characteristic features and reproduction, adaptation to land habit, broad classification, evolutionary trends in Bryophytes. Brief account of *Marchantia*, *Funaria*.

Unit7: Pteridophytes **Hours: 8**

General characteristic features and reproduction, broad classification, evolutionary trends in Pteridophytes, affinities with Bryophytes. Brief account of *Adiantum*, *Selaginella*.

Unit8: Gymnosperms **Hours: 8**

General characteristic features and reproduction, broad classification, evolutionary trends in Gymnosperm, affinities with Pteridophytes. Brief account of *Gnetum*, *Ephedra*.

Unit9: Angiosperms **Hours: 8**

General characteristic features and reproduction, Concept of natural, artificial and phylogenetic system of classification. Affinities with Gymnosperms.

Practical component (60 Hours)

1. To study structure of TMV and Bacteriophage (electronmicrographs/models). (**01)**
2. To study morphology of *Volvox*, *Oedogonium*, *Chara*, *Fucus* and *Polysiphonia* (Temporary preparation/specimens/slides). (02)
3. To study *Rhizopus*, *Penicillium*, *Alternaria* (Temporary preparations), symptoms of rust of wheat, white rust of crucifer (specimen). (02)
4. To study *Marchantia* (morphology, WM of rhizoids and scales), *Anthoceros* (morphology), *Sphagnum* (morphology, WM of leaf), *Funaria* (morphology WM of rhizoid and leaf). (02)
5. To study *Selaginella* (morphology, WM of strobilus and spores), *Equisetum* (morphology, WM of spores), *Pteris* (morphology, tease mount of sporangia and spores). (03)
6. To study *Cycas* (morphology, leaf, leaflet anatomy, coralloid root, bulbils, megasporophyll and microsporophyll); *Pinus* (morphology of dwarf shoot, needle anatomy, male and female cones, WM pollen grains). (02)
7. To study variation in leaf venations in dicots and monocots (at least two specimens each). (01)
8. To study the types of inflorescences in angiosperms (through specimens).(01)
9. To study the types of fruits in angiosperms (through specimens). (01)

Essential/recommended readings

- Campbell,N.A.,Reece,J.B.(2008.)Biology,8thedition,PearsonBenjaminCummings,San Francisco.
- Evert,RF.,Eichhorn,S.E.(2012).RavenBiologyofPlants,8thedition, NewYork,NY: W.H.Freeman and Company.
- Bhatnagar,S.P.,Moitra,A.(1996).Gymnosperms.NewDelhi,Delhi:NewAgeInternational(P)

Ltd Publishers.

- Kumar,H.D.(1999).IntroductoryPhycology,2ndedition.Delhi,Delhi:AffiliatedEast-West. Press Pvt. Ltd.
- Pelczar,M.J.(2001).Microbiology,5thedition.NewDelhi,Delhi:TataMcGraw-HillCo.
- Puri,P.(1985).Bryophytes.NewDelhi,Delhi,AtmaRam andSons.
- Sethi,I.K.andWalia,S.K.(2018).TextbookofFungiandTheirAllies.(2ndEdition),Medtech Publishers, Delhi.
- Tortora,G.J.,Funke,B.R.,Case.C.L.(2007).Microbiology.SanFrancisco,U.S.A:Pearson Benjamin Cummings.
- Vashishta,P.C.,Sinha,A.K.,Kumar,A.(2010).Pteridophyta.NewDelhi,Delhi:S.Chand &Co Ltd.
- Singh,G.(2019)PlantSystematics-AnIntegratedApproach.4th edition.CRCPress,TaylorandFrancisGroup.
- Blackmore,S.,Crane,P.(2019)HowPlantsWork–Form,Diversity,Survival,PrincetonUniversity Press; Illustrated edition
- Ingrouille,M.,Eddie,B.(2006)Plants:EvolutionandDiversity.CambridgeUniversityPress.

Suggestive readings

- Parihar,N.S.(1991).AnIntroductiontoEmbryophyta.Vol.II.Pteridophytes.Prayagraj:U.P.: CentralBook Depot.
- Singh,V.,Pandey,P.C.,Jain,D.K.(2001).ATextBookofBotany.Meerut,UP:Rastogiand Co.
- Webster,J.,Weber,R.(2007).IntroductiontoFungi.Cambridge,CambridgeUniversityPress.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: Cell Biology: Organelles and

CREDIT DI STRIBUTION, E LIGIBILITY AND PRE-REQUISITES O F TH E COURSE

Course t itle & Code	Credits	Credit di stribution o f t he course			Eligibility criteria	Pre-requisite of t he course (if any)
		Lecture	Tutorial	Practical/ Practice		
Cell Biology: Organelles and Biomolecules	DSC-2	**2**	0	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- Cell as a structural and functional unit of life.
- Types of biomolecules (proteins, carbohydrates, lipids and nucleic acids) and their roles in cell structure and function.
- Structures of different organelles and their role in fundamental metabolic processes of a cell.

Learning outcomes

The Learning Outcomes of this course are as follows:

By studying this course students will gain basic knowledge on

- The relationships between the properties of macromolecules, their cellularactivities and biological functions.
- Physico-chemical composition of organelles and their functional organization.
- Basic principles and concepts of evolution that contribute to plant diversity.

SYLLABUS OF DSC-2

Unit 1: Biomolecules **Hours: 10**

Types of chemical bonds and their biological significance. Structure and biological roles of carbohydrates, lipids, proteins and nucleic acids. ATP: structure and its role as an energy currency molecule.

Unit 2: The Cell **Hours: 04**

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit 3: Cell Wall and Plasma Membrane **Hours: 06**

Chemistry, structure and function of Plant Cell Wall. Singer and Nicolson's fluid mosaic model of cell membrane.

Unit 4: Cell Organelles: Structure and function of the following Organelles

Hours: 11

Nucleus: Structure and function (nuclear envelope, nuclear pore complex, nuclear lamina); types of chromatins; nucleolus.
Chloroplast and Mitochondria: Structural organization; Function; Semi- autonomous nature of mitochondria and chloroplast.
Endomembrane system: Endoplasmic Reticulum – Structure and function of RER and SER, protein folding, processing in ER, export of proteins and lipids; Golgi Apparatus Organization, protein glycosylation, protein sorting and export from Golgi Apparatus. Introduction to post- translational modifications.
Peroxisome and Lysosomes: Structure and function.

Cytoskeleton: Role and structure of microtubules, microfilaments, intermediary filament and motor proteins.

Unit 5: Cell division **Hours: 08**

Eukaryotic cell cycle, mitosis and meiosis; regulation of cell cycle.

Practical component (60 Hours):

1. Study of cell and its organelles with the help of electron micrographs and other digital resources. (02)
2. Study of plant cell structure with the help of epidermal peel mount of *Allium*/*Rhoeo*/*Crinum*. (01)
3. Microchemical tests for carbohydrates (reducing, non-reducing sugars and starch), lipids and proteins. (02)
4. Separation of chloroplast pigments by paper chromatography/ Thin Layer Chromatography. (01)
5. Separation of amino acids by paper chromatography. (01)
6. Study the effect of organic solvent and temperature on membrane permeability. 02
7. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf. (01)
8. Demonstration of the phenomenon of plasmolysis and deplasmolysis. (01)
9. Demonstration of separation of biomolecules by dialysis. (01)

Essential/recommended Readings:

- Hardin, J. and Lodolce, J.P. (2022). Becker's World of the cell, 10th edition, Pearson
- Berg, J.M., Tymoczko, J.L., Stryer, L. (2011). *Biochemistry.* New York, NY: W. H. Freeman and Company.
- Campbell, N. A. (2020). Biology: A Global Approach, 12th Edition, Pearson
- Campbell, P.N., Smith, A.D. (2011). *Biochemistry Illustrated*, 4th edition.London, UK: Churchill Livingstone.

Suggested readings:

1. Cooper, G.M., Hausman, R.E. (2019). The Cell: A Molecular Approach, 7th edition. Sinauer/OUP.
2. Iwasa, J, Marshall , W. (2020). Karps's Cell Biology, 9th edition, New Jersey, U.S.A.: John Wiley & Sons.
3. Majumdar, R., Sisodia, R. (2019). Laboratory Manual of Cell Biology, with reference to Plant Cells. New Delhi, Delhi: Prestige Publication.
4. Nelson, D.L., Cox, M.M. (2021). Lehninger Principles of Biochemistry, 8th edition. New York, NY: W.H. Freeman and Company.
5. Reven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H.Freeman and Company.
6. Tymoczko, J.L., Berg, J.M., Stryer, L. (2012). Biochemistry: A short course, 2nd edition. New York, NY: W.H.Freeman and Company.

Note: Examination scheme and modes shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 3: Basic Laboratory and Field Skills in

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Laboratory and Field Skills in Plant Biology	**DSC-3**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objectives

The course will help students gain knowledge about:

- To learn fundamental skills important for performing laboratory and field experiments

Learning outcomes

This course will be able to demonstrate basic knowledge and understanding of:

- Good laboratory practices, management of laboratory waste, understanding hazards and risks to ensure a safe laboratory environment.
- Basics of measurements, units and common mathematical calculations, sampling and data collection.
- Operation and maintenance of instruments
- Presentation, analysis of data and interpretation of results.

SYLLABUS OF DSC-3

Unit 1: Lab safety and good lab practices **Hours: 08**

General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid spills and injury), safety symbols, lab safety equipments (fire extinguisher, fume hood, safety glasses), classes of laboratory chemicals, maintenance and handling of chemicals (Labels, Quality - LR/ AR/ Molecular biology grade/ HPLC grade; Expiry date; Precautions for use), Disinfectants, Biocontainment, Disposal of hazardous chemicals, radioactive and biological waste, Laboratory waste management.

Unit 2: Use and maintenance of Laboratory equipment **Hours: 08**

Weighing balance (Top loading and Analytical), pH meter (calibration and use), magnetic stirrer, pipettes and micropipettes, autoclave, laminar airflow, BOD incubator, incubator shaker, micrometer, haemocytometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGE unit, centrifuge, distillation unit, conductivity meter, Lux meter.

Unit 3: Microscopy, sample and slide preparation **Hours: 05**

Microscopes (Dissecting, Compound and Electron microscopes), Fixation and Preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of microscopes (Confocal, Fluorescence)

Unit 4: Measurements and calculations **Hours: 04**

Units of measurements and conversion from one unit to another, measurement of volumes of liquids, Weighing, calculations: scientific notations, powers, logarithm and fractions.

Unit 5: Solutions and Buffers **Hours: 04**

Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series, pH, acids and bases, buffers - phosphate, Tris- acetate, Tris- Cl and Citrate buffer.

Unit 6: Basic culturing techniques **Hours: 06**

Basic culture media (LB, YEB, MS)- liquid and solid, Culture techniques: plating (streak, spread & pour), replica plating, serial dilution.

Unit 7: Data collection, statistical analysis and interpretation **Hours: 08**

Fundamentals of data collection, data types - primary and secondary, methods of data collection, sample, sampling methods - merits and demerits, technical and biological replicates, classification - tabulation and presentation of data, Descriptive statistics - Mean, Mode, Median, Variance, Standard Deviation, Standard error, Coefficient of Variation, difference between sample mean and population mean.

Unit 8: Basic computer skills for biology **Hours: 08**

MS-Word, PowerPoint, Excel, introduction to biological databases.

Unit 9: Field Skills **Hours: 04**

Identification, collection, cataloguing and preservation of plant specimens, Herbarium and Museum.

Practical component (60 Hours):

1. Preparation of solutions- molar, molal, normal, percentage, stock, standard and serial dilution (01)
2. Determining pH of solutions (pH paper, Universal indicator, pH meter) and preparation of buffers (Phosphate, Tris-Cl, Electrophoresis buffers - TBE/TAE) (01)
3. Working of instruments -light microscope, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide). (01)
4. Temporary peel mount slide preparation and staining (safranin and acetocarmine). (01)
5. Calculate cell size using micrometer. (01)
6. Calculate number of cells (pollen/spores) using haemocytometer. (01)
7. Preparation of LB medium, growth and maintenance of bacterial cultures (liquid -serial dilution method; and semi-solid cultures - streak, spread and pour plates) (02)
8. Isolation of genomic DNA from *E. coli* and plant leaf material, Agarose gel electrophoresis (01)
9. Calculation of mean, mode, median, standard deviation using data set (collected from experiments 5,6). (01)
10. Using software to draw tables, graphs and calculating descriptive statistics (Microsoft Excel (01)
11. Laboratory safety equipment (Fire extinguisher, Fume hood, safety glasses) (01)
12. Mounting of a properly dried and processed plant specimen with herbarium label. (01)

Essential/recommended Readings:

- Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
- Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
- Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. Tata McGraw-Hill Education.
- Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wiley and Sons Inc.
- Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
- Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
- Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences, 1st edition. CRC Press.

Suggested readings:

- Zar, Z. H. (2010). Biostatistical Analysis, 5th edition, Pearson Prentice Hall, New Jersey, USA.

Note: Examination scheme and modes hall be as prescribed by the Examination Branch, University of Delhi, from time to time.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES
Offered by Department of Botany
Category-IV

GENERIC ELECTIVES (GE-1)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Plant Diversity and Human Welfare	GE-01	4	0	2	12th Pass	NIL

Learning Objectives

The Learning Objectives of this course are as follows:
Build awareness about the different groups of plants and their roles in supportinghuman life.

Learning outcomes

After studying this course the student will gain knowledge about:

- the diversity of various groups of plants, their characteristics and identification.
- different phytogeographic zones in India.
- the basic principles of conservation of Biodiversity and Sustainable DevelopmentGoals (SDG).
- the role of plants in human welfare.

SYLLABUS OF GE-1

Unit 1: Understanding biodiversity

Hours: 06

Understanding biodiversity - definition of key terms; plant diversity in India; assigning value to plant diversity; economic and ecological importance of algae, bryophytes, pteridophytes and gymnosperms; insights into flowering plant diversity with special focus on

agrobiodiversity.

Unit 2: Crop diversity

Hours: 08

Crop diversity in various phytogeographic regions in India and their traditional importance as food (including cereals, pulses, oil crops, spices, beverages, fruits and nuts, vegetables, condiments), medicines (Ashwagandha and Sarpagandha) and adornments

Unit 3: Role of forests

Hours: 06

Forests, woodlands, and vegetation stands: diversity and their importance in ecological, aesthetic, and overall well-being; social dimensions of plant diversity; commercial value and utilization of plant wealth.

Unit 4: Cash Crops

Hours: 5

Crops of high economic value (tobacco, sugarcane, cotton, basmati rice, sandalwood, saffron); Petro crops: the future industry (*Jatropha* sp., corn and sugarcane).

Unit 5: Conservation of biodiversity

Hours: 3

Conservation of biodiversity using community driven conservation strategies, sustainable utilization keeping Sustainable Development Goals (SDGs) in mind, Innovative approaches and traditional methods of biodiversity utilization and waste minimization during product formation.

Unit 6: Policy issues in conservation of Biodiversity

Hours: 02

National and International initiatives and programmes/schemes focussing on Plant Diversity and human welfare (Tribal Rights Bill, Convention on Biological Diversity (CBD), International Union for Conservation of Nature (IUCN), Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA).

Practicals: (60 Hours)

1. To study local plant diversity (common algae, bryophytes, pteridophytes, gymnosperms

(any two of each) in and around the campus; and understand their ecological and economic importance.

2. Microchemical tests for carbohydrates, proteins and oils.
3. To study (any three) commonly found tree species in the vicinity and understandtheir role in human welfare.
4. To prepare an inventory of common medicinal plants in your campus (identify tothe family level, list their uses in Indian System of Medicines)
5. To visit the local parks and list the trees planted. Also assess some for their dust pollution mitigation capacity using standard procedures.
6. Industrial visit to see how the drugs are extracted from plants (report to be submitted for evaluation).

Essential/recommended readings

1. Bilgrami, K. S. (1998). Phytodiversification and Human Welfare: Dedicated toLate Prof. KS Bilgrami, FNA (1933-96). MD Publications Pvt. Ltd.
2. Utting, P. (2013). Trees, People and Power. Routledge.
3. Manoharachary, C., Nagaraju, D. (2016). Medicinal plants for human health and welfare. Ann. Phytomed, *5*(1), 24-34.

.

Suggestive reading

Myers, N. (2019). A wealth of wild species: storehouse for human welfare.Routledge

GENERIC ELECTIVES (GE-2)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
Biofertilizers	GE-02	4		2	12th Pass	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To develop an understanding of biological systems used as fertilizers and build skills in handling microbial inoculants.
- To understand the optimum conditions for growth and multiplication of useful microbes such as *Rhizobium*, cyanobacteria, mycorrhizae, *Azotobacter* etc.
- To understand the role of microbes in mineral cycling and nutrition of plants.
- To gain expertise in various methods of decomposition of biodegradable waste, conversion into compost and apply this knowledge and skill in their daily life.

Learning outcomes

On successful completion of this course, a student will be able to:

- visualize and identify different types of microorganisms with a compound microscope.
- understand the classification of microorganisms according to their shape/ structure for morphological identification. Prepare and sterilize different types of culture media.
- isolate of microorganisms from the environmental samples and culture in aseptic conditions.

SYLLABUS OF GE-2

Unit 1: Introduction

Hours: 7

Introduction to microbial inoculants or biofertilizers, macro and micro nutrition of plants, chemical fertilizers versus biofertilizers; Methods and steps in mass multiplication of biofertilizers: stock culture, broth culture, growth medium, fermentation, blending with the carrier, packaging, and quality check, ISI standard specification for biofertilizers; scope of biofertilizers in India.

Unit 2: Microbial Inoculants

Hours: 08

Study of important microbial inoculants: *Rhizobium*, *Azospirillum*, *Azotobacter*, Actinorhizae; Characteristics, isolation, identification, and crop response.

Unit 3: Role of Cyanobacteria

Hours: 02

Role of Cyanobacteria (blue-green algae) in rice cultivation; *Azolla* and *Anabaena azollae* association, nitrogen fixation, and factors affecting growth.

Unit 4: Mycorrhizal association

Hours: 08

Types of mycorrhizal association, taxonomy, occurrence and distribution; Role of Arbuscular mycorrhizal fungi in phosphorus nutrition, growth and yield of crop plants; AMF – methods in isolation (wet sieving and decanting), identification (morphological and molecular methods). Methods of inoculum production (Pot culture and root culture).

Unit 5: Organic farming

Hours: 5

Introduction to organic farming, recycling of biodegradable municipal (domestic), agricultural and industrial waste; green manuring, bio-composting, vermicomposting and their field application.

Practicals: (60 Hours)

1. Study of *Rhizobium* from root nodules of leguminous plants by Gram staining method. **Hours: 01**

2. Observation of arbuscular mycorrhizal fungi from plant roots. **Hours: 02**

3. Isolation of arbuscular mycorrhizal spores from rhizosphere soil. **Hours: 01**

4. Isolation of *Anabaena* from *Azolla* leaf. **Hours: 01**

5. Study of Earthworm, *Azolla*, AMF: Arbuscules-vesicles through specimen / digital resources. **Hours: 01**

6. Study of Biocontrol methods and their application -Pheromone trap, *Trichoderma*, *Pseudomonas*, Neem etc. through digital resources. **Hours: 01**

7. Rapid test for pH, $NO3^{-}$, $SO4^{2-}$, Cl^{-} and organic matter of different composts. **Hours: 02**

8. Projects on any one of the following topics: *Rhizobium* technology, AMF technology, Organic farming, Bio composting, Vermicomposting, *Azolla* culture etc. (The design of the project should be such that it includes a continuous work of at least 6 Hours and a dissertation submission). **Hours:06**

Essential/recommended readings

- Kumaresan, V. (2005). Biotechnology. New Delhi, Delhi: Saras Publication.
- Sathe, T.V. (2004). Vermiculture and Organic Farming. New Delhi, Delhi: Daya publishers.
- Subha Rao, N.S. (2020). Soil Microbiology, 5th edn. New Delhi, Delhi: Oxford & IBH Publishers.
- Reeta Khosla (2017). Biofertilizers and Biocontrol Agents for Organic Farming, Kojo Press

Suggestive readings

- *Azotobacter* - Isolation and characterization - https://youtu.be/1Z1VhgJ2h6U
- *Rhizobium* - Identification and characterization - https://youtu.be/jELlo-pMvc4.
- 3-Days Online Workshop On Arbuscular Mycorrhizal Fungi - Biodiversity, Taxonomy and Propagation 19-2 (2022-01-20 at 02_27 GMT-8) - https://youtu.be/LKzK4IuSRc4.
- Vayas, S.C, Vayas, S., Modi, H.A. (1998). Bio-fertilizers and organic Farming. Nadiad, Gujarat: Akta Prakashan.

GENERIC ELECTIVES (GE-3)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Protected Agriculture – Hydroponics and Organic Cultivation	GE-03	4		2	12th Pass	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide knowledge and expertise of various aspects of hydroponics, aquaponics and organic cultivation to the students.
- To make students economically self-reliant by growing and marketing organic herbs, vegetables, microgreens and fruits.

Learning outcomes

- The Learning Outcomes of this course are as follows:
- Students will develop a thorough understanding of the concept of Hydroponics, Aquaponics and Organic farming.
- Students will be trained in establishing hydroponic facility. Students will learn the development of various organic products such as biopesticides, biofertilizers and biogrowth promoters.
- Students will understand various government policies in marketing of hydroponicand organic produce.
- Understand Good Agricultural Practices associated with protected agriculture.

SYLLABUS OF GE-3

Unit 1: Introduction to Protected Agriculture

Hours: 02

Protected Agriculture types (hydroponics, aquaponics and organic farming), definition history, terminology, importance and advantages over traditional agriculture, limitations and challenges.

Unit 2: Plant Growth Requirements and Media formulations

Hours: 5

Physical parameters - light (quality and quantity) artificial light, light balancers; pH, conductivity, salinity (Dissolved Oxygen-DO, Total Dissolved Solid - TDS) andtemperature; Chemical parameters- mineral nutrient requirements, deficiencies, toxicities, growth regulators (auxins, gibberellins, cytokinins and abscisic acids); Growth media- types, properties, uses, nutrient formulae, preparation of solutions, solid Media and nutrient film.

Unit 3: Hydroponic growing systems

Hours: 7

Basic concepts and designs (closed and open systems techniques Nutrient Film Technique (NFT), Deep Water Culture (DWC), Dutch Bucket and other small-scale systems), systems layout. Strengths and weaknesses of various systems, site considerations, componentry, nutrient delivery, pumping

Unit 4: Hydroponics associated pest and diseases

Hours: 06

Hydroponics associated pest - mites, thrips, whiteflies, leaf miners; Identification and management of diseases -bacterial, fungal and viral diseases; safety practices (Good Agricultural Practices (GAP) and Integrated Pest Management (IPM).

Unit 5: Organic farming and its management

Hours: 06

Organic farming and associated management practices (nutritional requirements, pest, diseases, weeds); use of biofertilizers, biopesticides, bioherbicides, biocontrol agents (plant growth promoting rhizobacteria (PGPR), pheromone trapping, *Trichoderma*, *Pseudomonas*, neem oil, garlic etc.) in management.

Unit 6: Marketing and Policies

Hours: 04

Marketing of the produce and government institutes and policies related to protected farming (hydroponics and organic farming).

Practicals: (60 Hours)

1. Study of various instruments used in hydroponics.
2. Preparation of growth media for hydroponics.
3. Estimation of NPK, DO, TDS, pH of growing media
4. Demonstration of different irrigation techniques in hydroponics.
5. Demonstration of construction of a sustainable hydroponic unit.
6. Perform rapid tests for estimation of NPK in different soil samples (at leastthree).
7. Bulk density and porosity of soilless media e.g. coco-peat, perlite, vermiculite, expanded clay, rockwool (any two media).

8. Demonstration of growing a leafy vegetable/fruity vegetable/ medicinal herb/aromatic plant in Hydroponics solution.
9. Study of traditional organic inputs and formulation of biofertilizer.
10. Preparation of biopesticides, plant health promoters like *Panchgavya, Beejamrut* etc. Field visit to organic farm/hydroponic farm and submission of visit report.

Essential/recommended readings

- Schwarz, M. (1995). Soilless Culture Management. Advanced Series in Agricultural Sciences, vol. 24. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-79093-5_2.
- Hasan, M., Sabir, N., Singh, A.K., Singh, M.C., Patel, N., Khanna, M., Rai, T., Pragnya, P. (2018). Hydroponics Technology for Horticultural Crops, Tech. Bull. TB-ICN 188/2018. Publ. by I.A.R.I., New Delhi-110012 INDIA.
- Misra S., Misra S., Misra R.L. (2017). Soilless Crop production. Daya PublishingHouse, Astral International (P) Ltd., New Delhi.
- Palaniappan S. P., Annadurai K. (2018). Organic Farming: Theory & Practice. Scientific Publisher.
- Goddek, S., Joyce, A., Kotzen, B., Burnell, G.M. (2019). Aquaponics FoodProduction Systems. Springer, Cham.

Suggestive readings

- Jones, J. B. (2014). Complete Guide for Growing Plants Hydroponically. CRCPress.
- Vayas, S.C, Vayas, S., Modi, H.A. (1998). Bio-fertilizers and organic Farming.Akta Prakashan, Nadiad.

GENERIC ELECTIVES (GE-4)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
Basic Laboratory and Field Skills in Plant Biology	GE-02	4		2	12th Pass	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

To learn fundamental skills important for performing laboratory and fieldexperiments.

Learning outcomes

After completion of this course the student will learn:

- Good Lab Practices, management of laboratory waste, understanding hazards andrisks to ensure a safe laboratory environment.
- Basics of measurements, units and common mathematical calculations, samplingand data collection.
- Handling and maintenance of instruments
- Presentation, analysis and interpretation of results.

SYLLABUS OF GE-4

Unit 1: Lab safety and good lab practices

Hours: 04

General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid and injury), safety symbols, lab safety equipments (Fireextinguisher, fume hood, safety glasses), classes of laboratory chemicals, maintenance and handling of chemicals (Labels, Quality - LR/ AR/ Molecular biology grade/ HPLC grade; Expiry date; Precautions for use), Disinfectants, Biocontainment, Disposal of hazardous chemicals, radioactive and biological waste, Laboratory waste management

Unit 2: Use and maintenance of Laboratory equipments

Hours: 04

Weighing balance (Top loading and Analytical), pH meter (calibration and use), magnetic stirrer, pipettes, autoclave, laminar airflow, BOD incubator, incubator shaker, micrometer, haemocytometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGE unit, centrifuge, distillation unit, conductivity meter, Lux meter.

Unit 3: Microscopy, sample and slide preparation:

Hours: 5

Microscopes (Dissecting, compound, electron microscope), Fixation and Preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of

microscopes (confocal, fluorescence)

Unit 4: Measurements and calculations

Hours: 02

Units of measurements and conversion from one unit to another, measurement of volumes of liquids, Weighing, calculations: scientific notations, powers, logarithmand fractions

Unit 5: Solutions and Buffers

Hours: 02

Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series, pH, acid and bases, buffers- Phosphate, Tris- acetate, Tris-Cl and Citrate buffer

Unit 6: Basic culturing techniques

Hours: 03

Basic culture media (LB, YEB, MS)- Liquid and solid, Culture techniques : plating (streak, spread & pour),replica plating , serial dilution

Unit 7: Data collection, statistical analysis and interpretation

Hours: 04

Fundamentals of data collection, data types - primary and secondary, methods of data collection, sample, sampling methods - merits and demerits, technical and biological replicates, classification - tabulation and presentation of data, Descriptive statistics - Mean, mode, median, Variance, Standard Deviation, Standard error, Coefficient of Variation, difference between sample and population mean.

Unit 8: Basic computer skills for biology

Hours: 04

MS- Word, PowerPoint, Excel, introduction to biological databases

Unit 9: Field Skills

Hours: 02

Identification, collection, cataloguing and preservation of plant specimens, Herbariumand Museum

Practicals: (60 Hours)

1. Preparation of solution- molar, molal, normal, percentage, stock, standard andserial dilution
2. Determining pH of solutions (pH paper, Universal indicator, pH meter) andpreparation of buffers (Phosphate, Tris-Cl, Electrophoresis buffers- TBE/TAE)
3. Working of instruments - light microscope, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide gels)
4. Temporary peel mount slide preparation and staining (safranin and acetocarmine).
5. Calculate cell size using micrometer.
6. To calculate number of cells using haemocytometer per unit volume (using pollen/spores)
7. Preparation of LB medium, growth and maintenance of bacterial cultures (liquid -serial dilution method; and semi-solid cultures - streak, spread and pour plates)
8. Isolation of genomic DNA from *E. coli* and plant leaf material, Agarose gel electrophoresis.
9. Calculation of mean, mode, median, standard deviation using data set (collectedfrom experiments 5,6.
10. Using software to draw tables, graphs and calculating descriptive statistics(Microsoft Excel)
11. Laboratory safety equipments (Fire extinguisher, Fume hood, safety glasses)
12. Mounting of a properly dried and processed plant specimen with herbarium label

Essential/recommended readings

- Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
- Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
- Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. TataMcGraw-Hill Education.
- Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wileyand Sons Inc.
- Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.

- Jones, A., Reed, R.,Weyers, J. (2016) Practical Skills in Biology, 6th Edition, Pearson.
- Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences (1st edition). CRC Press.

Suggestive readings

Zar, Z. H. (2010). Biostatistical Analysis, 5th edition, Pearson Prentice Hall, New Jersey, USA.

GENERIC ELECTIVES (GE-5)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Green Belt Development and Urban Management for Smart Cities	GE-02	4		2	12th Pass	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- Green Belt Development is a major step in the development of a sustainable ecosystem, particularly under the Smart Cities Program for urban development (Government of India).
- To introduce students with one of the key green skill development programs under the Skill India mission by the Government of India.
- To acquaint students with various methods and techniques used in development of green infrastructure for smart cities

Learning outcomes

Students will gain as the:

- Course familiarizes students with green skills that contribute to preserving or restoring the environment for a sustainable future that protect ecosystems and biodiversity, reduce energy and minimize waste and pollution.
- This course will help students understand the role of green belt in capturing the

transient emissions, prevent soil erosion and degradation, containing water run- offs and recharging ground water, attenuate the noise generated and improve the aesthetics.

- Students would be well trained (knowledge & skills) to contribute to Green Sector Skill program.

SYLLABUS OF GE-5

Unit 1: Introduction

Hours: 02

Definition, History and Concept of Green Belt; Aesthetics and Importance; Recommended Guidelines for green belt development for industries; Advantages and Applications.

Unit 2: Pollution and Carbon emission

Hours: 04

Type and various source of Emissions; Methods of estimation and monitoring of pollutants; Mechanism of deposition; Regulatory standards for major pollutants.

Unit 3: Plant-Pollutant Interaction

Hours: 04

Methods of sampling and screening local flora, Native and Exotic Plants, Various indicators (Morphological, Anatomical, Physiological and Biochemical) for selection of pollution mitigating plants; Sensitive/indicator, Resistant/ Tolerant Plant Species for different pollutants (air, water, land and sound). Factors effecting plant regeneration and growth.

Unit 4: Structural and Functional Aspects of Green Belt

Hours: 06

Methods of Planting and Propagation, Various approaches for green belt development, Theoretical Models; Site specific ecological requirements, parameters involved that effect landscape design, Methods to evaluate the effectiveness of green belt. Various tools for assessment and monitoring of green belt (GIS and Remote Sensing)

Unit 5: Green Belt for Mitigating Climate change

Hours: 04

Objectives of UNFCCC for mitigating greenhouses gases in urban sectors, Green Finance

and Green Infrastructure development, Methods to Evaluate total carbon sequestered; Carbon stocks and credits.

Unit 6: Waste water treatment through constructed wetlands

Hours: 06

Introduction: Wetlands values and functions, natural and constructed wetlands for wastewater treatments; Life forms in wetlands: microbes and vegetation in wetlands, plants adapted to pollutants and flooding, Role of macrophytes in constructed wetlands; physical and chemical characteristics of freshwater wetlands, constructed wetlands: types, role and management including key parameters for assessment.

Unit 7: Economics of Green Infrastructure

Hours: 04

Understanding of key plants for green economy - NFTP (Non-Forest timber products), biodiesel plants, herbal garden; Evaluating the cost and benefits of green belt development with type studies, Environmental accounting, Ecosystem services and constituents of wellbeing. Environmental Impact Assessment

Practicals: (60 Hours)

1. Methods of Vegetation Sampling and calculation of importance value index.
2. Measuring Tree Height and Cover to estimate green cover of an area.
3. Estimation of total carbon of an area.
4. Methods for selection of plants according to pollutant load both air and water (includes field survey)
5. Open Sources Software for mapping the GPS points and generating a cover map.
6. Measurement of Dissolved Oxygen (DO) from treated waste water.
7. Measurement of BOD and TDS from intake and treated pond.

Suggested Readings:

- Vesilind, P. A., Peirce, J. J., Weiner, R., (1998). Environmental Pollution and Control Netherlands: Elsevier Science.
- Burnwal, K., Jagwani, D. (2013). Air Pollution Abatement through Trees & Green Belt Development. LAP Lambert Academic Publishing.

- CPCB (2000). Guidelines for Green Belt development, CPCB, MoEF, GoI, New Delhi.
- Zhou, S. W. W., Zhou, S. W. W. (2020). Carbon Management for a Sustainable Environment. Germany: Springer International Publishing.
- Yunus, M., Singh, N. *de* Kok, L.J. (2013). Environmental Stress: Indication,Mitigation and Eco-conservation.Netherlands: Springer Netherlands
- Acar, S., Yeldan, A.E. (2019). Handbook of Green Economics Netherlands: Elsevier Science.
- Stefanakis, A., (2018). Constructed Wetlands for Industrial Wastewater Treatment United Kingdom, Wiley.
- Kröpfelová, L., Vymazal, J., Kröpfelová, L., Vymazal, J. (2008). Wastewater Treatment in Constructed Wetlands with Horizontal Sub-Surface Flow. Czechia: Springer Netherlands.

Suggestive readings

Amati, M. (2016). Urban Green Belts in the Twenty-first Century (Urban Planning and Environment) 1st Edition. Routledge publishers

Note: Examination scheme and modes hall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DEPARTMENT OF ZOOLOGY

BSC (Hons.) Zoology

Category-I

CREDIT DI STRIBUTION, E LIGIBILITY AND PRE-REQUISITES O F TH E COURSE

Course title & Code	Credits	Credit di stribution of t he course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Nonchordata – Protists to Pseudocoelomates	**4**	**2**	**0**	**2**	**Class X II pass w ith Biology as one of t he papers i n Class XII**	**-**

Learning Objectives

The course would provide an insight to the learner about the existence of different life forms on the earth and appreciate the diversity of animal life. It will help the students to understand the features of non-chordates and their systematic organization based on evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; the economic, ecological, and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

Learning outcomes

Upon completion of the course, students should be able to:

- Learn about the importance of systematics, taxonomy, and structural organization of non-chordates.
- Appreciate the diversity of non-chordates living in varied habits and habitats
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of nonchordates.
- Recognize the life functions and the ecological roles of the animals belonging to different phyla.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

SYLLABUS OF DSC-1

Unit I: Introduction to Non-chordates (2 Hours)

General characteristics of non-chordates and basis of classification.

Unit II: Protista (07 Hours)

General characteristics and classification; Life cycle of *Plasmodium vivax;* Locomotion and reproduction in Protista.

Unit III: Porifera (05 Hours)

Introduction to Parazoa; General characteristics and classification; Canal system in sponges.

Unit IV: Cnidaria and Ctenophora (8 Hours)

Introduction to Metazoa; General characteristics and classification; Polymorphism in Cnidaria; Corals and coral reefs.

Unit V: Platyhelminthes and Nemathelminthes (8 Hours)

General characteristics and classification; Parasitic adaptations of Helminthes; Life cycle of *Taenia solium* and *Ascaris lumbricoides*.

Note: Outline classification up to classes to be followed from "Ruppert, Fox and Barnes (2004). Invertebrate Zoology: A Functional Evolutionary Approach". VII Edition, Cengage Learning, India

Practical component

1. Study of whole mount of Euglena, Amoeba, Noctiluca, Paramecium, Binary fission in Paramecium and Conjugation in Paramecium.
2. Examination of pond water collected from different places to observe diversity inProtista.
3. Study of Sycon, Hyalonema, Euplectella, Spongilla, T.S. of Sycon, L.S. of Sycon.
4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium/Adamsia, Pennatula, Fungia, Meandrina, Madrepora.*
5. Specimen/slide of any one Ctenophore.
6. Study of adult *Fasciola hepatica, Taenia solium* and their life stages (Slides/microphotographs).
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/microphotographs).
8. To submit a Project Report on the life cycle of any one parasite or pathogen/corals/coral reefs.
9. Examination of soil samples collected from different places to observe diversity in nematodes.

Essential readings

1. Ruppert, Fox and Barnes (2004). Invertebrate Zoology. VII Edition, Cengage Learning, India.
2. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis. III Edition, Blackwell Science.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2) Biology of Cell: Structure

Credit distribution, Eligibility and Prerequisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biology of Cell: Structure and Function	**4**	**2**	**--**	**2**	**Class X II p ass with B iology as one o f t he papers in Class XII**	**-**

Learning Objectives

The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Learning outcomes

Upon completion of the course, students should be able to:

- Understand the fundamental principles of cell biology.
- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Appreciate how cells grow, divide, survive, die, and regulate these important processes.
- Comprehend the process of cell signaling and its role in cellular functions.
- Have an insight into how defects in the functioning of cell organelles and regulation of cellular processes can develop into diseases. Learn the advances made in the field of cell biology and their applications

SYLLABUS OF DSC- 2

Unit I: Overview of Cells and Plasma membrane (05 Hours)

Prokaryotic and Eukaryotic cells; Various models of plasma membrane structures, Transport across membranes: active and passive transport, facilitated transport; Cell-cell junctions, structures, and functions: Tight junctions, adherens junctions, gap junctions.

Unit II: Endomembrane System (10 Hours)

Structure and Functions: Endoplasmic Reticulum (ER), Golgi apparatus, Signal hypothesis, Vesicular transport from ER to Golgi apparatus, Protein sorting and transport from Golgi apparatus, Coated Vesicles, Lysosomes, Peroxisomes. Structure of Mitochondria, Semiautonomous nature, Endosymbiotic hypothesis; Respiratory chain, Chemiosmotic hypothesis, ATP Synthase.

Unit III: Cytoskeleton (2 Hours)

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

Unit IV: Nucleus (4 Hours)
Structure of Nucleus, Nuclear envelope, nuclear pore complex, Transport of molecules across nuclear membrane, nucleosome, nucleolus; Chromatin: euchromatin, heterochromatin.

Unit V: Cell Division (4 Hours)
Mitosis, Meiosis, Cell cycle and its regulation.

Unit VI: Introduction to Cell Signaling (05 Hours)
Cell Signaling through G-protein coupled receptor (GPCR) and role of secondary messenger: cAMP and protein kinase A.

Practical component (60 Hours)

1. Microscopy: Compound microscope: principle, components and handling; Phase contrast microscope; Electron microscope; Differential Interference Contrast (DIC) Microscope.
2. Principle and types of cell fixation and staining; Cell fractionation.
3. To study prokaryotic cells by Gram staining and eukaryotic cell (cheek cells) by hematoxylin/methylene blue.
4. To study the effect of hypotonic, isotonic, and hypertonic solutions on cell permeability.
5. Preparation of a temporary slide of squashed and stained onion root tip to study various stages of mitosis.
6. Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
7. Study of various stages of meiosis through permanent slides.
8. Preparation of stained mount to show the presence of Barr body in human female blood cells/cheek cells.
9. Cytochemical demonstration of:
    a. DNA by Feulgen reaction
    b. Mucopolysaccharides by PAS reaction
    c. Proteins by Mercuric Bromophenol Blue/Acid Fast Green

Essential readings

1. Cooper, G.M., Hausman, R.E. (2019) The Cell: A Molecular Approach. VIII Edition, ASM Press and Sinauer Associates.
2. Becker, Kleinsmith, and Hardin (2018) The World of the Cell, IX Edition, Benjamin Cummings Publishing, San Francisco.
3. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc.
4. Renu Gupta, Seema Makhija and Ravi Toteja (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi
5. VK Sharma (1991). Techniques in Microscopy and Cell Biology, Tata McGraw-Hill Publishing Company Limited, New Delhi

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3) Concepts of Ecology

Credit distribution, Eligibility and Pre-requisites of the Course

Course	Credits	Credit distribution of the course	Eligibility	Pre-requisite

title & Code		Lecture	Tutorial	Practical/ Practice	criteria	of the course(if any)
Concept of Ecology	4	2	0	2	Class XII pass with Biology as one of the papers in Class XII	NIL

Learning Objectives

The primary aim of this course is to develop a scientific understanding of the diverse aspects of the field of ecology. The students will be familiarized with the interactions between the organisms and their physical environment. Additionally, various attributes of populations and communities with help of theoretical concepts and field examples will be discussed. It provides a platform to understand the varied forces that lead to variations among populations of a species.

Learning outcomes

Upon completion of the course, the students should be able to:

- Demonstrate an understanding of the basic concepts of the subject
- Explain the characteristics, dynamics, and growth of populations
- Understand the characteristics of the community, ecosystem development and climax theories
- Gain knowledge about the relationship of the evolution of various species and the
- environment they live in.
- Design basic field studies, collect data and interpret it
- Carry out population and community studies

SYLLABUS OF DSC-3

Unit I: Introduction to Ecology (03 Hours)
Autecology and Synecology, Laws of limiting factors, Study of physical factors: Temperature and Light.

Unit II: Population (07 Hours)
Unitary and Modular populations; Unique and group attributes of population: density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equations and patterns, *r* and *k* strategies; Intraspecific population regulation: density-dependent and independent factors.

Unit III: Species Interactions (06 Hours)
Types of species interactions, Interspecific competition: Lotka-Volterra model of competition, Gause's Principle with laboratory and field examples, Niche concept; Predation: Lotka-Volterra equations, Functional and numerical responses, predator defence mechanisms, Resource partitioning.

Unit IV: Community (05 Hours)

Community characteristics: species richness, dominance, diversity, abundance, guilds, ecotone and edge effect; Ecological succession with examples and types.

Unit V: Ecosystem (6 Hours)
Types of Ecosystems: Terrestrial ecosystem, vertical stratification in tropical forest; Food chain: detritus and grazing food chains, linear and Y-shaped food chains, food web; Energy flow through the ecosystem; Ecological pyramids and Ecological efficiencies; Biogeochemical cycle- nitrogen cycle.

Unit VI: Applied Ecology (03 Hours)
Ecology in wildlife conservation and management, Protected areas: National Parks, Biosphere reserves and Sanctuaries; Restoration ecology, Principles of Environmental impact assessment.

Practical components (60 Hours)

1. Study of life tables and plotting of survivorship curves of different types from hypothetical/ real data
2. Determination of population density in a natural or a hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index.
3. Study of an aquatic ecosystem:
   a) Phytoplankton and zooplankton
   b) Measurement of temperature, turbidity/penetration of light, determination of pH
   c) Dissolved oxygen content (Winkler's method), chemical oxygen demand
   d) Free carbon dioxide and alkalinity
4. Study of ten endemic animals of India with slides/pictures/videos.
5. Report on a visit to a National Park/Biodiversity Park/Wildlife Sanctuary.

Essential readings

1. Odum, E.P. and Barrett G. W. (2008). Fundamentals of Ecology. Indian Edition (5th).Publisher: Brooks/Cole.
2. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
3. Saha G.K. and Mazumdar S. (2020) Wildlife Biology, An Indian Perspective. Publisher: PHI Learning Private Limited
4. Zimmer C. and Emlen D. J., (2013) 1st Edition. Evolution: Making Sense of Life, Roberts & Co.
5. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Edition. Evolutionary Biology, Oxford University Press

Note: Examination scheme and modes shall be as prescribed by the Examination Branch, University of Delhi, from time to time

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES
Offered by Department of Zoology
Category-IV

GENERIC ELECTIVES (GE-1): Human Physiology

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Human Physiology	4	2	-	2	12th Pass	Nil	Zoology

Learning Objectives

This course offers an overview of the concepts of normal biological functions in the human body. The fundamentals of human physiology and histological structures will be correlated. The concept of homeostasis in response to changes in the external environment will be introduced. Further, students will be provided with knowledge that can be applied in everyday life. The students will be encouraged to pursue further studies in physiology and related fields as well as multidisciplinary subjects that require an understanding of the physiology of humans.

Learning outcomes

Upon completion of the course, students will be able to:

- Understand the principles of normal biological function in the human body.
- Outline basic human physiology and correlate it with histological structures.
- Understand the homeostasis in animals in response to changes in their external environment.

SYLLABUS OF GE-1

Unit I: Tissues (05 Hours)
Types of Tissues; Structure and Function of Epithelial, Connective, Muscular and Nervous tissues.

Unit II: Functioning of Excitable Tissue (Nerve and Muscle) (05 Hours)
Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Mechanism of muscle contraction (Sliding filament theory).

Unit III: Digestion and Absorption of Food (05 Hours)
Structure and function of digestive system; Digestion and absorption of carbohydrates, fats and proteins.

Unit IV: Respiratory Physiology (04 Hours)

Structure and function of respiratory tract and lungs; Ventilation, External and Internal respiration; Transport of oxygen and carbon dioxide in blood.

Unit V: Cardiovascular System (04 Hours)
Structure of heart, Cardiac cycle, Composition of blood

Unit VI: Renal Physiology (03 Hours)
Functional anatomy of kidney

Unit VII: Reproductive Physiology (04 Hours)
Structure of testis and ovary; Spermatogenesis and Oogenesis.

Practical component (if any) (60 Hours)
1. Preparation of temporary mount of neurons and blood cells (blood film preparation).
2. Preparation of haemin and haemochromogen crystals.
3. Haemoglobin estimation using Sahli's haemoglobinometer.
4. Determination of ABO Blood group.
5. Recording of blood pressure using a Sphygmomanometer.
6. Examination and detailed study of permanent histological sections of mammalian Stomach, Duodenum, Liver, Lung, Kidney, Pancreas, Testis and Ovary.

Essential readings
1. Tortora, G.J. and Derrickson, B.H. (2012). Principles of Anatomy and Physiology. XIIIth Edition, John Wiley and Sons, Inc.
2. Widmaier E, Raff H and Strang K. (2013). Vander's Human Physiology: The Mechanism of Body Functions. XIIIth Edition, McGraw-Hill Education.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.
5. Prakash, G. (2012) Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand and Company Ltd.

GENERIC ELECTIVES (GE-2): Nature and Wildlife Studies

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Nature and Wildlife Studies	4	2	-	2	12th Pass	Nil	Zoology

Learning Objectives

The course is designed to acquaint students with varied aspects of wildlife conservation, including its importance, major threats, and management of habitats and populations. The emphasis will be on developing interest and invoking a sense of responsibility among students towards wildlife conservation. The course also explores different techniques, perspectives, and approaches to both identify and achieve wildlife management goals. Further, students will be motivated to pursue careers in the field of wildlife conservation and management..

Learning outcomes

By studying the course the students will develop:

- Understanding about wild life
- Evaluation and Management of Wildlife
- Wild life resources and protection

SYLLABUS OF GE-2

Unit I: Conservation of Nature and Wildlife (06 Hours)
Values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies: Wildlife Conservation Society (WCS), Convention on Biological Diversity (CBD), Agenda 21 of United Nations.

Unit II: Evaluation and Management of Wildlife (06 Hours)
Habitat analysis: a) Physical parameters: Topography, Geology, Soil and water; b) Biological Parameters: food, cover, forage; Census method

Unit III: Management of Natural Habitats (04 Hours)
Setting back succession: Grazing logging, Mechanical treatment, Advancing the successional process.

Unit IV: Management Planning of Wildlife in Protected Areas (04 Hours)
Human-wildlife conflict, Captive Breeding, Ecotourism.

Unit V: Wildlife Health and Management (04 Hours)
Care of injured and diseased animals, Quarantine; Zoonotic diseases: Ebola, Salmonellosis, Rabies, Foot and Mouth Disease, MonkeyPox, SARS, Bovine and Avian Flu.

Unit VI: Protected Areas (06 Hours)
National parks and sanctuaries, Biosphere reserves, Conservation and Community reserve, Important features of protected areas in India, Tiger conservation , management and challenges.

Practical component (if any) (60 Hours)

1. Identification of mammalian fauna, avian fauna, herpeto-fauna through direct and indirect evidences seen on a field trip to a wildlife conservation site.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field: Identification of animals
4. through pug marks, hoof marks and scats.

5. To study the various animal tracking system: Global Positioning System, Remote Sensing and Biotelemetry.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).
7. A report based on a visit to National Park/ Wildlife Sanctuary/ Biodiversity Park or any other wildlife conservation site.

Essential readings

1. Saha, G.K. and Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHI learning Pvt. Ltd. ISBN: 8120353137, 978-812035313
2. A.R.E. Sinclair, J.M. Fryxell and G. Caughley (2006). Wildlife Ecology, Conservation and Management. Wiley-Blackwell, Oxford, UK.
3. S.K. Singh (2005). Textbook of Wildlife Management. IBDC, Lucknow.
4. K. Banerjee (2002). Biodiversity conservation in managed and protected areas. Agrobios, India.
5. B.D. Sharma (1999). Indian Wildlife Resources Ecology and Development. Daya Publishing House, Delhi.
6. R.B. Primack (1998). Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, MA.
7. B. B. Hossetti (1997). Concepts in Wildlife Management. Daya Publishing House, Delhi.

ACBR

BSc (H) Biomedical Science

Category-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course (if any)
		Lecture	Tutorial	Practical/ Practice		
BIOORGANIC CHEMISTRY	**4**	**3**	**-**	**1**	**Student should have studied science (Biological science/ physical sciences)**	**-**

Learning Objectives

The Learning Objectives of this course are as follows:
Bioorganic Chemistry is a discipline that integrates organic chemistry and biochemistry. It aims at understanding the relevance of biological processes using the fundamental concepts of organic chemistry. This course includes basic principles of organic chemistry like concepts of stereochemistry and their importance in understanding various bio-molecular reactions along with introduction to biomolecules.

Learning outcomes

The Learning Outcomes of this course are as follows:
The students will be able:

- Identify, assess and analyze different types of stereoisomers and their properties in organic compounds and biomolecules.
- Explain the structures and function of biomolecules (carbohydrates, amino acids, lipids and nucleotide.
- To understand the mechanism of biologically significant name reaction and their role in biological systems.

SYLLABUS OF DSC-1

UNIT – I Stereochemistry (9 Hours)

Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diastereoisomers.
Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity.

Geometrical isomerism: Definition, nomenclature– E and Z.

UNIT – II Introduction to Biomolecules I (12 Hours)

Carbohydrates:

Monosaccharides- cyclization of aldoses and ketoses, conformations, concept of mutarotation, anomers, epimers.

Disaccharides- structure, reducing and non-reducing sugars. Polysaccharides- Starch, glycogen and cellulose.

Lipids:

Fatty acids, triacylglycerols, phospholipids, lipid bilayer formation, steroids (cholesterol)

UNIT – III Introduction to Biomolecules II (12 Hours)

Amino Acids:

Structure and classification of amino acids, ionization, chemistry of peptide bond, non-ribosomal peptide bond formation, essential and non-essential amino acids, amino acids as precursors of other bioactive compounds, zwitterion, isoelectric point, optical properties of amino acids, Definition of a peptide, peptide unit, peptide group, bond length, cis and transconformation, primary, secondary (alpha helix, beta sheet, beta turn, collagen helix), tertiary and quaternary structures (with examples).

Nucleotides:

Sugars and Bases, conformation of sugar phosphate backbone, hydrogen bonding and tautomerism in nucleic acid basesEffect of structure on reactivity of biomolecules.

UNIT – IV Biologically Significant Name Reactions (12 Hours)

Aldol (Glucogenesis), retro-aldol (Glycolysis), benzoin condensation (umpolungdecarboxylation of pyruvate in the presence of TPP), Claisen condensation (synthesis of fatty acids), Michael addition (Dehydrases), Cannizzaro (Sugarmetabolism), Bayer Villiger reaction (FAD dependent ketone synthesis), Pinacol-pinacolone rearrangement (1,2-carboncarbonshift)

Practical component (12 Sessions x 2 hrs) – 30 Hours

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Mohlisch, Barfoed, Fehling/ Tollen/ Benedict tests
2. Qualitative tests for carbohydrates toidentify the given unknown carbohydrate solution: Iodine test, Selvinoff, Osazone, Bial's tests
3. Qualitative tests for Amino acids and Proteins: Ninhydrin, Xanthoproteic, Million's, Lead Acetate, Biuret test
4. Qualitative test for Fats
5. Todetermine the Iodine number of the given oil/fat.
6. Tofind pKa value of acetic acid
7. To study the titration curve of glycine
8. Absorption spectrum of Protein
9. Absorption spectrum of DNA
10. Estimation of a Reducing sugar in a given sample.

Essential readings

1. Berg, J. M., Tymoczko J. L. and Stryer L. (2019) 9th Edition, International edition
2. Biochemistry. New York, USA: W. H. Freeman and Co. ISBN-9781319114671
3. Campbell, M. K. and Farrel, S. O. (2012) 7th Edition. Biochemistry. Boston, USA:Brooks/Cole Cengage Learning. ISBN: 13:978-1-111-42564-7
4. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4
5. Morrison, R.N., Boyd, R.N., Bhattacharjee, S.K. (2010), Organic Chemistry, 7th Edition,
6. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). ISBN 10:8131704815 ISBN 13:9788131704813
7. Eliel, L. (1975). 1st Edition. Stereochemistry of carbon compounds, New York, USA: Tata McGraw Hill. ISBN-13: 9780070992900
8. Finar, I.L. (2002), Organic Chemistry (Volume 1), 6th Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). ISBN-13: 978-0582305601
9. Dugas, H. (1999) 3rd Edition. Bioorganic chemistry. New York, USA: Springer Verlag. ISBN-13: 978- 0387989105

Suggestive readings:

- Nelson, D. L. and Michael M. Cox (2021) 8th Edition. Lehninger Principles of Biochemistry. New Jersey, USA: Prentice Hall Publishers. ISBN-13:978-1319228002.
- Nasipuri, D. (2020), Stereochemistry of Organic Compounds: Principles and Applications, 4 th Edition, New Age International. ISBN 10: 9389802474
- Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2017), Organic Chemistry, 12th
- Edition, Wiley. ISBN: 978-1-119-24897-2
- Plummer, D. (2017) An Introduction to Practical Biochemistry, 3rd edition. McGraw-Hill College; ISBN-13: 978-0070841659.
- Hoffman, A. 8th Edition (2018). Wilson And Walker's Principles and Techniques of
- Biochemistry and Molecular Biology. Cambridge: Cambridge University Press. ISBN13: 9781316677056

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2): CELL BIOLOGY

Credit distribution, Eligibility and Prerequisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CELL BIOLOGY	4	3	-	1	Student should have studied science (Biological science/ physical sciences)	-

Learning Objectives

The Learning Objectives of this course are as follows:
Structure and functions of various cellular compartments and organelles

- Fundamentals of transport of biomolecules inside the cell and its cytoskeleton
- Cell growth, cell-division and cell-cycle control mechanisms.
- Cell to cell communication and participation of signal transduction pathways, in driving cell response mechanics

Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will learn about how the cell has evolved and the basic types of cells present.
- Students will acquire insights into the composition and structure of cell membrane by navigating through various proposed cell models. Students will also learn the functions in detail about the processes of transport across cell membranes.
- Students will learn about the structure and function of various cellular compartments and organelles along with the concept of protein sorting and distribution in unique ways.
- Students will understand the association between cells through unique types of communication and developing junctions for attachment between neighbouring cells.
- Students will understand various cytoskeleton elements and their participation in maintaining cell shape and integrity. Students will gain knowledge about an overview of cell response to its environment, and involvement of cell- cell signalling mechanisms and to study signal transduction pathways.

SYLLABUS OF DSC- 2

UNIT – I The Cell (3 Hours)

Historical background, significant landmarks, cell theory, structure of prokaryotic and eukaryotic cells

UNIT – II Cell Membrane and Membrane Transport (6 Hours)

Functions, different models of membrane structure, types of membrane lipids, membrane proteins: types, methods to study membrane proteins (detergents, RBC ghosts), RBC membrane as a model, membrane carbohydrates, membrane asymmetry and fluidity, lipid rafts.

A. Transport of small molecules: Passive transport (simple diffusion and facilitated diffusion) and active transport and their types (P, V, F and ABC transporter) with example of Na+/K+ pump.

B. Transport of macromolecules: Endocytosis (pinocytosis, phagocytosis), exocytosis

UNIT – III Cell Organelles (15 Hours)

Structure and functions of various organelles:

- Nucleus: Different components, nuclear envelope- its structure, pore complex, nucleocytoplasmic, interaction (NLS and NES), nucleolus- structure and functions.
- Endoplasmic reticulum: RER- Biosynthesis and processing of proteins, co-translational and post-translational transport of proteins, signal hypothesis, protein sorting. SER- detoxification, biosynthesis of membrane, carbohydrate metabolism, steroid synthesis.
- Golgi apparatus: Golgi stack (cis, trans and medial cisternae), flow of proteins through Golgi body, glycosylation and protein sorting.

- Lysosomes: Development of different forms of lysosomes, role in cellular digestion, lysosomal storage diseases- Hurler syndrome, Hunter syndrome, Tay-Sachs disease and Inclusion cell disease (I-cell disease).
- Peroxisomes: Assembly, functions- H2O2 metabolism, oxidation of Fatty acids, glyoxysomes
- Mitochondria: Detailed structure, endosymbiotic theory, its genome and functions in brief
- Chloroplast: Detailed structure, its genome and functions in brief

UNIT – IV Cell -Cell communication (9 Hours)

Structures and functions of different types of anchoring junctions (desmosomes and hemidesmosomes), tight junctions, and communication junctions (gap junction and plasmodesmata).

UNIT – V Cytoskeletal Elements (6 Hours)

Structure, assembly and functions of:

A. Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies).
B. Microfilaments: Globular and filamentous actin, general idea about myosin.
C. Intermediate filaments: Different classes.

Unit VI: Cell Signaling and Cell Cycle (6 Hours)

Signaling molecules and their receptors (extracellular and intracellular), functions of extracellular receptors; Intracellular signal transduction pathways (cAMP, cGMP, steroid hormone response element). Different phases of cell cycle and their significance, mitosis and meiosis, checkpoints and regulation of cell cycle.

Practical component (30 Hours)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Light microscopy: Principle, construction and types. Study of positive and negative staining using photomicrographs.
2. Fluorescence microscopy: principle and applications. Concept of GFP
3. Electron microscopy: Principle, construction and types. Study of positive and negative staining, freeze fracture, freeze etching, shadow casting, endocytosis, exocytosis and phagocytosis using electron micrographs
4. To explain mitosis and meiosis using permanent slides.
5. To measure cell size using a stage micrometer.
6. To cytochemically demonstrate presence of total and basic proteins in cheek cells or onion peel using mercuric bromophenol blue or fast green.
7. To cytochemically demonstrate presence of carbohydrates in cheek cells or onion peel using periodic acid Schiff's reagent.
8. To cytochemically demonstrate presence of DNA in cheek cells or onion peel using Feulgen reagent.
9. To study the effect of isotonic, hypotonic and hypertonic solutions on cell.

Essential readings

- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551

- Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2008). 7th Edition. The world of the cell. San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 0805393934.
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Lodish H et al. (2003). 5th Revised edition. Molecular Cell Biology. W.H.Freeman & Co Ltd; ISBN13 : 978-0716743668

Suggestive readings

- Cooper, G. M. (2018). 8th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605357072
- Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2016). 9th Edition. The world of the cell. San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 -0321934925.
- Karp, G. (2019). 9th Edition. Cell and molecular biology: New Jersey, USA: Wiley Publishers. ISBN-978—1-119-59816-9.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3): HUMAN PHYSIOLOGY

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the co urse (if any)
		Lecture	Tutorial	Practical/ Practice		
HUMAN PHYSIOLOGY AND ANATOMY-I	4	3	-	1	Student should have studied science (Biological science/ physical sciences)	

Learning Objectives

The Learning Objectives of this course are as follows:

- The course curriculum is a systematic presentation of physiological concepts to ensure appropriate depth and breadth of basic functioning of the human body and its interrelations with respect to heart, lung, kidney, gonads, endocrine glands and digestive system.
- It would give students exposure of physiological concepts needed as foundations for further studies in pharmacology, pathology and pathophysiology etc.
- It would provide a base to understand body defenses and the mechanisms of deranged function of human body
- The curricular objectives are focused primarily on normal body function. Accordingly, wherever possible clinical examples have been illustrated to the underlying physiological

principles.

Learning outcomes

The Learning Outcomes of this course are as follows:
Having successfully completed this course, students shall be able to learn and appreciate:

- The usefulness of dividing the human body in different anatomical planes and sections, cavities, along with the role of feedback system in maintaining homeostasis. Functional anatomy of the epithelial and connective tissues while focusing on integumentary and skeletal system. Overview of structure, types and function of cartilage, bone and joints.
- Structure, function and regulation of components/different formed elements of blood and the mechanism of clotting. Students would be able to understand different blood groups, basis of their classification, their importance in blood transfusions and tissue grafting and basic concepts of blood and bleeding disorders
- Student would be able to understand neurons their role and significance and how as a part of the brain they help in brain physiology. Appreciation of basic concepts of action potential/ graded potential in the conduction of nerve impulse. Action and significance of different neurotransmitters at the synapse along with the mechanism of synaptic transmission using different ligand gated ion channels, G protein coupled receptors and their ligands as example.
- Students would learn organization of brain, with identification of structures and function of different brain regions. Identify different neural pathways and explain their significance. They would understand the innate responses and conditioned response of day today life by studying autonomic nervous system and effect of its stimulation on different organs.
- The five senses which help an individual to perceive the world would be studied in detail. Stimulus modality, sensory adaptation and the role of generator potential in the sensory physiology of touch, gustation, olfaction, hearing and vision. They would recognize and explain the common disorders related to the senses.
- Students would be able to describe and distinguish between the structure, mechanism and regulation of contraction of skeletal, cardiac and smooth muscles. Enlist the energy requirements, characteristic features of different muscle fibers and their role in generating muscle tension. Demonstrate the concept of muscle fatigue, adaptation to physical training, and muscle degeneration and associated disorders.

SYLLABUS OF DSC-3

UNIT – I Body organization and Integumentary system (6 Hours)

General Anatomy of the body, Introduction to various kinds of body planes, cavities and their membranes, Tissues level of organization (Types, origin, function & repair). Structure and functions of human skin.

UNIT – II Blood (6 Hours)

Composition and Function of Blood and its components (RBC, WBC, platelets and plasma). Hematopoiesis, Hemoglobin structure, function and abnormal hemoglobin. Basic concepts about Anemia and types. Blood Hemostasis (blood coagulation/ clotting, platelet function and role of endothelium).

UNIT – III Nerve physiology (6 Hours)

Structure, function and types of neuron, conduction of nerve impulse, Resting membrane potential, Action and graded potential. Synapse its types, Synaptic Transmission, Neurotransmitters and their receptors; types and function

UNIT – IV Nervous System I: Organization of nervous system (6 Hours)

Structure, function and organization of Central nervous system, Peripheral nervous system and Autonomic nervous system. Motor physiology: Reflexes, types and reflex arch

UNIT – V Nervous System II: Sensory Physiology (6 Hours)

Concept of receptors in the body and their types, structure, functional anatomy, regulation and common disorders of the following sensations: Vision, Hearing, Taste, Smell and other senses (Touch, Pain, Temp).

UNIT – VI Muscular system (9 Hours)

Functional anatomy of muscular system, types of muscles, neuromuscular junction structure property and transmission, General characteristics, molecular mechanism and properties of skeletal muscle excitation and contraction, energetics and characteristics of whole muscle contraction.

Unit- VII Skeletal System (6 Hours)

Cartilage: structure, types and function. Bones: structure, function, location and types.
Joints: structure, function and types

Practical components (30 Hours)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Estimation of haemoglobin (Sahli's method)
2. Determination of total erythrocyte count.
3. Determination of total leukocyte count.
4. Preparation of blood smears and identifying various WBC
5. To perform differential leukocyte count of blood.
6. To study a simple reflex arc
7. To study the sensation of taste, touch and smell.
8. To study different human organs and their sections through permanent histological slides T.S. of brain, spinal cord, skeletal fibres, cardiac muscles, skeletal muscles, cartilage joints and different tissues. (Minimum 8 slides covering the systems mentioned in theory.)

Essential readings

- Guyton and Hall Textbook of Medical Physiology, 12th edition (2011), J. E. Hall; W B Saunders and Company, ISBN: 978-1-4160-4574-8 International Edition: 978-08089-2400-5
- Human Physiology, 12thedition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN 978007–337811–4MHID 0–07–337811–9.

Suggestive readings

- Principles of Anatomy and Physiology, 16th edition (2020), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN: 978-1-119-66268-6.(e book),ISBN: 978-1-119-70438-6 (for print book).

- Ganong'sReviewofMedicalphysiology,26thedition(2019),K.E.Barett,S.M.Barman,S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-260-12240-4 (for print book) ISBN: 978-1-26-012241-1(for eBook)
- Textbook of Practical Physiology, 9th edition (2018), CL Ghai; Jaypee Publication, ISBN13: 978-9352705320 ISBN-10: 9352705327

Common Pool of Generic Electives (GE) Courses Offered by ACBR

Category-IV

Note: Examination scheme and modes hall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-1): CONCEPTS IN BIOTECHNOLOGY

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical / Practice		
CONCEPTS IN BIOTECHNOLOGY	4	3	-	1	The student should have studied science (Biological science/physical sciences)	NA

Learning Objectives

The Learning Objectives of this course are as follows:
The purpose of this course is to introduce students to importance of Biotechnology in allied fields. It will enable students from diverse backgrounds to understand basic concepts in Gene Cloning and DNA Analysis, and appreciate applications of Biotechnology in everyday life. The course will provide students with an insight into the various molecular biology techniques commonly used in Biotechnology, and some of the relevant bio-safety issues and ethical concerns.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn about basic biotechnology techniques and key concepts that are used in isolation and characterization of biomolecules (DNA and proteins).
- Develop basic understanding of the robust techniques with wide applications (such as PCR, DNA sequencing) and appreciate their contribution in development of biotechnology.
- Comprehend the importance of gene cloning in biotechnology and learn the intricacies of gene cloning using plasmids and bacteriophages as cloning vectors.

- Understand the importance of construction of genomic libraries and their specialized screening methods to identify gene of interest.
- Learn the concept and application of DNA fingerprinting, recombinant protein expression, biopharmaceutical protein production, and gene therapy.
- Gain an insight of safe handling of GMO's, their environmental release and ethical practices.

SYLLABUS OF GE-1

UNIT – I Techniques Used in Biotechnology (12 Hours)

Brief history of biotechnology and its importance. Isolation and purification of plasmid DNA. Agarose and Polyacrylamide gel electrophoresis (Native and SDS). Southern and Western hybridization. Polymerase Chain Reaction (PCR): Principle, DNA polymerases in PCR, Primer Designing, Types of PCR - Hot Start, Multiplex and Reverse Transcription and their Applications. Sequencing: Enzymatic (Sanger's dideoxy) method, Introduction to Automated Sequencing.

UNIT – II Process of Gene Cloning, Expression and Protein Purification (15 Hours)

Restriction endonucleases: Restriction and Modification Systems, Nomenclature and Types of Restriction Enzymes (Type I-IV), Recognition of Restriction Sites. Joining of DNA Molecules: Sticky End and Blunt End Ligations, Role of DNA Ligase, Adaptors, Linkers, Homopolymer Tailing. Vectors: Plasmids (pUC Vectors), Bacteriophage (Lambda Phage Derived Replacement And Insertion Vectors), Cosmids, In Vitro Packaging, Expression Vectors (One example each of prokaryotic and eukaryotic expression vectors). Bacterial Transformation, Antibiotic Selection and Blue/White Screening of Transformants. Challenges in Expression of Eukaryotic Proteins in Prokaryotic Hosts

UNIT – III Genomic and cDNA Libraries (18 Hours)

Construction of Genomic and cDNA Libraries, their Screening by Nucleic Acid Hybridization (Colony and Plaque Hybridization).

UNIT – IV Applications of Biotechnology (6 Hours)

DNA Fingerprinting. Using the Example of Human Insulin learn the Importance of Various Applications of Biotechnology: Recombinant Protein Expression, Biopharmaceutical Protein Production and Gene Therapy.

UNIT – V Biosafety and Ethical Issues (6 Hours)

Safe Handling and Disposal of GMOs and Relevant Ethical Issues. Impact of GMOs on the Environment (Bt. Toxin).

Practical component- (12 Sessions x 2 = 24 hrs)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. To prepare laboratory reagents.
2. To perform plasmid DNA isolation.
3. To perform agarose gel electrophoresis of isolated plasmid DNA.
4. To perform restriction digestion of plasmid DNA.
5. To perform agarose gel electrophoresis of digested DNA.
6. To study restriction mapping.
7. To amplify DNA using PCR.
8. To perform agarose gel electrophoresis of amplified DNA

Essential readings

- Cantor, C. R. and Smith, C. L. (2004). 1st Edition. Genomics: The science and technology behind the human genome project. New York, USA: John Wiley and Sons. ISBN-13: 978-0471461869.
- Old, R. W. and Primrose, S. B. (1994). 7th Edition. Principles of Gene Manipulation: an Introduction to Genetic Engineering. Boston: Wiley. ISBN-13: 978-0632037124.
- Joseph Sambrook, E.F. Fritsch, T. Maniatis. (1989). 2nd Edition. Molecular Cloning: A Laboratory Manual. New York, USA: Cold Spring Harbor Laboratory. Press ISBN- 978-0879693732.

Suggestive readings

- Glick, B. R. and Patten, C. L. (2022). 6thEdition. Molecular Biotechnology: Principles and Applications of Recombinant DNA. USA: ASM press, ISBN-13: 978-1683673668.
- Brown, T. A. (2020). 8thEdition. Gene cloning and DNA analysis: An introduction. New York, USA: John Wiley and Sons, ISBN-13: 978-1119640783.
- Karp, G. (2016). 8th Edition. Cell and Molecular Biology: Concepts and Experiments. United states: Wiley. ISBN-13: 9781538832462.
- Primrose, S. B. and Twyman, R. B. (2014). 7th Edition. Principles of Gene Manipulation and Genomics. New York, USA: John Wiley and Sons. ISBN-13: 978-1118653883.
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual (three-volume set). New York, USA: Cold Spring Harbor Laboratory Press ISBN-13: 978- 1936113422

GENERIC ELECTIVES (GE-2): LANDMARK DISCOVERIES IN SCIENCE

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of t he course
		Lecture	Tutorial	Practical/ Practice		
LANDMARK DISCOVERIES IN SCIENCE	4	3	-	1	The student should have studied science (Biological science/physical sciences)	NA

Learning Objectives

The Learning Objectives of this course are as follows:
The objective of the course is to ensure students appreciate the convenience and comfort that they have is all because of discoveries and inventions of the past. Meticulous execution of historical experiments in very little resources would also motivate them towards doing valuable research with enormous facilities that they have. The historical accounts of science provide grounds for interpretation and may be useful in arousing appreciation of science. The course would provide: Detailed analysis of classically designed and executed experiments in Life Sciences over the years. It will provide a foundation of biology by uncovering various players in the machinery of biological processes. I will also be helpful in technical, scientific analysis with historical background for a robust understanding of various discoveries. Critical

analysis of the history of biology would surely help students comprehend futuristic scientific discoveries.

Learning outcomes

The Learning Outcomes of this course are as follows:
The students will be able:

- Students will be able to learn how was light manipulated during the past to peer into previously invisible world—those too small or too far away to be seen by the naked eye.
- Students will learn about experiments that had fundamental contribution to our present understanding of key molecular elements of life. They will understand how to examine microbial cells and colonies, using various techniques to manipulate color, size, and contrast in ways that helped Scientists to identify species and diagnose disease.
- Studying this unit, students would come to know that there were three group of Naturalists working simultaneously to find answers to inheritance, evolution and basic composition of life. Students will be divulged with hereditary aspects of life. They will get familiar with genes and their roles in living organisms.
- Having understood the relationship of genes and inheritance, students would find interesting to learn the mystical molecule that make up these genes. Sequential study of these experiments would step by step unravel the mystery of genetic material.
- Students at this point of course would be curious to know the structure of molecule that forms the genetic material. They would learn how the information present on DNA manifests itself as specific characteristic features and help in diversity among organisms.
- Students will be explained how the in depth knowledge about became the most important tool for in vitro research, modification and applications thereof.
- Students will be briefed about some landmark discoveries which helped the field of medicine to grow tremendously and played a significant role in improving the overall health of the human population.
- Students can be given small projects to write discoveries done in conventional way.
- They will be required to provide a descriptive view of the topics assigned to them. Students should highlight the research topic with reference to current understanding.

SYLLABUS OF GE-2

UNIT – I View of the invisible Biology (6 Hours)
Rudimentary microscopes to magnify objects; Use of eye glasses as simplest microscopes - Flea or fly glasses; Observing nature in the new world under lens; Book of Optics; Scientific use of Microscopes; Importance of Malphigi microscope that used field lens; Compound Microscope; Robert Hooke's observations in Micrographia; Foldscope by Manu Prakash

UNIT – II Origin of Life – A question (6 Hours)
Spontaneous generation versus biogenesis; Problem of spores; Microbiology and Medicine - Germ theory of Disease; Recognition of agents of infection – Koch's Postulates.

UNIT – III Understanding Biology by observations (6 Hours)
A) Study of evolution of life: Darwins Theory (B) Study of Inheritance of Life: classical era with contributions of Aristotle, Epicurus, and others; Modern genetics: Gregor Johann Mendel, his work on pea plants, theory of Mendelian inheritance (C) Study of composition of Life : Levels of cellular and molecular organization; Cells, tissues and organs in our body; Pioneers of chromosome studies; Discovery of nucleic acids; Nuclein verified as a distinct chemical entity; Early identification of purines and pyrimidines; building blocks of Nucleic

acids and proteins; Chemistry of Nucleic acids; Levene's tetranucleotide hypothesis.

UNIT – IV DNA as the hereditary material – An experimental view (4.5 Hours)
Transformation: Classic work of Frederick Griffith; DNA as the Pneumococcal Transforming Factor; In vitro Transformation system; Announcement that the transforming Principle was DNA; Mirsky's Criticism; The Avery, MacLeod and McCarty proclamation; Additional experiments that supported DNA as the transforming principle; Hershey and Chase clinched the role of DNA as the Genetic Material

UNIT – V Solving the puzzle of DNA structure (4.5 Hours)
Early studies of diffraction of X Rays by DNA fibers – contributions of Rosalind Franklin; Use of X – rays in medicines and research; Erwin Chargaff's discovery of base complementarity in DNA; Watson and Crick model of DNA; Contribution of Linus Pauling; DNA is replicated in Semi-conservative Fashion; Deciphering the Genetic Code; One Gene One Enzyme Edict.

UNIT – VI Technical advancements in biology (6 Hours)
Polymerase Chain Reaction – a revolution in modern biology; DNA Manipulations using Restriction enzymes; Discovery of reverse transcriptase leading to development of RT-PCR for RNA amplification; Work of Stanley Cohen and Herbert Boyer; Advent of gene cloning - History and current applications

UNIT – VII Research as a backbone of modern medicine (6 Hours)
(A) Discovery of antimicrobial agents; Contribution of Joseph Lister and later by Alexander Flemming leading to Discovery of Magic bullets; (B) Control of Infectious Diseases – Variolation, mithridatism and vaccination from the view of Edward Jenner; Vaccine production strategies – with examples of BCG and SARS-CoV2 vaccines; Historical timeline of vaccination strategies; (C) Marie Curie – Use of radiation in medicine.

UNIT – VIII Project Work [On any one topic] (6 Hours)
Study historical research papers and provide a descriptive view of research that was carried out by Scientists as Minor Project.
(A) Ancient system of medicine
(B) Contribution of any one Indian Scientists in Biology
(C) Contribution of any Physicists or Chemists in Biology (for topics listed above)

Practical component (if any) - (30 Hours)
(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)
1. Comparison of invisible life under the view of microscopes versus foldscope.
2. Cells as a unit of life and observation under the microscopes.
3. How do the cells divide – a view under the microscope: (mount of an onion root tip, onion bud cells or grasshopper testis).
4. Mendel's laws of inheritance – clues from nature.
5. Extraction of genomic DNA
6. Use of electric field to analyse DNA and other biomolecules.
7. Sneak Peek through the discovery of Polymerase chain reaction (PCR): Demonstration of original method and comparison with today's sophistication.
8. To test Flemming's hypothesis that the mold killed the bacteria.
9. Group Discussion on Research Topics assigned to students.

Essential readings

- Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Bryson, B. (2003) A short history of nearly everything. Transworld Publishers. London W5 5SA. A Random House Group Company. ISBN: 9780552997041.
- Lodish H et al. (2003). 5th Revised edition. Molecular Cell Biology. W.H.Freeman& Co Ltd; ISBN-13 : 978-0716743668
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual, New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13:978-1936113422.
- Kornberg, A. (2005). 2nd Edition. DNA Replication. California, United States: University Science Books, ISBN-13: 978-1891389443.

Suggestive readings -

- Watson, J. D. (2011) The Double Helix – A personal account of the discovery of the structure of DNA. Scribner. ISBN 9780743219174.
- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Cox, M. M. Doudna J. A. and Donnell, M. O. (2012). 1st Edition. Molecular Biology: Principles and Practice. London, United Kingdom: W H Freeman & Co Publishers, ISBN-13: 978-0-716-7998-8.
- Watson, J. D. Baker T. A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2013). 7th
- Edition. Molecular Biology of the Gene. New York, United States: Cold Spring
- Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

GENERIC ELECTIVES (GE-3): TOXIC SUBSTANCES AND HUMAN HEALTH

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of t he course
		Lecture	Tutorial	Practical/ Practice		
TOXIC S UBSTANCES AND H UMAN HEALTH	4	3	-	1	Open to Students from all subjects	NA

Learning Objectives

The Learning Objectives of this course are as follows:

In daily life, humans are exposed to several toxic substances. Many household products, medicines, cosmetic products, paints, and even food and water may contain toxic substances.; Frequent or improper use of many consumer products or exposure to higher amounts than prescribed, may cause serious health problems. This paper introduces the common toxic substances to which humans are routinely exposed; and health related issues in case of toxicity.

Learning outcomes

The Learning Outcomes of this course are as follows:
After studying, students will be able to:

- Introduction to the various toxic substances and how humans come in contact with toxic hazards. Definitions of various terminologies used in toxicology, and methods of assessment of toxicity of a substance are also covered.
- Upon contact with humans, toxic compounds may be absorbed in the body, and distributed to various organs to show toxic effects. Toxic compounds, once inside the body, are also metabolized or chemically altered. In most cases, after metabolism, the physicochemical properties of toxicants are altered, which helps in their speedy removal from the body.
- Many household products contain substances/ingredients which, if properly not used or applied on the body in excess, can cause serious health effects. These substances include cleaners, household pesticides, cosmetics, disposable utensils, paints, polish, etc. Students will be introduced to few such ingredients and their harmful effects.
- In addition to nutrients, our food also contains several substances which are unavoidable or added unintentionally. These substances and food adulterants, if taken for long time can cause adverse effects.
- Drugs are used to treat diseases. However, if taken at high dose (such as overdosing), drugs act as potential toxic substances. Moreover, several drugs have side effects even at prescribed dose or if used for prolonged duration.
- Anthropogenic activity and natural causes in some cases leads to contamination of soil, water and air with several potential toxicants. These toxicants enter human body via air that we breathe, drinking water and food. With examples of a few toxic substances, students will be introduced how toxicants enter the body from the environment and the adverse health effects caused by them.

SYLLABUS OF GE-3

UNIT – I Introduction to toxic substances and assessment of toxicity (9 Hours)

Types of toxic substances, human contact/exposure with toxic substances (occupational, intentional, accidental etc.); various definitions (toxin, toxicants, xenobiotics, exposure, acute toxicity, chronic toxicity etc); Dose Response Relationship, efficacy, potency, LD50, TD50, NOAEL, ADI; selective toxicity.

UNIT – II Movement of toxic substances inside the body (6 Hours)

Brief introduction to absorption of toxicants via various routes, concept of bioavailability, first pass metabolism, distribution and excretion.

UNIT – III Household toxicants (9 Hours)

Route of exposure, mechanism of toxicity and health effects of common household toxicants:

i). Cleaners, disinfectants, air fresheners (sodium hypochlorite, ammonia, phenol, naphthalene, 1, 4-Dichlorobenzene, methanol).
ii). Garden products, and home mosquito repellents and rat kills (pesticides: organophosphates, pyrethroids, aluminium and zinc phosphide).
iii). Cosmetic products (metals: lead, cadmium; solvents: toluene, acetone).
iv). Other products: disposable utensils (styrene), antifreezing agents (ethylene glycol), Volatile Organic Compounds (VOCs).

UNIT – IV Toxicants and toxins in food (6 Hours)

Mechanism of toxicity and health effects of:

i. Pesticide residues (DDT, lindane)

ii. Toxins (amatoxin, muscarine, bacterial toxins)

Brief discuss on food preservatives, colouring agents and flavouring agents etc, and food adulterants.

UNIT – V Drugs as toxicants (6 Hours)

Brief introduction of drugs as toxicants with examples; adverse effects of drugs at therapeutic doses, and overdosing.

UNIT – VI Environmental toxicants (9 Hours)

Route of exposure, mechanism of toxicity and health effects of:

i. Industrial chemicals (mercury, Polycyclic Aromatic Hydrocarbons, dioxins).

ii. Gaseous air pollutants (nitrogen oxides, sulfur dioxide, carbon monoxide).

iii. Particulate matter (PM).

Practical component - (30 Hours)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Calculation of LD50 value of an insecticide from the data provided.
2. To estimate formaldehyde content in the given sample.
3. To detect presence of paracetamol in the given sample.
4. Analysis of sodium hypochlorite content in various household products.
5. To detect primary alcohol in sample/ household products.
6. To detect aromatic amines in the sample/ household products.
7. To study various toxic substances in terms of exposure, health effects, from various online resources (such as https://www.atsdr.cdc.gov/ , TOXNET or other sources)
8. To separate a mixture of naphthol and naphthalene by solvent extraction method.

Essential readings

- Klaassen, C.D. (2018). 9th Edition. Casarett and Doull's Toxicology, The Basic
- Science of the Poisons. McGraw Hill. ISBN-13: 978-1259863745.
- Stine, K.E. and Brown T.M (2015). 3rd Edition. Principles of Toxicology.
- Florida, USA: CRC Press. ISBN-13: 9781466503434.
- Timbrell. J. (2001). 3rd Edition. Introduction to Toxicology. CRC Press. ISBN13: 978-0415247634.

Suggestive readings

- https://www.atsdr.cdc.gov/
- https://www.cdc.gov/
- Klaassen, C.D and Watkins, J.B. (2015). 3rd Edition. Casarett and Doull's
- Essentials of Toxicology. McGraw Hill Education. ISBN-13:978-0071847087.
- Klaassen, C.D and Watkins, J.B. (2021). 4th Edition. Casarett and Doull's
- Essentials of Toxicology. McGraw Hill, ISBN-13: 978-1260452297.

DEPARTMENT OF GEOLOGY

BSC (Hons.) Geology
Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-1) Earth System Science

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Earth System Science	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology students only**	**NIL**

Learning Objectives

Introduction to the subject Geology. Holistic understanding of Earth as a planet in the Solar System and its relationships with other terrestrial planets. Understanding of the processes occurring in lithosphere, hydrosphere, biosphere, and atmosphere

Learning outcomes

After completion of this course, students will be able to understand and comprehend the connectivity and dynamics of the atmosphere, lithosphere, and hydrosphere of the Earth. A thorough understanding of Geology, its various branches and the overall scope of Earth Science will be possible through this course.

SYLLABUS OF DSC-1

Unit 1: **(12 Hours)**

Holistic understanding of dynamic planet 'Earth' and its orbital parameters. Introduction to various branches of Earth Sciences. General characteristics and theories about the origin of the Universe including our Solar System and its planets. The terrestrial and Jovian planets. Interior of the Earth. Meteorites and Asteroids. Earth's origin, size, shape, mass, density, rotational and revolution parameters. Methods to determine age of the Earth. Earth's Magnetic Field and Palaeomagnetism. Applications of paleomagnetism.

Unit 2: **(9 Hours)**

Plate Tectonics: Concept of plate tectonics, sea-floor spreading and continental drift.
Earthquake and earthquake belts; Volcanoes- types, products and distribution of volcanic belts.

Unit 3: **(9 Hours)**

Hydrosphere and Atmosphere: Layers of the Atmosphere. Various cells of the atmospheric circulation. World surface oceanic currents and their distribution. Earth's heat budget. Orogeny and epeirogeny. Major mountain belts of the world.

Unit 4: (15 Hours)

Understanding the past from geologic records; Nature of geologic records; Standard Geological time scale and introduction to the concept of time in geological studies; Introduction to geochronological methods and their application in geological studies. History of development in concepts of uniformitarianism, catastrophism, and Neptunism, Physiographic divisions of India.

Practical (30 Hours)

1. Study of major geomorphic features and their relationships with outcrops through physiographic models.
2. Detailed study of topographic sheets and preparation of physiographic description of an area
3. Study of distribution of major dams on map of India and their impact on river systems
4. Study of major ocean currents of the World
5. Study of different rock types
6. Study of fossils and their application
7. Study of physiographic map of earth during different Geological ages

Essential readings

- Cesare Emiliani,1992; Planet Earth: Cosmology, Geology, and the Evolution of Life and Environment
- Arthur Holmes, 197; Holmes Principles Of Physical Geology, by John Wiley & Sons

Suggestive readings (if any)

- Physical Geology, 15th Edition, Charles C. Plummer, Diane H. Carlson, Lisa Hammersley McGraw-Hill Education- 2016
- Essentials of Geology, 13th Edition Frederick K. Lutgens, Edward J. Tarbuck, Dennis G. Tasa- Pearson Publications 2016
- Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.
- Gross, M. G. (1977). Oceanography: A view of the earth.
- Duff, P. M. D. & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2) : Mineral Science

Credit distribution, Eligibility and Prerequisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Mineral Science	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology students only**	**NIL**

Learning Objectives

Major objectives for this course are to understand:

1. the characteristics of major mineral groups in hand specimen and thin section
2. phase equilibria, formation environments and associations of rock-forming minerals
3. crystal symmetry, crystallography, and atomic structure

Learning outcomes

At the end of this course, you will be able to:

1. identify common rock-forming minerals in hand specimens and in thin sections using diagnostic physical, optical, and chemical properties.
2. infer something about the formation environment of a silicate mineral using only its formula;
3. read a phase diagram;
4. predict the physical properties of a substance from its symmetry content;
5. plot crystal faces on a stereo projection

SYLLABUS OF DSC- 2

Unit 1: Chemical and Physical Fundamentals

- Importance of minerals, the definition of a mineral, atoms, ions, periodic table, bonding in minerals, compositional variations in minerals. **(6 Hours)**
- Crystallization, crystal imperfections (defects, zoning, twinning), crystal precipitation, mineral classification schemes, and physical properties of minerals (appearance, crystal shape, strength, density, magnetism, reaction with acid). **(6 Hours)**
- Polarized light, refractive index, uniaxial and biaxial indicatrixes, interference figures. **(3 Hours)**

Unit 2: Rock-forming minerals

- Igneous minerals (silicates), phase relations **(6 Hours)**
- Sedimentary minerals (zeolites, clays, sulfates, halides, oxides, carbonates), weathering processes. **(6 Hours)**
- Metamorphic minerals, textures, reactions, phase equilibria. **(3 Hours)**

- Economic minerals (magmatic, hydrothermal, and sedimentary ores; native metals, sulfides and sulfosalts, oxides and hydroxides, gemstones) (**3 Hours)**

Unit 3: Symmetry, Crystallography, and Atomic Structure

- Symmetry, stereo diagrams, forms and crystal morphology. **(3 Hours)**

- Unit cells and lattices in two dimensions and three dimensions, Bravais lattices, unit cell symmetry and crystal symmetry, crystal structures, crystal habit and crystal faces. **(6 Hours)**
- Ionic radii, coordination number, packing, Pauling's rules, silicate structures, substitutions, structures of non-silicates. **(3 Hours)**

Practical:

1. Study of physical properties of minerals in hand specimen
   Silicates: Olivine, Garnet, Kyanite, Staurolite, Tourmaline, Serpentine, Talc, Muscovite, Biotite, Quartz, Orthoclase, Plagioclase, Microcline, Nepheline, Sodalite. Quartz varieties: Chert, Flint, Chalcedony, Agate, Jasper, Amethyst, Rosequartz, Smoky quartz, Rock crystal. Native Metals/non-metals, Sulfides, Oxides-Copper, Sulfur, Graphite, Pyrite, Corundum, Magnetite Hydroxides, Halides, Carbonates, Sulfates, Phosphates: Psilomelane, Fluorite, Calcite, Malachite, Gypsum, Apatite.
2. Study of some key silicate minerals under an optical microscope and their characteristic properties.
3. Mineral stochiometry related numerical.
4. Numericals related to parameters and indices of crystals faces.
5. Stereographic projection of crystal faces.

Essential readings

- Cornelis Klein and Barbara Dutrow, The manual of Mineral Science, Wiley Publication 2007
- Nesse W. D., Introduction to Optical mineralogy.2008, Oxford University Press.
- Deer W. A., Howie.R. A. and Zussman, J., An introduction to the rock-forming minerals 1992

Suggestive readings

1. Cornelis Klein and Barbara Dutrow, The manual of Mineral Science, Wiley Publication 2007
2. Nesse W. D., Introduction to Optical mineralogy.2008, Oxford University Press.
3. Deer W. A., Howie.R. A. and Zussman, J., An introduction to the rock-forming minerals 1992

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3) Concepts of Stratigraphy

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of t he course(if any)
		Lecture	Tutorial	Practical/ Practice		
Concepts of Stratigraphy	4	3	0	1	B.Sc. Hons. Geology students only	NIL

Learning Objectives
This is to introduce students with the fundamental concepts of stacking of sediments in both space and time based on principles of stratigraphy and sedimentation.

Learning outcomes
Students will be able to learn the distribution of sedimentary rocks in both space and time and appreciate the stacking of sediments following the fundamental concepts of stratigraphy

SYLLABUS OF DSC-3

Unit 1: Principles of stratigraphy, geological time scale **(3 Hours)**

Unit 2 : Stratigraphic units: lithostratigraphic, chronostratigraphic and biostratigraphic units **(2 weeks)**

Unit 3 : Stratigraphic classification and correlation. Methods of collecting stratigraphic data, identification of stratigraphic contacts and unconformities. **(6 Hours)**

Unit 4: Facies concept in stratigraphy. Applications of lithostratigraphy **(3 Hours)**

Unit 5: Fossils and stratigraphy; Evolutionary trends, Biozones and zone fossils **(3 Hours)**

Unit 6: Biostratigraphy in relation to other stratigraphic techniques **(6 Hours)**

Unit 7: Radiometric dating (K-Ar, Rb-Sr, U-Pb) and correlation techniques **(6 Hours)**

Unit 8 : Basic principles of magnetostratigraphy, seismic stratigraphy and sequence stratigraphy. **(6 Hours)**

Unit 9 : Concept of Stratotypes. Global Stratotype Section and Point (GSSP). International and Indian code for stratigraphic classification. **(6 Hours)**

Practical (30 Hours)
Preparation and study of stratigraphic maps:

a) Correlation diagrams using lithologs of fossiliferous and non-fossiliferous stratigraphic units. Geophysical logs.
b) Examination of isopach and isofacies maps.

c) Exercises related to stratigraphic classification and correlation.

Essential readings

- Blatt, H., Berry, W.B. and Brande, S., 1991. Principles of stratigraphic analysis. Blackwell scientific publications, Oxford
- Nicols G., 2009 Sedimentology and Stratigraphy 2nd Edition, Wiley-Blackwell
- Brookfield, M.E., 2016 Principles of stratigraphy, Wiley India

Suggestive readings

1. Blatt, H., Berry, W.B. and Brande, S., 1991. Principles of stratigraphic analysis. Blackwell scientific publications, Oxford Annexure-III Page 24 of 25
2. Nicols G., 2009 Sedimentology and Stratigraphy 2nd Edition, Wiley-Blackwell
3. Brookfield, M.E., 2016 Principles of stratigraphy, Wiley India

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

Offered by Department of Geology

Category-IV

GENERIC ELECTIVES (GE-1): Essentials of Geology

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of t he course
		Lecture	Tutorial	Practical/ Practice		
Essentials of Geology	**4**	**4**	**0**	**0**	**12th Pass**	**Nil**

Learning Objectives

1. Interactive and interdisciplinary nature of geology
2. Interplanetary scope of geology
3. Introduction to atmosphere, hydrosphere, biosphere and lithosphere

Learning outcomes

1. Earth, its origin and concept of geological time
2. Formation of planets and solar system
3. Composition of inner as well as surficial components of planet earth
4. Major geomorphic features, and compositions of various parts of earth and major earth processes
5. Earth Resources

SYLLABUS OF GE-1

Unit 1: Introduction to geology, scope, sub-disciplines and relationship with other branches of sciences Solar system and its origin: Terrestrial and Jovian planets; Nebular hypothesis. Earth's size, shape, mass, density, rotational and evolutional parameters Earth in comparison to other bodies in the solar system. **(16 Hours)**

Unit 2: Internal constitution of the earth - core, mantle and crust (Chemical and mechanical differentiation) Convections in the earth's core and production of magnetic field; Concept of Plate Tectonics as a unifying theory. **(16 Hours)**

Unit 3: Origin and composition of hydrosphere and atmosphere; Origin of biosphere; Origin of oceans, continents and mountains. **(12 Hours)**

Unit 4: Geological Time Scale Radioactivity dating and its application in determining the age of the rocks. Earth Resources and their sustainable use. **(16 Hours)**

Essential readings

- Holmes, A. (1992). Principles of Physical Geology, 1992, Chapman and Hall.
- Emiliani, C. (1992). Planet Earth, Cosmology, Geology and the Evolution of Life and
- Environment, Cambridge University Press.

Suggestive readings

1. Holmes, A. (1992). Principles of Physical Geology, 1992, Chapman and Hall.
2. Emiliani, C. (1992). Planet Earth, Cosmology, Geology and the Evolution of Life and Annexure-IV Page 25 of 25 Environment, Cambridge University Press.
3. Gross, M.G. (1977). Oceanography: A view of the Earth, Prentice Hall.
4. Grotzinger, J.P. & Jordan, T.H. (2020) Understanding Earth. 8th Edition, W.H. Freeman and Company

DEPARTMENT OF PHYSICS

BSc. (Hons.) Physics

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-1) Mathematical Physics I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mathematical Physics I	4	3	0	1	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

The emphasis of the course is on applications in solving problems of interest to physicists. The course will teach the students to model a physics problem mathematically and then solve those numerically using computational methods. The course will expose the students to fundamental computational physics skills enabling them to solve a wide range of physics problems. The skills developed during course will prepare them not only for doing fundamental and applied research but also for a wide variety of careers.

Learning Outcomes

After completing this course, student will be able to,

- Draw and interpret graphs of various elementary functions and their combinations.
- Understand the vector quantities as entities with Cartesian components which satisfy appropriate rules of transformation under rotation of the axes.
- Use index notation to write the product of vectors in compact form easily applicable in computational work.
- Solve first and second order differential equations and apply these to physics problems.
- Understand the functions of more than one variable and concept of partial derivatives.
- Understand the concept of scalar field, vector field, gradient of scalar field and divergence and curl of vector fields.
- Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's theorems to compute these integrals and apply these to physics problems
- Understand the properties of discrete and continuous distribution functions.

In the laboratory course, the students will learn to,

- Prepare algorithms and flowcharts for solving a problem.
- Design, code and test simple programs in Python/C++ to solve various problems.

- Perform various operations of 1-d and 2-d arrays.
- Visualize data and functions graphically using Matplotlib/Gnuplot

SYLLABUS OF DSC – 1

THEORY COMPONENT

Unit 1 (18 Hours)

Functions: Plotting elementary functions and their combinations, Interpreting graphs of functions using the concepts of calculus, Taylor's series expansion for elementary functions.

Ordinary Differential E quations: First order differential equations of degree one and those reducible to this form, Exact and Inexact equations, Integrating Factor, Applications to physics problems

Higher order linear homogeneous differential equations with constant coefficients, Wronskian and linearly independent functions. Non-homogeneous second order linear differential equations with constant coefficients, complimentary function, particular integral and general solution, Determination of particular integral using method of undetermined coefficients and method of variation of parameters, Cauchy-Euler equation, Initial value problems. Applications to physics problems

Unit 2 (12 Hours)

Vector Algebra: Transformation of Cartesian components of vectors under rotation of the axes, Introduction to index notation and summation convention. Product of vectors - scalar and vector product of two, three and four vectors in index notation using δ_{ij} and ε_{ijk} (as symbols only – no rigorous proof of properties). Invariance of scalar product under rotation transformation.

Vector D ifferential C alculus: Functions of more than one variable, Partial derivatives, chain rule for partial derivatives. Scalar and vector fields, concept of directional derivative, the vector differential operator $\vec{\nabla}$, gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field and their physical interpretation. Laplacian operator. Vector identities.

Unit 3 (15 Hours)

Vector I ntegral C alculus: Integrals of vector-valued functions of single scalar variable. Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field. Gauss divergence theorem, Green's and Stokes' Theorems (no proofs) and their applications

Probability D istributions: Discrete and continuous random variables, Probability distribution functions, Binomial, Poisson and Gaussian distributions, Mean and variance of these distributions.

PRACTICAL COMPONENT (30 Hours)

The aim of this lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. The course will consist of practical sessions and lectures on the related theoretical aspects of the laboratory. Assessment is to be done not only on the programming but also on the basis of formulating the problem.

- Every student must perform at least 6 programs covering each unit.
- The list of recommended programs is suggestive only. Students should be encouraged to do more practice. Emphasis should be given to assess student's ability to formulate a physics problem as mathematical one and solve by computational methods.
- The implementation can be either in Python or C++. Accordingly, the instructor can choose section A or B respectively from Unit 1 and 2. The list of programs is common for both sections. If C++ is used, then for all plotting programs, Gnuplot has to be used.

Basics of scientific computing (Mandatory):

(a) Binary and decimal arithmetic, Floating point numbers, single and double precision arithmetic, underflow and overflow, numerical errors of elementary floating point operations, round off and truncation errors with examples.

(b) Introduction to Algorithms and Flow charts. Branching with examples of conditional statements, for and while loops.

Unit 1

Section A:

Basic Elements of Python: The Python interpreter, the print statement, comments, Python as simple calculator, objects and expressions, variables (numeric, character and sequence types) and assignments, mathematical operators. Strings, Lists, Tuples and Dictionaries, type conversions, input statement, list methods. List mutability, Formatting in the print statement.

Control S tructures: Conditional operations, if, if-else, if-elif-else, while and for loops, indentation, break and continue, List comprehension. Simple programs for practice like solving quadratic equations, temperature conversion etc.

Functions: Inbuilt functions, user-defined functions, local and global variables, passing functions, modules, importing modules, math module, making new modules. Writing functions to perform simple operations like finding largest of three numbers, listing prime numbers, etc., Generating pseudo random numbers.

OR

Section B:

Introduction to C++: Basic idea of Compilers. Structured programming. Idea of Headers, Data Types, Enumerated Data, Conversion and casting, constants and variables, Mathematical, Relational, Logical and Bit wise Operators. Precedence of Operators, Expressions and Statements, Scope and Visibility of Data, block, Local and Global variables, Auto, static and External variables. Input and output statements. I/O

manipulations, iostream and cmath header files, using namespace.

Control Statements: The if-statement, if-else statement, Nested if Structure, If - Else if – else block, Ternary operator, Goto statement, switch statement, Unconditional and Conditional looping, While loop, Do-while loop, For loop, nested loops, break and continue statements. Simple programs for practice like solving quadratic equations, temperature conversion etc.

Functions: Inbuilt functions. User-defined functions, function declaration, function definition, function prototype, void functions and function arguments, return statement. Local and global variables. The main function. Passing parameter by value and by reference. Inline functions. Function overloading. Writing functions to perform simple operations like finding largest of three numbers, listing prime numbers etc., Generating pseudo random numbers.

Recommended List of Programs (At least Two)

(a) Make a function that takes a number N as input and returns the value of factorial of N. Use this function to print the number of ways a set of m red and n blue balls can be arranged.
(b) Generate random numbers (integers and floats) in a given range and calculate area and volume of regular shapes with random dimensions.
(c) Generate data for coordinates of a projectile and plot the trajectory. Determine the range, maximum height and time of flight for a projectile motion.

Unit 2

Section A:

NumPy Fundamentals: Importing Numpy, Difference between List and NumPy array, Adding, removing and sorting elements, creating arrays using ones(), zeros(), random(), arange(), linspace(). Basic array operations (sum, max, min, mean, variance), 2-d arrays, matrix operations, reshaping and transposing arrays, savetxt() and loadtxt().

Plotting with Matplotlib: matplotlib.pyplot functions, Plotting of functions given in closed form as well as in the form of discrete data and making histograms.

OR

Section B:

Arrays: Array definition, passing arrays to functions, Finding sum, maximum, minimum, mean and variance of given array. 2-d arrays, matrix operations (sum, product, transpose etc). Saving data generated by a C++ program in a file.

Gnuplot: Introduction to Gnuplot. Visualization of discrete data and plotting functions given in closed form and data for graphical visualization. Plotting data from the output file created by a C++ program, making histogram.

Recommended List of Programs (At least Three)

(a) To plot the displacement-time and velocity-time graph for the un-damped, under-damped

critically damped and over-damped oscillator using matplotlib (or Gnuplot) using given formulae.

(b) To compute the left, right and central approximations for derivative of a function given in closed form. Plot both the function and derivative on the same graph. Plot (using matplotlib/Gnuplot) the error as a function of step size on a log-log graph, study the behaviour of the plot as step size decreases and hence discuss the effect of round off error.

(c) To generate array of N random numbers drawn from a given distribution (uniform, binomial, poisson and gaussian) and plot them using matplotlib/Gnuplot for increasing N to verify the distribution. Verify the central limit theorem.

(d) To implement the transformation of physical observables under Galilean, Lorentz and Rotation transformation

Unit 3

Recommended List of Programs (At least one)

(a) To find value of π and to integrate a given function using acceptance-rejection method.

(b) To perform linear fitting of data using the inbuilt function scipy.stats.linregress in Python or using Gnuplot. Plot the data points and the fitted line on the same graph.

References (for Laboratory Work):

1) Documentation at the Python home page (https://docs.python.org/3/) and the tutorials there (https://docs.python.org/3/tutorial/).

2) Documentation of NumPy and Matplotlib : https://numpy.org/doc/stable/user/ and https://matplotlib.org/stable/tutorials/

3) Schaum's Outline of Programming with C++, J. Hubbard, 2000, McGraw-Hill Education.

4) C++ How to Program, Paul J. Deitel and Harvey Deitel, Pearson (2016).

5) Computational Physics, Darren Walker, 1st Edn., Scientific International Pvt. Ltd (2015).

6) Elementary Numerical Analysis, K. E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

7) An Introduction to Computational Physics, T. Pang, Cambridge University Press (2010).

8) Introduction to Numerical Analysis, S. S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.

9) Applied numerical analysis, Cutis F. Gerald and P. O. Wheatley, Pearson Education, India (2007).

Essential/Recommended Readings

REFERENCES FOR THEORY COMPONENT

1) An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.

2) Differential Equations, George F. Simmons, 2007, McGraw Hill.

3) Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.

4) Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.

5) Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
6) Probability and Statistics, Murray R Spiegel, John J Schiller and R Alu Srinivasan, 2018, McGraw Hill Education Private Limited.
7) Essential Mathematical Methods, K.F.Riley and M.P.Hobson, 2011, Cambridge Univ. Press.
8) Vector Analysis and Cartesian Tensors, D.E. Bourne and P.C. Kendall, 3 Ed. , 2017, CRC Press.
9) Vector Analysis, Murray Spiegel, 2 Ed., 2017, Schaum's outlines series.
10) John E. Freund's Mathematical Statistics with Applications, I. Miller and M. Miller, 7th Ed., 2003, Pearson Education, Asia.

.**Suggestive readings:**

1) Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 7 Ed., 2013, Elsevier.
2) Introduction to Electrodynamics, Chapter 1, David J. Griffiths, 4 Ed., 2017, Cambridge University Press.
3) The Feynman Lectures on Physics, Volume II, Feynman, Leighton and Sands, 2008, Narosa Publishing House.
4) Introduction to Vector Analysis, Davis and Snider, 6 Ed., 1990, McGraw Hill.
5) Differential Equations, R. Bronson and G.B. Costa, Schaum's outline series.
6) Mathematical Physics, A.K. Ghatak, I.C. Goyal and S.J. Chua, Laxmi Publications Private Limited (2017)
7) Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC - 2) MECHANICS

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mechanics **DSC – 2**	**4**	**3**	**0**	**1**	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. The students will learn the collisions in the centre of mass frame, rotational motion and central forces. They will be able to apply the concepts learnt to several real world problems. In the laboratory part of the course, the students will learn to use various instruments, estimate the error for

every experiment performed and report the result of experiment along with the uncertainty in the result up to correct significant figures.

Learning Outcomes

Upon completion of this course, students will be able to,

- Learn the Galilean invariance of Newton's laws of motion.
- Understand translational and rotational dynamics of a system of particles.
- Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.
- Understand Einstein's postulates of special relativity.
- Apply Lorentz transformations to describe simultaneity, time dilation and length contraction
- Use various instruments for measurements and perform experiments related to rotational dynamics, elastic properties, fluid dynamics, acceleration due to gravity, collisions, etc.
- Use propagation of errors to estimate uncertainty in the outcome of an experiment and perform the statistical analysis of the random errors in the observations.

SYLLABUS OF DSC- 2

THEORY COMPONENT

Unit 1: (14 Hours)

Fundamentals of Dynamics: Inertial and Non-inertial frames, Newton's Laws of Motion and their invariance under Galilean transformations. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry. Differential analysis of a static vertically hanging massive rope

Work and Energy: Work and Kinetic Energy Theorem. Conservative forces and examples (Gravitational and electrostatic), non-conservative forces and examples (velocity dependent forces e.g. frictional force, magnetic force), Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of the potential energy. Work done by non-conservative forces.

Collisions: Elastic and inelastic collisions between two spherical bodies. Kinematics of 2 $\rightarrow$ 2 scattering in centre of mass and laboratory frames.

Unit 2: (12 Hours)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Determination of moment of inertia of symmetric rigid bodies (rectangular, cylindrical and spherical) using parallel and perpendicular axes theorems. Kinetic energy of rotation. Motion involving both translation and rotation.

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.

Unit 3: (7 Hours)

Central Force Motion: Central forces, Law of conservation of angular momentum for

central forces, Two-body problem and its reduction to equivalent one-body problem and its solution. Concept of effective potential energy and stability of orbits for central potentials of the form kr^n for n = 2 and -1 using energy diagram, discussion on trajectories for n=-2. Solution of the Kepler Problem, Kepler's Laws for planetary motion, orbit for artificial satellites

Unit 4: (12 Hours)

Relativity: Postulates of Special Theory of Relativity, Lorentz Transformations, simultaneity, length contraction, time dilation, proper length and proper time, life time of a relativistic particle (for example muon decay time and decay length). Space-like, time-like and light-like separated events, relativistic transformation of velocity and acceleration, variation of mass with velocity, mass-energy equivalence, transformation of energy and momentum.

PRACTICAL COMPONENT (30 Hours)

Introductory Concepts and related activities (Mandatory)

- **Use of Basic Instruments**

Determination of least count and use of instruments like meter scale, vernier callipers, screw gauge and travelling microscope for measuring lengths.

- Errors

(a) Types of errors in measurements (instrumental limitations, systematic errors and random errors), accuracy and precision of observations, significant figures.
(b) Introduction to error estimation, propagation of errors and reporting of results along with uncertainties with correct number of significant figures.
(c) Statistical analysis of random errors, need for making multiple observations, standard error in the mean as estimate of the error.

- Graph Plotting

Pictorial visualisation of relation between two physical quantities, Points to be kept in mind while plotting a graph manually.

- Data Analysis

Principle of least square fitting (LSF) and its application in plotting linear relations, estimation of LSF values of slope, intercept and uncertainties in slope and intercept.

Mandatory Activities

- Determine the least count of meter scale, vernier callipers, screw gauge and travelling microscope, use these instruments to measure the length of various objects multiple time, find the mean and report the result along with the uncertainty up to appropriate number of significant digits.
- Take multiple observations of the quantities like length, radius etc. for some spherical, cylindrical and cubic objects, find mean of these observations and use them to

determine the surface area and volume of these objects. Estimate the uncertainties in the outcome using law of propagation of errors. Report the result to appropriate number of significant figures.

- Given a data (x, y) corresponding to quantities x and y related by a relation $y = f(x)$ that can be linearised, plot the data points (manually) with appropriate choice of scale, perform least square fitting to determine the slope and intercept of the LSF line and use them to determine some unknown quantity in the relation. Determine the uncertainties in slope and intercept and use these to estimate the uncertainty in the value of unknown quantity.

Every student must perform at least 4 experiments from the following list.

1) To study the random errors in observations. It is advisable to keep observables of the order of least count of the instruments.
2) To determine the moment of inertia of a symmetric as well as asymmetric flywheel
3) To determine coefficient of viscosity of water by Capillary Flow Method (Poiseuille's method).
4) To determine g and velocity for a freely falling body using Digital Timing Technique.
5) To determine the Young's Modulus of a Wire by Optical Lever Method.
6) To determine the vertical distance between two given points using sextant.
7) To determine the coefficients of sliding and rolling friction experienced by a trolley on an inclined plane.
8) To verify the law of conservation of linear momentum in collisions on air track.

Suggested additional activities:

1) Virtual lab collision experiments on two dimensional elastic and inelastic collisions (for example available on following suggested links
   a) https://archive.cnx.org/specials/2c7acb3c-2fbd-11e5-b2d9-e7f92291703c/collision-lab/#sim-advanced-sim)
   b) https://phet.colorado.edu/en/simulations/collision-lab
2) Amrita Virtual Mechanics Lab: https://vlab.amrita.edu/?sub=1&brch=74

References (for Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worshnop, 1971, Asia Publishing House.

2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.

4) A Text Book of Practical Physics, Vol I, Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.

5) An introduction to Error Analysis: The study of uncertainties in Physical Measurements, J.
R. Taylor, 1997, University Science Books

Essential readings:

FOR THEORY COMPONENT

1) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
2) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
3) Classical Mechanics by Peter Dourmashkin, 2013, John Wiley and Sons.
4) Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education.
5) Introduction to Classical Mechanics With Problems and Solutions, David Morin, 2008, Cambridge University Press.
6) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
7) Introduction to Special Relativity, Robert Resnick, 2007, Wiley.

Suggestive Link:
https://phys.libretexts.org/Bookshelves/Classical_Mechanics/classical_Mechanics_(Dourmash kin)/

Suggestive readings:

1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
3) Classical Mechanics, H. Goldstein, C. P. Poole, J. L. Safko, 3/e, 2002, Pearson Education.
4) Newtonian Mechanics, A.P. French, 2017, Viva Books.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC – 3) WAVES AND OSCILLATIONS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Waves and Oscillations **DSC – 3**	**4**	**2**	**0**	**2**	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

This course reviews the concepts of waves and oscillations learnt at school from a more advanced perspective and goes on to build new concepts. It begins with explaining ideas of free oscillations and superposition of harmonic motion leading to physics of damped and forced oscillations. The course will also introduce students to coupled oscillators, normal

modes of oscillations and free vibrations of stretched strings. Concurrently, in the laboratory component of the course students will perform experiments that expose them to different aspects of real oscillatory systems.

Learning Outcomes

On successful completion of this course, the students will have the skill and knowledge to,

- Understand simple harmonic motion
- Understand superposition of N collinear harmonic oscillations
- Understand superposition of two perpendicular harmonic oscillations
- Understand free, damped and forced oscillations
- Understand coupled oscillators and normal modes of oscillations
- Understand travelling and standing waves, stretched strings

SYLLABUS OF DSC – 3

THEORY COMPONENT

Unit 1: Simple Harmonic Motion (12 Hours)

Differential equation of simple harmonic oscillator, its solution and characteristics, energy in simple harmonic motion, linearity and superposition principle, rotating vector representation of simple harmonic oscillation, motion of simple and compound pendulum (Bar and Kater's pendulum), loaded spring.

Superposition of N collinear harmonic oscillations with (1) equal phase differences and (2) equal frequency differences, Beats

Superposition of two perpendicular harmonic oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies, effect of variation of phase

Unit 2: Damped and Forced Oscillations (8 Hours)

Damped Oscillations: Equation of motion, dead beat motion, critically damped system, lightly damped system: relaxation time, logarithmic decrement, quality factor

Forced Oscillations: Equation of motion, complete solution, steady state solution, resonance, sharpness of resonance, power dissipation, quality factor

Unit 3: Coupled Oscillations **(6 Hours)**

Coupled oscillators, normal coordinates and normal modes, energy relation and energy transfer, di-atomic molecules, representation of a general solution as a linear sum of normal modes, normal modes of N coupled oscillators.

Unit 4: Wave Motion **(4 Hours)**

One dimensional plane wave, classical wave equation, standing wave on a stretched string (both ends fixed), normal modes. Travelling wave solution

PRACTICAL COMPONENT (60 Hours)

Every student must perform at least 5 experiments

1) Experiments using bar pendulum:
    a) Estimate limits on angular displacement for SHM by measuring the time period at different angular displacements and compare it with the expected value of time period for SHM.
    b) Determine the value of g using bar pendulum.
    c) To study damped oscillations using bar pendulum
    d) Study the effect of area of the damper on damped oscillations. Plot amplitude as a function of time and determine the damping coefficient and Q factor for different dampers.
2) To determine the value of acceleration due to gravity using Kater's pendulum for both the cases (a) $T_1 \approx T_2$ and (b) $T_1 \neq T_2$ and discuss the relative merits of both cases by estimation of error in the two cases.
3) Understand the applications of CRO by measuring voltage and time period of a periodic waveform using CRO. And study the superposition of two perpendicular simple harmonic oscillations using CRO (Lissajous figures)
4) Experiments with spring and mass system
    a) To calculate g, spring constant and mass of a spring using static and dynamic methods.
    b) To calculate spring constant of series and parallel combination of two springs.
5) To study normal modes and beats in coupled pendulums or coupled springs.
6) To determine the frequency of an electrically maintained tuning fork by Melde's experiment and to verify $\lambda^2 - T$ Law.
7) To determine the current amplitude and phase response of a driven series LCR circuit with driving frequency and resistance. Draw resonance curves and find quality factor for low and high damping.

References (For Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A Text Book of Practical Physics, Vol I and II, Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) An Introduction to Error Analysis: The study of uncertainties in Physical Measurements,

J. R. Taylor, 1997, University Science Books List of experiments

Essential Readings:

FOR THEORY COMPONENT

1) Vibrations and Waves by A. P. French. (CBS Pub. and Dist., 1987)

2) The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988)
3) Fundamentals of Waves and Oscillations By K. Uno Ingard (Cambridge University Press, 1988)
4) An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)
5) Waves: BERKELEY PHYSICS COURSE by Franks Crawford (Tata McGrawHill, 2007).
6) Classical Mechanics by Peter Dourmashkin, John Wiley and Sons
7) https://phys.libretexts.org/Bookshelves/Classical_Mechanics/classical_Mechanics_(Dou r mashkin)

Suggestive Readings:

1) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
2) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.

BSc. Physical Sciences

Multidisciplinary

DISCIPLINE SPECIFIC CORE COURSE – 1 (PHYSICS DSC - 1)
MECHANICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mechanics **Physics DSC 1**	**4**	**2**	**0**	**2**	**Class XII pass with Physics and Mathematics as main subjects**	**Physics and Mathematics syllabus of class XII**

Learning Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with dynamics of a system of particles and ends with the special theory of relativity. Students will appreciate the concept of rotational motion, gravitation and oscillations. The students will be able to apply the concepts learnt to several real world problems.

Learning outcomes:

Upon completion of this course, students are expected to understand the following concepts.

- Laws of motion and their application to various dynamical situations.
- Conservation of momentum, angular momentum and energy. Their application to basic problems.
- Particle collision (elastic and in-elastic collisions)
- Motion of simple pendulum
- Postulates of special theory of relativity, inertial and non-inertial frame of reference and their transformation, relativistic effects on the mass and energy of a moving body.

In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier calliper and travelling microscope) student shall embark on verifying various principles and associated measurable quantities.

SYLLABUS OF PHYSICS DSC – 1

THEORY COMPONENT

Unit 1: Review of vectors and ordinary differential equation (4 Hours)

Gradient of a scalar field, divergence and curl of vectors field, polar and axial vectors Second order homogeneous ordinary differential equations with constant coefficients (Operator Method Only).

Unit 2: Fundamentals of Dynamics (7 Hours)

Dynamics of a system of particles, centre of mass, determination of centre of mass for discrete and continuous systems having spherical symmetry

Conservation of momentum and energy, Conservative and non-Conservative forces, work – energy theorem for conservative forces, force as a gradient of potential energy. Particle collision (Elastic and in-elastic collisions)

Unit 3: Rotational Dynamics and Oscillatory Motion (8 Hours)

Angular momentum, torque, conservation of angular momentum, Moment of inertia, Theorem of parallel and perpendicular axes (statements only). Calculation of moment of inertia of discrete and continuous objects (1-D and 2-D).

Idea of simple harmonic motion, differential equation of simple harmonic motion and its solution, Motion of simple pendulum, damped harmonic oscillator

Unit 4: Gravitation (3 Hours)

Newton's Law of Gravitation, Motion of a particle in a central force field, Kepler's Laws (statements only)

Unit 5: Special Theory of Relativity (8 Hours)

Frames of reference, Galilean transformations, inertial and non-inertial frames, Michelson Morley's Experiment, postulates of special theory of relativity, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass.

References:

Essential Readings:

1) Vector Analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
3) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
4) Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.
5) Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.

Additional Readings:

1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
5) Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.
6) Physics for Scientists and Engineers, Randall D Knight, 3/e, 2016, Pearson Education.

PRACTICAL COMPONENT (60 Hours)

The teacher is expected to give basic idea and working of various apparatus and instruments related to different experiments. Students should also be given knowledge of recording and analysing experimental data.

Every student should perform at least 06 experiments from the following list.

1) Measurement of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2) Study the random error in observations.
3) Determination of height of a building using a sextant.
4) Study of motion of the spring and calculate (a) spring constant and, (b) acceleration due to gravity
5) Determination of moment of inertia of a flywheel.
6) Determination of g and velocity for a freely falling body using digital timing technique.
7) Determination of modulus of rigidity of a wire using Maxwell's needle.
8) Determination of elastic constants of a wire by Searle's method.
9) Determination of value of g using bar pendulum.
10) Determination of value of g using Kater's pendulum.

References (for Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A Textbook of Practical Physics, I. Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) B. Sc. Practical Physics, Geeta Sanon, R. Chand and Co., 2016.

BSc. Physical Sciences with Electronics

Multidisciplinary

DISCIPLINE SPECIFIC CORE COURSE – 1 (PHYSICS DSC - 1) MECHANICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mechanics **Physics DSC 1**	**4**	**2**	**0**	**2**	**Class XII pass with Physics and Mathematics as main subjects**	**Physics and Mathematics syllabus of class XII**

Learning Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with dynamics of a system of particles and ends with the special theory of relativity. Students will appreciate the concept of rotational motion, gravitation and oscillations. The students will be able to apply the concepts learnt to several real world problems.

Learning Outcomes

Upon completion of this course, students are expected to understand the following concepts.

- Laws of motion and their application to various dynamical situations.
- Conservation of momentum, angular momentum and energy. Their application to basic problems.
- Particle collision (elastic and in-elastic collisions)
- Motion of simple pendulum
- Postulates of special theory of relativity, inertial and non-inertial frame of reference and their transformation, relativistic effects on the mass and energy of a moving body.

In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier calliper and travelling microscope) student shall embark on verifying various principles and associated measurable quantities.

SYLLABUS OF PHYSICS DSC-1

THEORY COMPONENT

Unit 1: Review of vectors and ordinary differential equation (04 Hours)

Gradient of a scalar field, divergence and curl of vectors field, polar and axial vectors Second order homogeneous ordinary differential equations with constant coefficients (Operator Method Only).

Unit 2: Fundamentals of Dynamics (07 Hours)

Dynamics of a system of particles, centre of mass, determination of centre of mass for discrete and continuous systems having spherical symmetry

Conservation of momentum and energy, Conservative and non-Conservative forces, work – energy theorem for conservative forces, force as a gradient of potential energy. Particle collision (Elastic and in-elastic collisions)

Unit 3: Rotational Dynamics and Oscillatory Motion (08 Hours)

Angular momentum, torque, conservation of angular momentum, Moment of inertia, Theorem of parallel and perpendicular axes (statements only). Calculation of moment of inertia of discrete and continuous objects (1-D and 2-D).

Idea of simple harmonic motion, differential equation of simple harmonic motion and its solution, Motion of simple pendulum, damped harmonic oscillator

Unit 4: Gravitation (03 Hours)

Newton's Law of Gravitation, Motion of a particle in a central force field, Kepler's Laws (statements only)

Unit 5: Special Theory of Relativity (08 Hours)

Frames of reference, Galilean transformations, inertial and non-inertial frames, Michelson Morley's Experiment, postulates of special theory of relativity, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass.

References:

Essential Readings:

1) Vector Analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
3) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
4) Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.
5) Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.

Additional Readings:

1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
5) Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.
6) Physics for Scientists and Engineers, Randall D Knight, 3/e, 2016, Pearson Education.

PRACTICAL COMPONENT (60 Hours)

The teacher is expected to give basic idea and working of various apparatus and instruments related to different experiments. Students should also be given knowledge of recording and analysing experimental data.

Every student should perform at least 06 experiments from the following list.

1) Measurement of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2) Study the random error in observations.
3) Determination of height of a building using a sextant.
4) Study of motion of the spring and calculate (a) spring constant and, (b) acceleration due to gravity
5) Determination of moment of inertia of a flywheel.
6) Determination of g and velocity for a freely falling body using digital timing technique.
7) Determination of modulus of rigidity of a wire using Maxwell's needle.
8) Determination of elastic constants of a wire by Searle's method.
9) Determination of value of g using bar pendulum.
10) Determination of value of g using Kater's pendulum.

References (for Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A Textbook of Practical Physics, I. Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) B. Sc. Practical Physics, Geeta Sanon, R. Chand and Co., 2016.

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC - 2)
Network Analysis and Analog Electronics

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Network Analysis and Analog Electronics **Physics DSC 2**	**4**	**2**	**0**	**2**	**Class XII pass with Physics and Mathematics as main subjects**	**Physics and Mathematics syllabus of class XII**

Learning Objectives

This course offers the basic knowledge to students to design and analyse the network circuit analysis and analog electronics. It gives the concept of voltage, current sources and various electrical network theorems, physics of semiconductor devices including junction diode, bipolar junction transistors, unipolar devices and their applications are discussed in detail. This also develops the understanding of amplifier and its applications.

Learning Outcomes

At the end of this course, students will be able to achieve the following learning outcomes.

- To understand the concept of voltage and current sources, Network theorems, Mesh Analysis.
- To develop an understanding of the basic operation and characteristics of different type of diodes and familiarity with its working and applications.
- Become familiar with Half-wave, Full-wave centre tapped and bridge rectifiers. To be able to calculate ripple factor and efficiency.
- To be able to recognize and explain the characteristics of a PNP or NPN transistor.
- Become familiar with the load-line analysis of the BJT configurations and understand the hybrid model (h- parameters) of the BJT transistors.
- To be able to perform small signal analysis of Amplifier and understand its classification.
- To be able to perform analysis of two stage R-C coupled Amplifier.
- To understand the concept of positive and negative feedback along with applications in case of oscillators.
- To become familiar with construction, working and characteristics of JFET and UJT.

SYLLABUS OF PHYSICS DSC – 2

THEORY COMPONENT

Unit 1: (8 Hours)

Circuit Analysis: Concept of Voltage and Current Sources (ideal and practical). Kirchhoff's Laws. Mesh Analysis, Node Analysis. Star and Delta networks and their Conversion Superposition Theorem. Thevenin's Theorem. Norton's Theorem. Reciprocity Theorem. Maximum Power Transfer Theorem.

Unit 2: (5 Hours)

Semiconductor Diode: PN junction diode (Ideal and practical), Diode equation (Qualitative only) and I-V characteristics. Idea of static and dynamic resistance, Zener diode working. Rectifiers: Half wave rectifier (Qualitative only), Full wave rectifiers (center tapped and bridge): circuit diagrams, working and waveforms, ripple factor and efficiency.
Filter circuits: Shunt capacitance and series Inductance filter (no derivation).
Regulation: Zener diode as voltage regulator for load and line regulation.

Unit 3: (7 Hours)

Bipolar Junction Transistor: Review of the characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β. Relations between α and β. dc load line and Q point.

Amplifiers: Transistor biasing and Stabilization circuits - Voltage Divider Bias. Thermal runaway, stability (Qualitative only). Transistor as a two-port network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains. Class A, B and C Amplifiers.

Unit 4: (10 Hours)

Cascaded Amplifiers: Two stage RC Coupled Amplifier and its frequency response.

Sinusoidal Oscillators: Concept of feedback (negative and positive feedback), Barkhausen criterion for sustained oscillations. Phase shift and Colpitt's oscillator. Determination of frequency and condition of oscillation

Unipolar Devices: JFET. Construction, working and I-V characteristics (output and transfer), Pinch-off voltage. UJT, basic construction, working, equivalent circuit and I-V characteristics. UJT Oscillator.

References:

Essential Readings:

1) Network, Lines and Fields, J. D. Ryder, Prentice Hall of India

2) Integrated Electronics, J. Millman and C.C. Halkias, Tata Mcgraw Hill (2001)

3) Electric Circuits , S. A. Nasar, Schaum Outline Series, Tata McGraw Hill (2004)

4) Electric Circuits, K.A. Smith and R. E. Alley, Cambridge University Press(2014)

5) 2000 Solved Problems in Electronics, J. J. Cathey, Schaum Outline Series, Tata McGraw Hill (1991)

Additional Readings:

1) Microelectronic Circuit, A. S. Sedra, K.C. Smith, A. N. Chandorkar, 6th Edition (2014), Oxford University Press

2) Electronic Circuits: Discreet and Integrated, D. L. Schilling and C. Belove, Tata McGraw Hill.

3) Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.

4) Electrical Circuits, M. Nahvi and J. Edminister, Schaum Outline Series, Tata McGraw Hill (2005)

PRACTICAL COMPONENT (60 Hours)

At least 06 experiments from the following.

1) To familiarize with basic electronic components (R, L, C, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope
2) Verification of
    a. Thevenin's theorem and
    b. Norton's theorem.
3) Verification of
    a. Superposition Theorem and
    b. Reciprocity Theorem
4) Verification of the Maximum Power Transfer Theorem.
5) Study of the I-V Characteristics of
    a. p-n junction Diode, and
    b. Zener diode.

6) Study of
    a. Half wave rectifier and
    b. Full wave rectifier (FWR).
7) Study the effect of
    a. C- filter and L- filter and
    b. Zener regulator.
8) Study of the I-V Characteristics of UJT and design relaxation oscillator.
9) Study of the output and transfer I-V characteristics of common source JFET.
10) Study of Voltage divider bias configuration for CE transistor.
11) Design of a Single Stage CE amplifier of given gain.
12) Study of the RC Phase Shift Oscillator.

References (For Laboratory Work):

1) Electronic Devices and Circuits, Allen Mottershead, Goodyear Publishing Corporation.

2) Electrical Circuits, M. Nahvi and J. Edminister, Schaum Outline Series, Tata McGraw Hill (2005)

3) Network, Lines and Fields, J. D. Ryder, Prentice Hall of India

4) Integrated Electronics, J. Millman and C.C. Halkias, Tata Mcgraw Hill (2001)

BSc. (HONOURS)
IN ANALYTICAL CHEMISTRY
&
IN INDUSTRIAL CHEMISTRY
Multidisciplinary

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Mechanics **DSC - 1**	**4**	**2**	**0**	**2**	**Class XII pass with Physics and Mathematics as main subjects**	**Physics and Mathematics syllabus of class XII**

Learning Objectives
This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with a review of vector algebra and ordinary differential equations. The students will learn Newton's laws of motion, conservation of momentum, conservation of energy, concept of simple harmonic motion, Newton's laws of gravitation, elasticity and the Special Theory of Relativity. They will be able to apply the concepts learnt to several real world problems.

Learning Outcomes
Upon completion of this course, students will be able to,
- Learn the laws of motion and their application to various dynamical situations.
- Understand the concept of conservation of momentum, angular momentum and energy. Their application to basic problems.
- Understand the motion of simple pendulum
- Understand the laws of gravitation and basic idea of global positioning system
- Understand the elastic properties
- Postulates of special theory of relativity, inertial and non-inertial frame of reference and their transformation, relativistic effects on the mass and energy of a moving body.

SYLLABUS OF DSC – 1

Vectors: Review of vector algebra. Scalar and vector product

(2 Hours)

Ordinary Differential Equations: First order homogeneous differential equations, second order homogeneous differential equation with constant coefficients

(4 Hours)

Brief review of Newton's laws of motion, dynamics of a system of particles, centre of mass, determination of centre of mass for continuous systems having spherical symmetry. Conservation of momentum and energy, work – energy theorem for conservative forces,

force as a gradient of potential energy, angular momentum, torque, conservation of angular momentum

(9 Hours)

Idea of simple harmonic motion, differential equation of simple harmonic motion and its solution, kinetic energy and potential energy, total energy and their time average for a body executing simple harmonic motion

(4 Hours)

Newton's law of gravitation, motion of a particle in a central force field, Kepler's laws,weightlessness, geosynchronous orbit, basic idea of global positioning system

(4 Hours)

Elasticity: Concept of stress and strain, Hooke's law, elastic moduli, twisting torque on awire, tensile strength, relation between elastic constants, Poisson's ratio, rigidity modulus

(3 Hours)

Postulates of special theory of relativity, Lorentz transformation relations, length contraction,time dilation, relativistic transformation of velocity

(4 Hours)

PRACTICAL COMPONENT (60 Hours)

Every student should perform at least 06 experiments from the following list.

1) Measurements of length (or diameter) using vernier calliper, screw gauge and travellingmicroscope.
2) Determination of height of a building using a sextant.
3) Study of motion of the spring and calculate (a) spring constant and, (b) acceleration dueto gravity (g)
4) Determination of moment of inertia of a flywheel.
5) Determination of Young's modulus of a wire by Optical Lever Method.
6) Determination of modulus of rigidity of a wire using Maxwell's needle.
7) Determination of elastic constants of a wire by Searle's method.
8) Determination of value of g using bar pendulum.
9) Determination of value of g using Kater's pendulum.

References (for Laboratory Work):

1) Advanced practical physics for students, B. L. Flint and H. T. Worsnop, 1971, AsiaPublishing House.
2) Engineering practical physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India
3) Practical physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A text book of practical physics, I. Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) B. Sc. practical physics, Geeta Sanon, R. Chand, 2016

Essential Readings:

FOR THEORY COMPONENT

1) Schaum's Outline of Vector Analysis, 2nd Edn., Murray Spiegel, Seymour Lipschutz,Tata McGraw-Hill, (2009)
2) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
3) Mechanics Berkeley Physics Course, Vol. 1, 2/e, Charles Kittel, et. al., 2017, McGrawHill Education
4) Mechanics, D. S. Mathur and P. S. Hemne, 2012, S. Chand.

.**Suggestive Readings:**

1) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
2) University Physics, H. D. Young and R. A. Freedman, 14/e, 2015, Pearson Education.
3) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
4) Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES
Offered by Department of Physics
Category-IV

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

Note: Examination scheme and modes shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE – 1): MECHANICS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Mechanics GE 1	4	3	0	1	Class XII pass	NIL	Physics and Astrophysics

Learning Objectives

This course reviews the concepts of mechanics learnt at school in a more advanced perspective and goes on to build new concepts. It begins with dynamics of a system of particles and ends with the special theory of relativity. Students will appreciate the concept of rotational motion, gravitation and oscillations. The students will be able to apply the concepts learnt to several real world problems. A brief recapitulation of vector algebra and differential equations is also done to familiarize students with basic mathematical concepts which are necessary for a course on mechanics.

Learning Outcomes

Upon completion of this course, students are expected to understand the following concepts.

- Laws of motion and their application to various dynamical situations. And their applications to conservation of momentum, angular momentum and energy.
- Motion of a simple and compound pendulum
- Application of Kepler's laws to describe the motion of satellites in circular orbit.
- The concept of geosynchronous orbits
- Concept of stress and strain and relation between elastic constants
- Postulates of Special Theory of Relativity, Lorentz transformation, relativistic effects on the mass and energy of a moving body.

In the laboratory course, after acquiring knowledge of how to handle measuring

instruments (like vernier calliper, screw gauge and travelling microscope) student shall embark on verifying various principles and associated measurable quantities.

SYLLABUS OF GE – 1

THEORY COMPONENT

Unit 1: Recapitulation of Vectors and Ordinary Differential Equation (8 Hours)

Vector algebra, scalar and vector product, gradient of a scalar field, divergence and curl of vectors field

Ordinary Differential Equations: First order homogeneous differential equations, second order homogeneous differential equation with constant coefficients

Unit 2: Fundamentals of Dynamics (10 Hours)

Review of Newton's laws of motion, dynamics of a system of particles, centre of mass, determination of centre of mass for discrete and continuous systems having spherical symmetry, Conservation of momentum and energy, Conservative and non-Conservative forces, work – energy theorem for conservative forces, force as a gradient of potential energy.

Unit 3: Rotational Dynamics and Oscillatory Motion (14 Hours)

Angular velocity, angular momentum, torque, conservation of angular momentum, Moment of inertia, Theorem of parallel and perpendicular axes, Calculation of moment of inertia of discrete and continuous objects (1-D and 2-D).

Idea of simple harmonic motion, Differential equation of simple harmonic motion and its solution, Motion of a simple pendulum and compound pendulum

Unit 4: Gravitation (5 Hours)

Newton's Law of Gravitation, Motion of a particle in a central force field, Kepler's Laws (statements only), Satellite in circular orbit and applications, geosynchronous orbits

Unit 5: Elasticity (3 Hours)

Concept of stress and strain, Hooke's law, elastic moduli, twisting torque on a wire, tensile strength, relation between elastic constants, Poisson's ratio, rigidity modulus

Unit 6: Special Theory of Relativity (5 Hours)

Postulates of Special Theory of Relativity, Lorentz transformation, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass, mass-energy equivalence

PRACTICAL COMPONENT (30 Hours)

The teacher is expected to give basic idea and working of various apparatus and instruments related to different experiments. Students should also be given knowledge of recording and analyzing experimental data.

Every student should perform at least 06 experiments from the following list.

1) Measurement of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2) Study the random error in observations.
3) Determination of height of a building using a sextant.
4) Study of motion of the spring and calculate (a) spring constant and, (b) acceleration due to gravity (g)
5) Determination of moment of inertia of a flywheel.
6) Determination of g and velocity for a freely falling body using digital timing technique.
7) Determination of modulus of rigidity of a wire using Maxwell's needle.
8) Determination of elastic constants of a wire by Searle's method.
9) Determination of value of g using bar pendulum.
10) Determination of value of g using Kater's pendulum.

References (for Laboratory Work):

1) Advanced practical physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2) Engineering practical physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A text book of practical physics, I. Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) B. Sc. practical physics, Geeta Sanon, R. Chand and Co., 2016.

Essential readings:

FOR THEORY COMPONENT

1) Vector Analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
2) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
3) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
4) Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.
5) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.

Suggestive readings

1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4) Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press
5) Physics for Scientists and Engineers, Randall D Knight, 3/e, 2016, Pearson Education.

GENERIC ELECTIVES (GE - 2): MATHEMATICAL PHYSICS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mathematical Physics GE – 2	4	3	1	0	Class XII pass	NIL

Learning Objectives

The emphasis of course is to equip students with the mathematical tools required in solving problem of interest to physicists. The course will expose students to fundamental computational physics skills and hence enable them to solve a wide range of physics problems.

Learning Outcomes

At the end of this course, the students will be able to,

- Understand functions of several variables.
- Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc.
- Obtain power series solution of differential equation of second order with variable coefficient using Frobenius method.
- Understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations and apply these to various physical problems such as in quantum mechanics.
- Learn about gamma and beta functions and their applications.
- Solve linear partial differential equations of second order with separation of variable method.
- Understand the basic concepts of complex analysis and integration.
- During the tutorial classes, students' skill will be developed to solve more problems related to the concerned topics.

SYLLABUS OF GE – 2

THEORY COMPONENT

Unit 1: **(6 Hours)**

Fourier s eries: Periodic functions. Orthogonality of sine and cosine functions, Convergence of Fourier series and Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions (Fourier Cosine Series and Fourier Sine Series).

Unit 2: (10 Hours)

Frobenius M ethod a nd Spe cial F unctions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre and Bessel Differential Equations.

Unit 3: (14 Hours)

Some S pecial Integrals: Beta and Gamma Functions and Relation between them. Expression of integrals in terms of Gamma Functions.

Partial D ifferential E quations: Multivariable functions, Partial derivatives, Functions Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular geometry, Solution of 1D wave equation.

Unit 4: (15 Hours)

Complex A nalysis: Functions of complex variable, limit, continuity, Analytic function, Cauchy-Riemann equations, singular points, Cauchy Goursat Theorem, Cauchy's Integral Formula, Residues, Cauchy's Residue Theorem.

Essential readings:

1) Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
2) Complex Variables and Applications, J. W. Brown and R. V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
3) Advanced Mathematics for Engineers and Scientists: Schaum Outline Series, M. R Spiegel, 2009, McGraw Hill Education.
4) Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Harvill, 2014, Dover Publications.
5) Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd Ed., 2006, Cambridge University Press.

Suggestive readings

1) Mathematical Physics, A. K. Ghatak, I. C. Goyal and S. J. Chua, 2017, Laxmi Publications Private Limited.
2) Advanced Engineering Mathematics, D. G. Zill and W. S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
3) An introduction to ordinary differential equations, E. A. Coddington, 2009, PHI Learning.
4) Differential Equations, George F. Simmons, 2007, McGraw Hill.
5) Mathematical methods for Scientists and Engineers, D. A. Mc Quarrie, 2003, Viva Books

GENERIC ELECTIVES (GE – 3): WAVES AND OPTICS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Waves and Optics GE 3	4	3	0	1	Class XII pass	NIL

Learning Objectives

This coursework reviews the concept of waves and optics learnt at school level from a more advanced perspective and builds new concepts. This course is divided into two main parts. The first part deals with vibrations and waves. The second part pertains to optics and provides the details of interference, diffraction and polarization.

Learning Outcomes

After the completion of this course, the students will have learnt the following.

- Simple harmonic motion, superposition principle and its application to find the resultant of superposition of harmonic oscillations.
- Concepts of vibrations in strings.
- Interference as superposition of waves from coherent sources.
- Basic concepts of Diffraction: Fraunhoffer and Fresnel Diffraction.
- Elementary concepts of the polarization of light.

SYLLABUS OF GE – 3

THEORY COMPONENT

Unit 1: (10 Hours)

Superposition of Harmonic Oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear harmonic oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of two perpendicular harmonic oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses.

Unit 2: (5 Hours)

Waves M otion: Types of waves: Longitudinal and Transverse (General idea). Travelling waves in a string, wave equation. Energy density. Standing waves in a string - modes of vibration. Phase velocity.

Unit 3: (12 Hours)

Interference o f L ight: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Interference: Division of amplitude and division of wave front. Young's Double Slit experiment. Fresnel's Biprism. Phase change on reflection: Stoke's treatment. Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: measurement of wavelength and refractive index.

Unit 4: (12 Hours)

Diffraction: Fraunhofer diffraction - Single slit, Double slit and Diffraction grating. Fresnel Diffraction - Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge using half-period zone analysis.

Unit 5: (6 Hours)

Polarization: Transverse nature of light waves. Plane polarized light. Production and detection of linearly polarized light. Malus's Law. Idea of circular and elliptical polarization.

PRACTICAL COMPONENT (30 Hours)

Every student must perform at least 05 experiments out of the list following experiments.

1) To determine the frequency of an electrically maintained tuning fork by Melde's experiment and to verify λ^2 – T Law.
2) To study Lissajous Figures.
3) Familiarization with Schuster`s focusing and determination of the angle of prism.
4) To determine the refractive index of the material of a prism using sodium light.
5) To determine the dispersive power of a prism using mercury light.
6) To determine wavelength of sodium light using Newton's rings.
7) To determine wavelength of sodium light using a plane diffraction grating.
8) To verify Malus's Law.
9) To determine the wavelength of Laser light using single slit diffraction. (Due care should be taken not to see Laser light source directly as it may cause injury to eyes.)

References (for Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, Asia Publishing House
2) A Text Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal
3) An advanced course in practical physics, D. Chattopadhyay and P. C. Rakshit, New Central Book Agency

Essential readings:

FOR THEORY COMPONENT

1) The Physics of Waves and Oscillations: N K Bajaj, Tata Mcgraw Hill
2) Optics: Ajoy Ghatak, Seventh edition, Mcgraw Hill
3) Principle of Optics: B. K. Mathur and T. P. Pandya, Gopal Printing Press
4) Optics: Brij Lal and N. Subramanyam, S. Chand
5) The Fundamentals of Optics: A. Kumar, H. R. Gulati and D. R. Khanna, R. Chand

Suggestive readings:

1) Vibrations and Waves: A. P. French, CRC
2) The physics of Vibrations and Waves: H. J. Pain, Wiley
3) Fundamentals of Optics: Jenkins and White, McGraw Hill
4) Optics: E. Hecht and A R. Ganesan, Pearson, India
5) Introduction to Optics: F. Pedrotti, L. M. Pedrotti and L. S. Pedrotti, Pearson, India

GENERIC ELECTIVES (GE - 6): INTRODUCTORY ASTRONOMY

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Introductory Astronomy GE 6	4	3	1	0	Class XII pass	NIL

Learning Objectives

This course is meant to introduce undergraduate students to the wonders of the Universe. Students will understand how astronomers over millennia have come to understand mysteries of the universe using laws of geometry and physics, and more recently chemistry and biology. They will be introduced to the Indian contribution to astronomy starting from ancient times up to the modern era. They will learn about diverse set of astronomical phenomenon, from the daily and yearly motion of stars and planets in the night sky which they can observe themselves, to the expansion of the universe deduced from the latest observations and cosmological models. Students will also be introduced to internet astronomy and the citizen science research platform in astronomy. The course presupposes school level understanding of mathematics and physics.

Learning Outcomes

- After completing this course, student will gain an understanding of,
- Different types of telescopes, diurnal and yearly motion of astronomical objects, astronomical coordinate systems and their transformations
- Brightness scale for stars, types of stars, their structure and evolution on HR diagram
- Components of solar system and its evolution
- Current research in detection of exoplanets
- Basic structure of different galaxies and rotation of the Milky Way galaxy
- Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life
- Internet based astronomy and the collaborative citizen astronomy projects

- India's contribution to astronomy, both in ancient times and in modern era.

SYLLABUS OF GE – 6

Unit 1: (8 Hours)

Introduction to Astronomy and Astronomical Scales: History of astronomy, wonders of the Universe, overview of the night sky, diurnal and yearly motions of the Sun, size, mass, density and temperature of astronomical objects, basic concepts of positional astronomy: Celestial sphere, Astronomical coordinate systems, Horizon system and Equatorial system

Unit 2: (6 Hours)

Basic Parameters of Stars: Stellar energy sources, determination of distance by parallax method, aberration, proper motion, brightness, radiant flux and luminosity, apparent and absolute magnitude scales, distance modulus, determination of stellar temperature and radius, basic results of Saha ionization formula and its applications for stellar astrophysics, stellar spectra, dependence of spectral types on temperature, luminosity classification, stellar evolutionary track on Hertzsprung-Russell diagram

Unit 3: (8 Hours)

Astronomical Instruments: Observing through the atmosphere (Scintillation, Seeing, Atmospheric Windows and Extinction). Basic Optical Definitions for Telescopes: Magnification, Light Gathering Power, Limiting magnitude, Resolving Power, Diffraction Limit. Optical telescopes, radio telescopes, Hubble space telescope, James Web space telescope, Fermi Gamma ray space telescope.

Astronomy in the Internet Age: Overview of Aladin Sky Atlas, Astrometrica, Sloan Digital Sky Survey, Stellarium, virtual telescope

Citizen Science Initiatives: Galaxy Zoo, SETI@Home, RAD@Home India

Unit 4: (8 Hours)

Sun and the solar system: Solar parameters, Sun's internal structure, solar photosphere, solar atmosphere, chromosphere, corona, solar activity, origin of the solar system, the nebular model, tidal forces and planetary rings

Exoplanets: Detection methods and characterization

Unit 5: (12 Hours)

Physics of Galaxies: Basic structure and properties of different types of Galaxies, Nature of rotation of the Milky Way (Differential rotation of the Galaxy), Idea of dark matter

Cosmology and Astrobiology: Standard Candles (Cepheids and SNe Type1a), Cosmic distance ladder, Olber's paradox, Hubble's expansion, History of the Universe, Chemistry of life, Origin of life, Chances of life in the solar system

Unit 6: (4 Hours)

Astronomy in India: Astronomy in ancient, medieval and early telescopic era of India, current Indian observatories (Hanle-Indian Astronomical Observatory, Devasthal Observatory, Vainu Bappu Observatory, Mount Abu Infrared Observatory, Gauribidanur Radio Observatory, Giant Metre-wave Radio Telescope, Udaipur Solar Observatory, LIGO -

India) (qualitative discussion), Indian astronomy missions (Astrosat, Aditya)

Essential readings:

1) Seven Wonders of the Cosmos, Jayant V Narlikar, Cambridge University Press
2) Fundamental of Astronomy, H. Karttunen et al. Springer
3) Modern Astrophysics, B.W. Carroll and D.A. Ostlie, Addison-Wesley Publishing Co.
4) Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, Saunders College Publishing.
5) The Molecular Universe, A.G.G.M. Tielens (Sections I, II and III), Reviews of Modern Physics, Volume 85, July-September, 2013
6) Astronomy in India: A Historical Perspective, Thanu Padmanabhan, Springer

Useful websites for astronomy education and citizen science research platform

1) https://aladin.u-strasbg.fr/
2) http://www.astrometrica.at/
3) https://www.sdss.org/
4) http://stellarium.org/
5) https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/
6) https://setiathome.berkeley.edu/
7) https://www.radathomeindia.org/

Suggestive readings:

1) Explorations: Introduction to Astronomy, Thomos Arny and Stephen Schneider, McGraw Hill
2) Astrophysics Stars and Galaxies K D Abhyankar, Universities Press
3) Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.
4) Baidyanath Basu, An introduction to Astrophysics, Prentice Hall of India Private Limited.
5) The Physical Universe: An Introduction to Astronomy, F H Shu, University Science Books

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry

Category-I

DISCIPLINE SPECIFIC CORE COURSE -1 (DSC-1): Atomic Structure & Chemical Bonding

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Atomic Structure & Chemical Bonding (DSC-1: Inorganic Chemistry -I)	**04**	**03**	—	**01**	Physics, Chemistry, Mathematics	**--**

Learning Objectives

The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic and covalent bonding, and explains that chemical bonding is best regarded as a continuum between the two cases. It discusses the periodicity in properties with reference to the s and p block, which is necessary in understanding their group chemistry. The student will also learn about the fundamentals of acid-base and redox titrimetric analysis.

Learning outcomes

By the end of the course, the students will be able to:

- Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization enthalpy and electron affinity of elements.
- Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).
- Understand the concept of lattice energy using Born-Landé and Kapustinskii equation.
- Calibrate the apparatus used in titrimetric analysis and prepare standard solutions for titration
- Understand the theory and application of various acid-base and redox titrations.
- Comprehend the theory of acid-base indicators

SYLLABUS OF DSC-1

UNIT – I (15 Hours)
Unit 1: Atomic Structure

Recapitulation of concept of atom in ancient India, Bohr's theory & its limitations, atomic spectrum of hydrogen atom.

de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Postulates of wave mechanics, Time independent Schrödinger's wave equation, well behaved wave function, significance of ψ and ψ^2. Quantum mechanical treatment of H- atom, Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial function plots, radial probability distribution plots, angular distribution curves. Shapes of *s*, *p*, and *d o*rbitals, Relative energies of orbitals.

Pauli's Exclusion Principle, Hund's rule of maximum spin multiplicity, Aufbau principle and its limitations.

UNIT – II (6 Hours)

Unit 2: Periodic properties of Elements & Periodic Trends

Brief discussion of the following properties of the elements, with reference to *s*- & *p*-block andtheir trends:

(a) Effective nuclear charge, shielding or screening effect and Slater's rules

(b) Atomic and ionic radii

(c) Ionization enthalpy (Successive ionization enthalpies)

(d) Electron gain enthalpy

(e) Electronegativity, Pauling's scale of electronegativity. Variation of electronegativity with bond order and hybridization.

UNIT – III (12 Hours)

Unit 3: Ionic bond

General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Lattice energy, Born-Landé equation with derivation, Madelung constant, importance of Kapustinskii equation for lattice energy. Born-Haber cycle and its applications.

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

UNIT – IV (12 Hours)
Unit 4: Covalent bond
Valence shell electron pair repulsion (VSEPR) theory, shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5,

SF_6, ClF_3, I_3, BrF_2^+, PCl_6^-, ICl_2^- ICl_4^-, and SO_4^{2-}. Application of VSEPR theory in predicting trends in bond lengths and bond angles.

Valence Bond theory (*Heitler-London* approach). Hybridization, equivalent and non-equivalent hybrid orbitals, Bent's rule.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Molecular orbital diagrams of homo & hetero diatomic molecules [N_2, O_2, C_2, B_2, F_2, CO, NO] and their ions; HCl (idea of s-p mixing and orbital interaction to be given).

Practical component
Practicals: Inorganic Chemistry-I **(30 Hours)**

(Laboratory periods: 15 classes of 2 hours each)

1. **Titrimetric Analysis:**
   (i) Calibration and use of apparatus
   (ii) Preparation of solutions ofdifferent Molarity/Normality.

2. **Acid-Base Titrations:** Principles of acid-base titrations to be discussed.
(i) Estimation of oxalic acid using standardized NaOH solution
(ii) Estimation of sodium carbonate using standardized HCl.
(iii) Estimation of carbonate and hydroxide present together in a mixture.
(iv) Estimation of carbonate and bicarbonate present together in a mixture.

3. **Redox Titration:** Principles of oxidation-reduction titrations to be discussed.
(i) Estimation of oxalic acid using standardized $KMnO_4$ solution
(ii) Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
(iii) Estimation of oxalic acid and sodium oxalate in a given mixture.

Essential/recommended readings
References:
Theory :

1. Lee, J.D. (2010), **Concise Inorganic Chemistry**, Wiley India.
2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education.
3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, Oxford University Press.
5. Pfennig, B. W. (2015), **Principles of Inorganic Chemistry.** John Wiley & Sons.
6. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5th Edition, Pearson.
7. Wulfsberg, G (2002), **Inorganic Chemistry,** Viva Books Private Limited.
8. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

9. Shiver, D.; Weller, M.; Overton, T.; Rourke, J.; Armstrong, F. (2014), **Inorganic Chemistry**, 6th Edition, Freeman & Company
10. Das, A. K.; Das, M. (2014), **Fundamental Concepts of Inorganic Chemistry**, 1st Edition, Volume CBS Publishers & Distributors Pvt. Ltd.

Practicals:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of **Quantitative Chemical Analysis,** John Wiley and Sons.
2. Harris, D. C.; Lucy,C. A.(2016), **Quantitative Chemical Analysis,** 9th Edition, Freeman andCompany

Note: Examination scheme and modes hall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2): Basic Concepts and Aliphatic Hydrocarbons

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Concepts and Aliphatic Hydrocarbons (DSC-2: Organic Chemistry-I)	**04**	**03**	**--**	**01**	Physics, Chemistry, Mathematics	**--**

Learning Objectives

The core course Organic Chemistry I is designed in a manner that it forms a cardinal part of the learning of organic chemistry for the subsequent semesters. The course is infused with the recapitulation of fundamental concepts of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space. To establish the applications of these concepts, the functional groups-alkanes, alkenes, alkynes are introduced. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Learning outcomes

On completion of the course, the student will be able to:

- Understand and explain the electronic displacements and reactive intermediates and their applications in basic concepts.
- Formulate the mechanistic route of organic reactions by recalling and correlating the fundamental concepts.

- Identify and comprehend mechanism for free radical substitution, electrophilic addition, nucleophilic substitution and elimination reactions.
- Understand the fundamental concepts of stereochemistry.
- Understand and suitably use the chemistry of hydrocarbons

SYLLABUS OF DSC- 2

UNIT – I (9 Hours)
Unit I: Basic Concepts of Organic Chemistry

Electronic displacements and their applications: inductive, electromeric, resonance and mesomeric effects and hyperconjugation. Dipole moment, acidity and basicity.

Homolytic and heterolytic fissions with suitable examples. Types, shape and relative stability of carbocations, carbanions, carbenes and free radicals.

Electrophiles & nucleophiles, and introduction to types of organic reactions: addition, elimination and substitution reactions.

UNIT – II (18 Hours)
Unit II: Stereochemistry

Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. specific rotation; Configuration and projection formulae: Newman, Sawhorse, Fischer and their interconversion. Chirality in molecules with one and two stereocentres; meso configuration.

Racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations (CIP rules).

Geometrical isomerism: *cis-trans, syn-anti* and *E/Z* notations.

Conformational Isomerism: Alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane). Relative stability of cycloalkanes (Baeyer strain theory), Cyclohexane conformations with energy diagram. Conformations of monosubstituted cyclohexanes.

UNIT – III (18)
Unit III: Aliphatic Hydrocarbons

Alkanes: Preparation, Halogenation of alkanes, Concept of relative reactivity v/s selectivity.

Alkenes and Alkynes: Methods of preparation of alkenes using Mechanisms of E1, E2, E1cb reactions, Saytzeff and Hoffmann eliminations. Electrophilic additions, mechanism with suitable examples, (Markownikoff/Anti-markownikoff addition), *syn* and *anti*-addition; addition of H_2, X_2, oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, hydroxylation, reaction with NBS, Reactions of alkynes; acidity, Alkylation of terminal alkynes, electrophilic addition: hydration to form carbonyl compounds, Relative reactivity of alkenes and alkynes, 1,2-and 1,4-addition reactions in conjugated dienes, Diels Alder reaction (excluding stereochemistry)

Practical component

Practical (30 Hours)
Credits: 01

(Laboratory periods: 15 classes of 2 hour each)

Note: *Students should be provided with handouts prior to the practical class*

1. Calibration of a thermometer and determination of the melting points of the organic compounds using any one of the following methods-Kjeldahl method, electrically heated melting point apparatus and BODMEL).

2. Concept of melting point and mixed melting point.

3. Concept of recrystallisation using alcohol/water/alcohol-water systems (Any two).
4. Determination of boiling point of liquid compounds (boiling point lower than and more than 100 °C by distillation, capillary method and BODMEL method)

5. Separation of a mixture of two amino acids/sugars by radial/ascending paper chromatography.

6. Separation of a mixture of *o*-and *p*-nitrophenol or *o*-and *p*-aminophenol by thin layer chromatography (TLC).

7. Detection of extra elements

Essential/recommended readings

References:

Theory

1. Morrison, R.N., Boyd, R.N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
2. Finar, I.L. (2002), **Organic Chemistry**, Volume 1, 6th Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
3. Eliel, E.L., Wilen, S.H. (1994), **Stereochemistry of Organic Compounds**; Wiley: London.

Practicals

1. Mann, F.G., Saunders, B.C. (2009), **Practical Organic Chemistry**, 4th Edition, Pearson Education.
2. Ahluwalia, V.K., Dhingra, S. (2004), **Comprehensive Practical Organic Chemistry: Qualitative Analysis**, University Press.
3. Furniss, B.S., Hannaford, A.J., Smith, P.W.G.; Tatchell, A.R (2004), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
4. Leonard, J., Lygo, B., Procter, G. (2013) **Advanced Practical Organic Chemistry**, 3rd Edition, CRC Press.
5. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume–I**, I K International Publishing house Pvt. Ltd, New Delhi

Suggestive readings

Additional Resources:

1. Solomons, T.W.G., Fryhle, C.B., Snyder, S.A. (2017), **Organic C hemistry**, 12th Edition, Wiley.
2. Bruice, P.Y. (2020), **Organic Chemistry**, 8th Edition, Pearson.
3. Clayden, J., Greeves, N., Warren, S. (2014), **Organic Chemistry**, Oxford.
4. Nasipuri, D. (2018), **Stereochemistry o f O rganic C ompounds: P rinciples a nd Applications**, 4th Edition, New Age International.
5. Gunstone, F.D. (1975), **Guidebook to Stereochemistry**, Prentice Hall Press.
6. Gupta, S.S. (2018), **Basic S tereochemistry o f O rganic Mo lecules,** 2nd Edition, Oxford University Press.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3): Gaseous and Liquid

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	**Credits**	**Credit distribution of the course**			**Eligibility criteria**	**Pre-requisite of t he co urse** (if any)
		Lecture	**Tutorial**	**Practical/ Practice**		
Gaseous and Liquid State (DSC-3: Physical Chemistry-I)	**04**	**02**	**--**	**02**	Physics, Chemistry, Mathematics	**--**

Learning Objectives

The objective of this course is to develop basic and advance concepts regarding gases and liquids. It aims to study the similarity and differences between the two states of matter and reasons responsible for these. The objective of the practicals is to develop skills for working in physical chemistry laboratory. The student will perform experiments based on the concepts learnt in Physical chemistry-I course.

Learning outcomes

By the end of the course, the students will be able to:

- Derive mathematical expressions for different properties of gas and liquid and understand their physical significance.
- Apply the concepts of gas equations and liquids while studying other chemistry courses and every-day life.
- Handle stalagmometer and Ostwald viscometer properly.
- Determine the density of aqueous solutions.
- Dilute the given solutions as per required concentrations.
- Data reduction using numerical and graphical methods.

SYLLABUS OF DSC-3

UNIT – I (24 Hours)
Gaseous state

Kinetic t heory o f g ases- postulates and derivation of kinetic gas equation, Maxwell distribution of molecular velocities and its use in evaluating average, root mean square and most probable velocities and average kinetic energy. Definition, expression, applications and temperature and pressure dependence of each one of the following properties of ideal gases: Collision frequency, Collision diameter, Mean free path. Coefficient of viscosity, definition, units and origin of viscosity of gases, relation between mean free path and coefficient of viscosity, temperature and pressure dependence of viscosity of a gas, calculation of molecular diameter from viscosity
Barometric distribution law, its derivation and applications, alternative forms of barometric distribution law in terms of density and number of molecules per unit volume, effect of height, temperature and molecular mass of the gas on barometric distribution

Behaviour of real gases- Compressibility factor, Z , Variation of compressibility factor with pressure at constant temperature *(plot of Z vs P)* for different gases (H_2, CO_2, CH_4 and NH_3), Cause of deviations from ideal gas behaviour and explanation of the observed behaviour of real gases in the light of molecular interactions

van der Waals (vdW) equation of state, Limitations of ideal gas equation of state and its modifications in the form of derivation of van der Waal equation, Physical significance of van der Waals constants, application of van der Waal equation to explain the observed behaviour of real gases.

Isotherms of real gases- Critical state, relation between critical constants and van der Waals constants, correlation of critical temperature of gases with intermolecular forces of attraction, Continuity of states, Limitations of van der Waals equation, Reduced equation of state and law of corresponding states (statement only).

Virial equation of state-Physical significance of second and third virial coefficients, van der Waals equation expressed in virial form, Relations between virial coefficients and van der Waals constants

UNIT – II (6 Hours)
Liquid state

Nature of liquid state, qualitative treatment of the structure of the liquid state

Physical properties of liquids-vapour pressure, its origin and definition, Vapour pressure of liquids and intermolecular forces, and boiling point

Surface tension, its origin and definition, Capillary action in relation to cohesive and adhesive forces, determination of surface tension by (i) using stalagmometer (drop number and drop mass method both) and (ii) capillary rise method, Effects of addition of sodium chloride, ethanol and detergent on the surface tension of water and its interpretation in terms of molecular interactions, Role of surface tension in the cleansing action of detergents

Coefficient of viscosity and its origin in liquids, Interpretation of viscosity data of pure liquids (water, ethanol, ether and glycerol) in the light of molecular interactions, Effects of addition of sodium chloride, ethanol and polymer on the viscosity of water, relative viscosity, specific viscosity and reduced viscosity of a solution, comparison of the origin of viscosity of liquids and gases, effect of temperature on the viscosity of a liquid and its comparison with that of a gas.

Practical component
Practicals **60 Hours**

(Laboratory periods: 15 classes of 4 hours each)

1. **Gases**
   a. To verify the Charles law using Charles law apparatus
   b. To determine the value of universal gas constant R using the reaction
   $Mg(s) + 2HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$

2. **Surface tension measurements using stalagmometer**
   a. Determine the surface tension of a liquid by drop number method.
   b. Determine the surface tension of a liquid by drop weight method.
   c. Study the variation of surface tension with different concentration of detergent solutions. Determine CMC.
   d. Study the effect of the addition of solutes on the surface tension of water at room temperature and explain the observations in terms of molecular interactions:
      (i) sugar
      (ii) ethanol
      (iii) sodium chloride
   e. Study the variation of surface tension with different concentration of sodium chloride solutions.

3. **Viscosity measurement using Ostwald's viscometer**
   a. Determination of co-efficient of viscosity of two unknown aqueous solution.
   b. Study the variation of viscosity with different concentration of sugar solutions.
   c. Study the effect of the addition of solutes such as (i) polymer (ii) ethanol (iii) sodium chloride on the viscosity of water at room temperature and explain the observations in terms of molecular interactions

d. Study the variation of viscosity of water with the amounts of a solute and calculate the intrinsic viscosity at room temperature.
e. Determine the viscosity average molecular mass of the polymer (PVA) using viscosity measurements.

Essential/recommended readings
References:

Theory:

1. Atkins, P.W.; Paula, J.de. (2014), **Atkin's P hysical C hemistry E d.**, 10th Edition, Oxford University Press.
2. Ball, D. W. (2017), **Physical Chemistry,** 2nd Edition, Cengage Learning, India.
3. Castellan, G. W. (2004), **Physical Chemistry**, 4th Edition, Narosa.
4. Kapoor, K.L. (2015), **A T extbook of P hysical C hemistry**, Vol 1, 6th Edition, McGraw Hill Education.

Practical:

- Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior P ractical Physical C hemistry**, R. Chand & Co, New Delhi.
- Kapoor, K.L. (2019), **A T extbook of P hysical C hemistry**, Vol.7, 1st Edition, McGraw Hill Education.
- Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments i n P hysical Chemistry**, 8th Edition, McGraw-Hill, New York.

Suggestive readings

Additional Resources:

1. Moore, W.J. (1972), **Physical C hemistry**, 5th Edition, Longmans Green & Co. Ltd. Glasstone, S. (1948), **Textbook of P hysical C hemistry**, D. Van Nostrand company, New York.

BSc. IN ANALYTICAL CHEMISTRY

Multidisciplinary

DISCIPLINE S PECIFIC CORE COURSE (DS C1-AC1): Basic Principles and Laboratory Operations

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Principles and Laboratory Operations (DSC1-AC1)	**04**	**02**	**00**	**02**	Physics, Chemistry and Mathematics	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- make students aware about the SI Units, concentration terms, various analytical methods, and safe usage of chemicals and its waste.

Learning outcomes

The Learning Outcomes of this course are as follows:

- The students will be able to Understand SI units
- The students will be able to Learn the use of analytical equipment
- The students will be able to Know the types of errors in chemical analysis
- The students will be able to handle statistical tests of data

SYLLABUS OF DSC1-AC1

UNIT – I: Basic Concepts (6 Hours)

A. SI Units

· Definitions of the Seven Base Units
· Derived units
· Conversion between units
· Significant figures

B. Chemical concentrations

· Mole, molar mass (calculations in grams and moles)
· Solutions and their concentrations

· Molar concentration
· Analytical molarity
· Equilibrium molarity of a particular species
· Percent concentration
· Parts per million/billion (ppm, ppb)
· Volume ratios for dilution procedures
· p-functions.

UNIT – II: Introduction to Analytical Chemistry and Analytical Methods (4 Hours)

1. General steps in chemical analysis.
2. Introduction to methods of detecting analytes
    a) Physical
    b) Electromagnetic radiations
    c) Electric charge.

UNIT – III: Errors in Chemical Analysis (20 Hours)

- Types of errors
- Accuracy and Precision, Absolute and relative uncertainty, propagation of uncertainty
- The Gaussian distribution
- Mean and standard deviation
- Confidence intervals
- Statistical tests of data (F test, t test, Q test for bad data)
- Method of least squares
- Calibration curve
- Safety with chemicals and waste

Practical component 60 Hours (Credits: 02; Laboratory Periods: 60; 15 Classes of 4 hours each)

1. Description, Use and Calibration of Common Laboratory Apparatus I: Glassware: Volumetric flasks, Burettes, Pipettes, Weighing bottles, Drying ovens.
2. Description, Use and Calibration of Common Laboratory Apparatus II: Different types of Funnels, Chromatographic columns, Chromatographic jars, Desiccators, Filter crucibles, Rubber policeman.
3. Preparing Solutions: Standard solutions (acids and bases), primary standards & secondary standards, and to find out their concentration by any suitable methods.
4. Determination of strength of given strong acid using strong base volumetrically
5. Estimation of sodium carbonate by titrating with hydrochloric acid.
6. Use and maintenance of pH meter. Determination of pH of given dilute solutions of shampoos, soaps, fruit juices, and different soft drinks.
7. Determination of cell constant of a conductometric cell using standard KCl solutions.
8. To check the conductivity of various water samples (*Collect at least four samples*).

Essential/recommended readings

- Higson, S. P.J. (2003), Analytical Chemistry, Oxford University Press.

- Skoog, D.A.; West, D.M. (2003), Fundamentals of Analytical Chemistry, Brooks/Cole.
- Christian, G.D. (2004), Analytical Chemistry, 6th Edition, John Wiley & Sons, New York.
- Fifield, F.W.; Kealey, D. (2000), Principles and Practice of Analytical Chemistry, Wiley.
- Harris, D. C. (2007), Exploring Chemical Analysis, W.H. Freeman and Co.

Suggestive readings

- Day. R. A.; Underwood, A. L. (1991), Quantitative Analysis, Prentice Hall of India.
- Gordus, A. A. (1985), Schaum's Outline of Analytical Chemistry, Tala McGraw-Hill.
- Dean J. A. (1997), Analytical Chemistry Handbook, McGraw Hill.
- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.

Note: Examination scheme and modes shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC2-C1): Fundamentals of Organic Chemistry, Stereochemistry and Hydrocarbons

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Fundamentals of Organic Chemistry, Stereochemistry and Hydrocarbons (DSC2-C1)	**04**	**02**	**00**	**02**	Physics, Chemistry and Mathematics	-

Learning Objectives

The Learning Objectives of this course are as follows:

- The course is infused with the recapitulation of fundamentals of organic chemistry and visualizing the organic molecules in a three-dimensional space.
- To establish the applications of these concepts different class of mechanism is included.
- The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Learning outcomes

By the end of the course, the students will be able to:

- Understand and explain the differential behaviour of organic compounds based on fundamental concepts learnt.
- Understand the stereochemistry of aliphatic and aromatic hydrocarbons
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reaction mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, and electrophilic substitution.
- Understand the mechanism of reactions of hydrocarbons

SYLLABUS OF DSC2-C1

UNIT – I: Fundamentals of Organic Chemistry (4 Hours)

Introduction to carbon compounds, an overview of Fundamentals (Electronic displacement-Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect). Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbene.

Acidity and basicity in carbon compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivative.

UNIT – II: Stereochemistry (8 Hours)

Types of projection formulas of carbon compound - Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.

Stereoisomerism: the concept of chirality (upto two carbon atoms). Configurational Isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; cis-trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z nomenclature (for upto two C=C systems).

Conformational isomerism with respect to ethane, butane and cyclohexane.

UNIT – III: Aliphatic Hydrocarbons (12 Hours)

Functional group approach for the following reactions: preparations, physical property & chemical reactions to be studied with the mechanism in context to their structure.

Alkanes: Preparation: catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Grignard reagent. Reactions: Free radical substitution: Halogenation.

Alkenes: Preparation: Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), the addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration oxidation.

Alkynes: Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetrahalides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides and acidity of alkynes, the addition of bromine and alkaline

$KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. Hydration to form carbonyl compounds.

UNIT – IV: Aromatic Hydrocarbons (6 Hours)
Aromaticity: benzenoids and Hückel's rule. Structure and aromatic character of benzene.
Preparation: methods of preparation of benzene from phenol, benzoic acid, acetylene and benzene sulphonic acid. Reactions: electrophilic substitution reactions in benzene citing examples of nitration, halogenation, sulphonation and Friedel-Craft's alkylation and acylation with emphasis on carbocationic rearrangement, side-chain oxidation of alkylbenzenes.

Practical component (60 Hours) (Credits: 02; Laboratory Periods: 60; 15 Classes of 4 hours each)

1. Purification of organic compounds by crystallization using the following solvents:
    a. Water
    b. Alcohol
    c. Water + alcohol
2. Determination of the melting points of organic compounds using Kjeldahl method and electrically heated melting point apparatus.
3. To study the effect of impurities on the melting point.
4. To identify the organic compounds using mixed melting point experiment. (*Identify at least two organic compounds*).
5. Determination of boiling point of liquid organic compounds using both distillation and capillary method.
6. Detection of extra elements present in an organic compounds (*Upto two extra elements*).
7. Organic Preparations:
    a. Bromination of acetanilide, phenol and aniline
    b. Nitration of nitrobenzene and bromobenzene

Essential/recommended readings

- Sykes, P.(2005), A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- Eliel, E. L. (2000), Stereochemistry of Carbon Compounds, Tata McGraw Hill.
- Morrison, R. N.; Boyd, R. N. (2010) Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 7th Edition.
- Bahl, A; Bahl, B. S. (2012), Advanced Organic Chemistry, S. Chand.
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), Vogel's Textbook of Practical Organic Chemistry, Pearson.
- Mann, F.G.; Saunders, B.C.(2009), Practical Organic Chemistry, Pearson Education.
- Dhingra, S; Ahluwalia V.K., (2017), Advanced Experimental Organic Chemistry, Manakin Press.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

BSc. In Industrial Chemistry
Multidisciplinary

DISCIPLINE SPECIFIC CORE COURSE (DSC-IC 1): INDUSTRIAL CHEMICALS AND ENVIRONMENT

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Industrial Chemicals and Environment, DSC- IC 1	**04**	**02**	**-**	**02**	Chemistry+Physics +Maths	**NA**

Industrial Chemicals and Environment, DSC- IC 1

Learning Objectives

The Learning Objectives of this course are as follows:

- The objective of this course is to teach the Chemistry of the general industrial separation and purification techniques.
- Production, uses and hazards associated with different industrial gases and chemicals.
- Air pollution, air pollutants, pollutants control procedures, greenhouse effect, global warming,
- Water pollution, water pollutants, industrial effluents and their treatment.
- Water quality parameters and water purification techniques.

Learning outcomes

The Learning Outcomes of this course are as follows:

By the end of the course, the students will be able to:

- Know the various separation and purification techniques used in industries like distillation, solvent extraction, absorption, adsorption etc.
- Know the production, uses and hazards of important gases like oxygen, helium, argon, hydrogen, acetylene, ammonia etc.

- Know the production, uses and hazards of important inorganic chemicals like hydrochloric acid, sulphuric acid, nitric acid, sodium hydroxide, potassium hydroxide etc.
- Learn about air pollution, air pollutants, their control procedure, global warming, ozone depletion, water pollution, water pollutants, effluents from different industries, their treatment, water quality parameters and water purification techniques like reverse osmosis, electrodialysis and ion exchange.

SYLLABUS OF DSC- IC-1

UNIT – I (06 Hours)
Unit 1: General industrial processes

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption

UNIT – II (12 Hours)
Unit 2: Industrial Gases and Inorganic Chemicals

(a) *Industrial Gases*: Production, uses and hazards in handling of the following gases: oxygen,
nitrogen, argon, neon, helium, hydrogen, acetylene, chlorine, fluorine and ammonia.
(b) *Inorganic Chemicals*: Production, uses and hazards in handling the following chemicals:
hydrochloric acid, nitric acid, sulphuric acid, sodium hydroxide, potassium hydroxide, bleaching
powder, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT – III (12 Hours)
Unit 3: Environment

(a) *Air Pollution*: Pollutants and their sources, pollution by SO2, CO, NOx. Methods of estimation of CO, NOx, SOx and their control procedures. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, Particulate matter and its types.
(b) *Water Quality Standards and Water pollution:* Water quality parameters like pH, alkalinity, DO, BOD, COD, chloride, sulphate, available chlorine etc. Water treatment and purification processes (reverse osmosis, electro dialysis, ion exchange). Pollutants and their sources. Effluent treatment (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: textile, tannery, dairy and petrochemicals and agrochemicals.

Practical component (60 Hours)
Practical
(Credits: 02, Laboratory periods: 60)
1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD).
3. Determination of Biological Oxygen Demand (BOD).

4. Measurement of chloride and sulphate ions of water samples by simple titration method. (With AgNO3 and potassium chromate).
5. Measurement of salinity of water samples by simple titration method. (With AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO32- , HCO3-) using double titration method.
7. Determination of Percentage of available chlorine in bleaching powder.
8. Isolation of compounds using solvent extraction method.

Essential/recommended readings

References (Theory):

1. Stocchi, E. (1990), **Industrial Chemistry**, Vol-I, Ellis Horwood Ltd. UK.
2. Kent, J. A. (ed.) (1997), **Riegel's Handbook of Industrial Chemistry**, CBS Publishers, New
Delhi.
3. Austin, G.T (2012), **Shreve's Chemical Process Industries**, Tata McGraw-Hill Education Private Limited.
4. Girard, J.E, (2011), **Principles of Environmental Chemistry**, Jones & Bartlett India Pvt. Limited.
5. Sodhi, G.S. ((2013), **Fundamental Concepts of Environmental Chemistry**, Narosa Publishing House.
6. Vermani, O.P; Narula, A.K. (2012), **Industrial Chemistry**, Galgotia Publishing Pvt. Limited.
7. Sharma, B.K. (2011), **Industrial Chemistry**, Goel Publishing House.
8. Pani, B. (2017), **Textbook of Environmental Chemistry**, I.K. International Publishing House.
9. De, A. K. (2015), **Environmental Chemistry**, New Age International Pvt, Ltd, New Delhi.10. Khopkar, S.M. (2012), **Environmental Pollution Analysis**, New Age International Publisher.

References (Practical):

1. Bassett,J.; Denney, R.C.; Jeffery, G.H.; Mendham, J.(1996) **Vogel Textbook of quantitative inorganic analysis**, 7th edition, ELBS edition.Prentice Hall Publications.
2. Furniss, B. S; Hannaford, A. J.; Smith, Peter W. G.; Tatchell, A. R; **Vogel's Text Book of Practical Organic Chemistry**, 5th Edition, Longman Scientific and Technical, Longman Group Ltd.
3. Mittal, K.; Chandra, L.(2013) **Experiments in organic chemistry**, Anne Books Pvt. Limited.
4. Gulati, S.; Sharma, J.L.; Manocha, S. (2017) **Practical Inorganic Chemistry**. CBS, Publications.
5. Rogers, A. (2015) **Laboratory Guide of Industrial chemistry**, Palala Press.

Suggestive readings (if any)

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-C 1):
Basic Concepts of Organic Chemistry

Credit distribution, Eligibility and Prerequisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Concepts of Organic Chemistry, DSC- C1	**04**	**02**	**-**	**02**	**NA**	**NA**

Basic Concepts of Organic Chemistry, DSC- C1

Learning Objectives

The Learning Objectives of this course are as follows:

- The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space. To establish the applications of these concepts, a study of diverse reactions through mechanisms is included.
- The constitution of the course strongly aids in the paramount learning of the basic concepts and their applications.

Learning outcomes

By the end of the course, the students will be able to:

- Understand and explain the differential behaviour of organic compounds based on fundamental concepts learnt.
- Understand the fundamental concepts of stereochemistry.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reactions and their mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.

SYLLABUS OF DSC- C 1

UNIT – I (6 Hours)
Unit 1: Fundamentals of organic chemistry

Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes.

Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)

UNIT – II (8 Hours)
Unit 2: Stereochemistry

Types of projection formulae: Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.
Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; *Cis-trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and *E*/*Z* nomenclature (for upto two C=C systems).
Conformational isomerism with respect to ethane, butane and cyclohexane.

UNIT – III (16 Hours)
Unit 3: Types of Organic Reactions (Including reactions of alkenes, alkyl and aryl halides, alcohols, aldehydes, ketones) Lectures: 18
Electrophilic addition reactions
Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration,
Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of
bromine (with stereochemistry).
Nucleophilic addition reactions
Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives
(Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard
reagent).
Elimination and Nucleophilic substitution reactions
Nucleophilic substitution reaction (SN1 and SN2) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction (E1 & E2), elimination *vs* substitution (*w.r.t.* potassium t-butoxide and KOH); Nucleophilic aromatic substitution in aryl
halides-elimination addition reaction *w.r.t.* chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions
Electrophilic substitution reactions
Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation :*o*-, *m*- and *p*- directive influence giving examples of toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene.
Reactive intermediates and Rearrangement Reactions
Free radicals (Birch Reduction); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); *Carbanions (*Michael Addition); *Carbenes* (Reimer Tiemann)

Practical component (60 Hours)

Practical

(Credits: 02, Laboratory periods: 60)

1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P.
2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
3. Detection of extra element
4. Preparations: (Mechanism of various reactions involved to be discussed).
    a. Bromination of phenol/aniline.
    b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
    c. Semicarbazone of aldehydes/ ketones
    d. Aldol condensation reaction using green method.
    e. Bromination of Stilbene.
    f. Acetanilide to p-Bromoacetanilide.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Essential/recommended readings

References (Theory):

1. Sykes, P.(2003), **A Guide Book to Mechanism in Organic Chemistry,** 6 th Edition Pearson Education.
2. Eliel, E. L. (2001), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Pearson Education.
4. Bahl, A; Bahl, B. S. (2019), **Advanced Organic Chemistry**, 22nd Edition, S. Chand.

References (Practical):

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.
3. Dhingra, S; Ahluwalia V.K., (2017), **Advanced Experimental Organic Chemistry**, Manakin Press.
4. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume I**, I K International Publishing House Pvt. Ltd., New Delhi.

DISCIPLINE SPECIFIC CORE COURSE – 3 (DSC-MP 1): Calculus

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Calculus, DSC-MP 1	**04**	**02**	**-**	**02**	**NA**	**NA**

Course Code: Mathematics DSC-MP 1
Course Title: Calculus

Learning Objectives

The Learning Objectives of this course are as follows:

Course Objectives: The primary objective of this course is to introduce the basic tools of calculus which are helpful in understanding their applications in many real-world problems. Students will be able to understand/create various mathematical models in everyday life.

Learning outcomes

The Learning Outcomes of this course are as follows:

This course will enable the students to:
i) Understand continuity and differentiability in terms of limits and graphs of certain functions.
ii) Describe asymptotic behaviour in terms of limits involving infinity.
iii) Use of derivatives to explore the behaviour of a given function locating and classify its extrema and graphing the function.
iv) Apply the concepts of asymptotes, and inflexion points in tracing of cartesian curves.
v) Compute the reduction formulae of standard transcendental functions with applications.

SYLLABUS OF DSC- MP 1

UNIT – I (10 Hours)
Unit 1: Limits, Continuity and Differentiability
Limit of a function, ε□–δ□definition of a limit, Infinite limits, Continuity and types of discontinuities; Differentiability of a function, Successive differentiation: Calculation of the *n*th derivatives, Leibnitz theorem; Partial differentiation, Euler's theorem on homogeneous functions.

UNIT – II (10 Hours)
Unit 2: Mean Value Theorems and its Applications
Rolle's theorem, Mean value theorems and applications to monotonic functions and inequalities; Taylor's theorem, Taylor's series, Maclaurin's series expansions of *ex* , sin *x*, cos *x*, log x□1□and□1□*x*□*m* ; Indeterminate forms.

UNIT – III (10 Hours)
Unit 3: Tracing of Curves and Reduction Formulae
Asymptotes (parallel to axes and oblique), Concavity and inflexion points, Singular points, Tangents at the origin and nature of singular points, Curve tracing (cartesian and polar equations). Reduction formulae for∫□sin*n x dx*,∫□cos*n x dx*, and ∫□sin*m x* cos*n x dx* and their applications.

Essential/recommended readings

References:

1. Prasad, Gorakh (2016). *Differential Calculus* (19th ed.). Pothishala Pvt. Ltd. Allahabad.
2. Prasad, Gorakh (2015). *Integral Calculus*. Pothishala Pvt. Ltd. Allahabad.

Additional Readings:

i. Apostol, T. M. (2007). *Calculus*: *One-Variable Calculus with An Introduction to Linear Algebra* (2nded.). Vol. 1. Wiley India Pvt. Ltd.
ii. Ross, Kenneth. A.(2013). *Elementary Analysis*: *The Theory of Calculus* (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian reprint.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

BSc. Life Sciences
Multidisciplinary

DISCIPLINE SPECIFIC CORE COURSE (DSC-1): Basic Concepts of Organic

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Concepts of Organic Chemistry	04	02	-	02	**12th Pass**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space.
- To establish the applications of these concepts, a study of diverse reactions through mechanisms is included.
- The constitution of the course strongly aids in the paramount learning of the basic concepts and their applications

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand and explain the differential behavior of organic compounds based on fundamental concepts learned.
- Understand the fundamental concepts of stereochemistry.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reactions and their mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.

SYLLABUS OF DSC-1

UNIT – I Fundamentals of organic chemistry (6 Hours)
Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes. Acidity and basicity in organic compounds (comparison of

carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)

UNIT – II Stereochemistry (6 Hours)

Types of projection formulae: Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.

Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; *Cis-trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and *E*/*Z* nomenclature (for upto two C=C systems).

Conformational isomerism with respect to ethane, butane and cyclohexane.

UNIT – III Types of Organic Reactions (Including reactions of alkenes, alkyl and aryl halides, alcohols, aldehydes, ketones) (18 Hours)

Electrophilic addition reactions

Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry).

Nucleophilic addition reactions

Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent).

Elimination and Nucleophilic substitution reactions

Nucleophilic substitution reaction (S_N1 and S_N2) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction (E1 & E2), elimination *vs* substitution (*w.r.t.* potassium t-butoxide and KOH); Nucleophilic aromatic substitution in aryl halides-elimination addition reaction *w.r.t.* chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions

Electrophilic substitution reactions

Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation :*o*-, *m*- and *p*- directive influence giving examples of toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene.

Reactive intermediates and Rearrangement Reactions

Free radicals (Birch Reduction); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); *Carbanions (*Michael Addition); *Carbenes* (Reimer-Tiemann).

Practical component (60 Hours)

1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P.
2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
3. Detection of extra element
4. Preparations: (Mechanism of various reactions involved to be discussed).

    a. Bromination of phenol/aniline.
    b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
    c. Semicarbazone of aldehydes/ ketones
    d. Aldol condensation reaction using green method.
    e. Bromination of Stilbene.
    f. Acetanilide to p-Bromoacetanilide.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Essential/recommended readings
Theory:

1. Sykes, P.(2003), **A Guide Book to Mechanism in Organic Chemistry,** 6th Edition Pearson Education.
2. Eliel, E. L. (2001), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Pearson Education.

Practical:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.
3. Dhingra, S; Ahluwalia V.K., (2017), **Advanced Experimental Organic Chemistry**, Manakin Press.

Suggestive readings

Theory:

1. Bahl, A; Bahl, B. S. (2019), **Advanced Organic Chemistry**, 22nd Edition, S. Chand.

Practical:

1. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume I**, I K International Publishing House Pvt. Ltd., New Delhi.

Note: Examination scheme and modes hall be as prescribed by the Examination Branch, University of Delhi, from time to time.

BSc. Physical Sciences

DISCIPLINE SPECIFIC CORE COURSE (DSC-1): Basic Concepts of Organic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Concepts of Organic Chemistry	04	02	-	02	**12th Pass**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space.
- To establish the applications of these concepts, a study of diverse reactions through mechanisms is included.
- The constitution of the course strongly aids in the paramount learning of the basic concepts and their applications

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand and explain the differential behavior of organic compounds based on fundamental concepts learned.
- Understand the fundamental concepts of stereochemistry.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reactions and their mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.

SYLLABUS OF DSC-1

UNIT – I Fundamentals of organic chemistry (6 Hours)

Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes.

Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)

UNIT – II Stereochemistry (6 Hours)

Types of projection formulae: Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.

Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; *Cis-trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and *E*/*Z* nomenclature (for upto two C=C systems).

Conformational isomerism with respect to ethane, butane and cyclohexane.

UNIT – III Types of Organic Reactions (Including reactions of alkenes, alkyl and aryl halides, alcohols, aldehydes, ketones) (18 Hours)

Electrophilic addition reactions

Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry).

Nucleophilic addition reactions

Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent).

Elimination and Nucleophilic substitution reactions

Nucleophilic substitution reaction (S_N1 and S_N2) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction (E1 & E2), elimination *vs* substitution (*w.r.t.* potassium t-butoxide and KOH); Nucleophilic aromatic substitution in aryl halides-elimination addition reaction *w.r.t.* chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions

Electrophilic substitution reactions

Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation :*o*-, *m*- and *p*- directive influence giving examples of toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene.

Reactive intermediates and Rearrangement Reactions

Free radicals (Birch Reduction); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); *Carbanions (*Michael Addition); *Carbenes* (Reimer-Tiemann).

Practical component (60 Hours)

1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P.
2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
3. Detection of extra element
4. Preparations: (Mechanism of various reactions involved to be discussed).
    a. Bromination of phenol/aniline.
    b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
    c. Semicarbazone of aldehydes/ ketones
    d. Aldol condensation reaction using green method.
    e. Bromination of Stilbene.
    f. Acetanilide to p-Bromoacetanilide.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Essential/recommended readings
Theory:

1. Sykes, P.(2003), **A Guide Book to Mechanism in Organic Chemistry,** 6th Edition Pearson Education.
2. Eliel, E. L. (2001), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Pearson Education.

Practical:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.
3. Dhingra, S; Ahluwalia V.K., (2017), **Advanced Experimental Organic Chemistry**, Manakin Press.

Suggestive readings
Theory:

1. Bahl, A; Bahl, B. S. (2019), **Advanced Organic Chemistry**, 22nd Edition, S. Chand.

Practical:

1. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume I**, I K International Publishing House Pvt. Ltd., New Delhi.

Note: Examination scheme and modes shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

OFFERED BY DEPARTMENT OF CHEMISTRY FOR ODD SEMESTER

GE 1: Chemistry: Atomic Structure and Chemical Bonding

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course titl e & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Atomic Structure and Chemical Bonding (GE-1)	4	2		2		Basic knowledge of Chemistry

Learning Objectives

The Learning Objectives of this course are as follows:

- To discuss the structure of atom as a necessary pre-requisite in understanding the nature of chemical bonding in compounds.
- To provide basic knowledge about ionic and covalent bonding.

Learning Outcomes

By the end of the course, the students will be able to:

- Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, and shapes of s, p, and d orbitals
- Understand the concept of lattice energy and solvation energy.
- Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).

SYLLABUS OF GE 1

Theory:

Unit – 1: Atomic Structure (14 Hours)

Review of: Bohr's theory and its limitations, Heisenberg uncertainty principle, Dual behaviour of matter and radiation, De-Broglie's relation, Hydrogen atom spectra, need of a new approach to atomic structure. Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom, radial

and angular parts of the hydrogen wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation), radial and angular nodes and their significance, radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and m_s. Shapes of s, p and d atomic orbitals, nodal planes, discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, electronic configurations of the atoms, stability of half-filled and completely filled orbitals, concept of exchange energy, relative energies of atomic orbitals, anomalous electronic configurations.

Unit – 2: Chemical Bonding and Molecular Structure (16 Hours)

Ionic Bonding: General characteristics of ionic bonding, energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds, statement of Born-Landé equation for calculation of lattice energy (no derivation), Born Haber cycle and its applications, covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules. Ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H_2O, NH_3, PCl_5, SF_6, ClF_3, SF_4) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for ss, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.

Practicals: (60 Hours)

(Laboratory Periods: 60)

1. Acid-Base Titrations: Principles of acid-base titrations to be discussed.

(i) Estimation of sodium carbonate using standardized HCl.
(ii) Estimation of carbonate and hydroxide present together in a mixture.
(iii) Estimation of carbonate and bicarbonate present together in a mixture.
(iv) Estimation of free alkali present in different soaps/detergents

2. Redox Titrations: Principles of oxidation-reduction titrations (electrode potentials) to be discussed.

(i) Estimation of oxalic acid by titrating it with $KMnO_4$.
(ii) Estimation of Mohr's salt by titrating it with $KMnO_4$.
(iii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iv) Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator (diphenylamine/ N-phenylanthranilic acid).

References:

Theory:

1. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India.
2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education.
3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, Oxford University Press.

Practicals:

- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

Additional Resources:

1. Wulfsberg, G (2002), **Inorganic Chemistry**, Viva Books Private Limited.
2. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

GE 3: Chemistry: Bioinorganic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Bioinorganic Chemistry (GE-3)	**4**	**2**		**2**		**Basic knowledge of Chemistry**

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce students to bioinorganic chemistry, currently a frontier area of chemistry providing an interface between organic chemistry, inorganic chemistry and biology.
- To make students learn about the importance of inorganic chemical species, especially metals, in biological systems, through discussions on topics such as the sodium-potassium pump, the applications of iron in physiology, including iron transport and storage system, role of magnesium in energy production and chlorophyll, toxicity of heavy metal ions and their antidotes.

Learning Outcomes

By the end of the course, the students will be able to:

- Classify metal ions in biological systems as essential, non-essential, trace & toxic.
- Diagrammatically explain the working of the sodium-potassium pump in organisms and the factors affecting it
- Understand the role of metal ions such as Mg, Ca and Fe in biological systems.
- Understand the toxicity of heavy metal ions (Hg, Pb, Cd and As) in the physiological system
- Explain the use of chelating agents in medicine

SYLLABUS OF GE-3

Theory:

Unit 1: Introduction (6 Hours)

A brief introduction to bio-inorganic chemistry. Metal ions present in biological systems and their classification on the basis of action (essential, non-essential, trace & toxic). Classification of metallobiomolecules (enzymes, transport and storage proteins and non-proteins). Brief idea about membrane transport, channels, pumps.

Unit 2:Role of s-block Elements in Biological System (8 Hours)

Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} and Ca^{2+} ions: Na/K pump; Ca pump, role of Mg^{2+} ions in energy production and chlor ophyll. Role of calcium in bone formation.

Unit 3:Role of iron in Biological System (8Hours)

Role of iron in oxygen transport and storage (haemoglobin and myoglobin), Perutz mechanism, Cooperative effect, Bohr effect, comparison of oxygen saturation curves of haemoglobin and myoglobin, carbon monoxide. Storage and transport of iron in humans (ferritin and transferrin).

Unit 4: Toxicity of Heavy Metal Ions (8 Hours)

Toxicity of heavy metal ions (Hg, Pb, Cd and As), reasons for toxicity and their antidotes

Practicals: (60 Hours)

WEEKS)

(Laboratory Periods: 60)

1. Spectrophotometric estimation:

(i) Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7/CoSO_4$ in a solution of unknown concentration

(ii) Spectrophotometric estimation of Fe^{2+} ions by using 1, 10- phenanthroline

(iii) Determination of the composition of the Fe^{3+} - salicylic acid complex in solution by Job's method.

2. Complexometric titrations using disodium salt of EDTA:

(i) Estimation of Zn^{2+} using EBT / Xylenol orange as indicator

(ii) Estimation of Mg^{2+}

(iii) Estimation of Ca^{2+} by substitution method

(iv) To estimate the concentration of Ca in commercially available medicines.

(v) To estimate the Mg present in multivitamins.

References:

Theory:

1. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education.
2. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry** 2nd Ed., Oxford University Press.
3. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. **Basic Inorganic Chemistry**, 3rd Edition,Wiley India.
4. Crichton, R.R. (2008), **Biological Inorganic Chemistry: An Introduction**. Amsterdam, Elsevier.
5. Kaim, W., B. Schwederski and A. Klein. (2014), **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life: An Introduction and Guide.** 2nd Edition, Wiley.

Practical:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

Additional Resources:

1. Lippard, S.J.; Berg, J.M. (1994), **Principles of Bioinorganic Chemistry**, Panima Publishing Company.
2. Greenwood, N.N.; Earnshaw, A. (1997), **Chemistry of the Elements**, 2nd Edition, Elsevier

GE 4: Chemistry: Basic Concepts of Organic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Basic Concepts of Organic Chemistry (GE-4)	4	2		2		

Learning Objectives

The Learning Objectives of this course are as follows:

- To teach the fundamentals of organic chemistry and the introduction of a new concept of visualizing the organic molecules in a three- dimensional space.
- To establish the applications of these concepts, different types of organic reactions are introduced.

Learning Outcomes

By the end of the course, the students will be able to:

- Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.
- Differentiate between various types of organic reactions possible on the basis of reaction conditions

SYLLABUS OF GE-4

Theory:

Unit 1: Basic Concepts (6 Hours)

Electronic displacements and their applications: Inductive, electromeric, resonance and mesomeric effects and hyperconjugation. Dipole moment, acidity and basicity.
Homolytic and heterolytic fissions with suitable examples. Types, shape and relative stability of carbocations, carbanions and free radicals. Electrophiles and nucleophiles
Concept of Aromaticity: Huckel's rule

Unit 2: Stereochemistry (10 Hours)

Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. specific rotation; Configuration and projection formulae: Newmann, Sawhorse, Fischer and their interconversion. Chirality in molecules with one and two stereocentres; meso configuration.
CIP rules: Erythro/Threo, D/L and R/S designations.
Geometrical isomerism: *cis-trans, syn-anti* and *E/Z* notations.

Unit 3: Types of Organic Reactions (14 Hours)

Introduction to substitution, addition, elimination, isomerization, rearrangement, oxidation and reduction reactions.
Free radical substitutions (Halogenation), concept of relative reactivity v/s selectivity. Free radical reactions in the biological reactions

Mechanisms of E1, E2, Saytzeff, Hoffmann eliminations and Cope elimination. Biological dehydration reactions

Electrophilic Additions reactions of alkenes and alkynes: mechanism with suitable examples, (Markownikoff/Antimarkownikoff addition), syn and anti-addition; addition of H_2, X_2, hydroboration-oxidation, ozonolysis, hydroxylation.

Nucleophilic substitution reactions – S_N1 and S_N2 mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution vs. elimination. Biological methylating agents

Electrophilic aromatic substitution: halogenation, nitration, sulphonation, Friedel Crafts alkylation/ acylation with their mechanism. Directing effects of groups in electrophilic substitution.

Practicals: (60 Hours)

(Laboratory Periods: 60)

1. Calibration of a thermometer and determination of the melting points of the organic compounds (Kjeldahl method, electrically heated melting point apparatus and BODMEL)
2. Purification of the organic compounds by crystallization using the following solvents:
3. a. Water b. Alcohol c. Alcohol-Water
4. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation, capillary method and BODMEL)
5. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and phenols (*β*-naphthol, salicylic acid) either by conventional or green method.
6. Bromination of acetanilide/aniline/phenol either by conventional or green method.
7. Nitration of chlorobenzene/nitrobenzene.

References:

Theory:

1. Sykes, P. (2005), **A Guide Book to Mechanism in Organic Chemistry**, Orient Longman.
2. Eliel, E. L. (2000), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. **Mehta B.; Mehta M. (2015),** Organic Chemistry**, PHI Learning Private Limited**
5. **Bahl, A; Bahl, B. S. (2012),** Advanced Organic Chemistry**, S. Chand.**

Practicals:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.

GE 7: Chemistry: States of Matter

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
States of Matter (GE-7)	4	2		2		

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students learn about the properties of ideal and real gases deviation from ideal behaviour, properties of liquid, types of solids with details about crystal structure.
- To make student learn about the reaction rate, order, activation energy and theories of reaction rates.

Learning Outcomes

By the end of the course, the students will be able to:

- Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal
- behaviour.
- Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases.
- Explain the properties of liquids especially surface tension and viscosity.
- Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl
- Define rate of reactions and the factors that affect the rates of reaction.
- Understand the concept of rate laws e.g., order, molecularity, half-life and their determination
- Learn about various theories of reaction rates and how these account for experimental observations.

SYLLABUS OF GE-7

Theory:

Unit 1: Kinetic Theory of Gases (12 Hours)

Postulates of kinetic theory of gases and derivation of the kinetic gas equation, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals

equation of state for real gases. Boyle temperature (derivation not required), critical phenomena, critical constants and their calculation from van der Waals equation, Andrews isotherms of CO_2, Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions, most probable, average and root mean square velocities (no derivation), collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules, viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Unit 2: Liquids State (6 Hours)

Surface tension and its determination using stalagmometer, Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer, effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents.

Unit 3: Solid State (12 Hours)

Forms of solids, symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of crystallography - law of constancy of interfacial angles. Law of rational indices, Miller indices. X–ray diffraction by crystals, Bragg's law and powder XRD. Powder diffraction patterns of NaCl, CsCl and KCl (qualitative treatment only), defects in crystals. Glasses and liquid crystals.

Practicals: (60 Hours)

(Laboratory periods: 60)

1. Surface tension measurement (use of organic solvents excluded): Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
2. Viscosity measurement (use of organic solvents excluded):

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald viscometer.
b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

3. Solid State: Powder XRD

c) Differentiate and classify the given set of the diffraction pattern as crystalline materials or amorphous (Glass) substance.
d) Carry out analysis of a given set of powder XRD and determine the type of the cubic crystal structure
e) Determination of approximate crystal size from a given set of powder XRD

References:

Theory:

1. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkin's Inorganic Chemistry**, Oxford.
2. Miessler, G. L.; Tarr, D.A. (2014), **Inorganic Chemistry**, Pearson.
3. Castellan, G. W. (2004), **Physical Chemistry**, Narosa.

4. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol.1, 6th Edition, McGraw Hill Education.
5. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol.5, 3rd Edition, McGraw Hill Education.

Practicals:

1. Khosla, B.D.; Garg, V.C.;Gulati, A.(2015),**Senior Practical Physical Chemistry**, R. Chand & Co.

GE 9: Chemistry: Conductance and Electrochemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Conductance and Electrochemistry (GE-9)	4	2		2		Basic knowledge of Chemistry

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students learn about conductance, its measurement and applications.
- To make students learn the principles of electrochemical cells: Electrolytic and Galvanic cell, measurement of, measurement of emf and its applications.

Learning outcomes

By the end of the course, the students will be able to:

- Explain the factors that affect conductance, migration of ions and application of conductance measurement.
- Understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.
- Understand applications of Emf measurements in relation to determination of activity coefficients, pH of a solution and Potentiometric titrations.

SYLLABUS OF GE-9

Theory:

Unit 1: Conductance **(10 Hours)**

Quantitative aspects of Faraday's laws of electrolysis. Arrhenius theory of electrolytic dissociation. Conductivity: equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, Kohlrausch Law of independent migration of ions. Wein Effect and Debye–Falkanhegan Effect.

Transference number and its experimental determination using Hittorf and moving boundary methods, Ionic mobility, applications of conductance measurements: determination of degree of ionization of weak electrolytes, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Unit 2: Electrochemistry (20 Hours)

Reversible and irreversible cells with Examples, concept of EMF of a cell, measurement of EMF of a cell, Nernst equation and its importance, types of electrodes, standard electrode potential (reduction Potential) and its application to Gas–ion half-cell. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference, liquid junction potential; determination of activity coefficients and salt bridge, pH determination using hydrogen electrode. Potentiometric titrations-qualitative treatment (acid-base and oxidation-reduction only).

Practicals: (60 Hours)

(Laboratory periods: 60)

1. Conductance

(i) Determination of cell constant.

(ii) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

(iii) Perform the following conductometric titrations:

a) Strong acid vs strong base

b) Weak acid vs strong base.

2. Potentiometry

Perform the potentiometric titrations of (i) Strong acid vs strong base, (ii) Weak acid vs strong base and (iii) Mohr's salt vs $KMnO_4$.

References:

Theory:

1. Castellan, G.W. (2004), **Physical Chemistry**, Narosa.
2. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**,Vol 1, 6th Edition, McGraw Hill Education.
3. Kapoor, K.L. (2013), **A Textbook of Physical Chemistry**,Vol 3, 3rd Edition, McGraw Hill Education.

Practicals:

1. Khosla, B.D.; Garg, V.C.;Gulati, A.(2015), **Senior Practical Physical Chemistry**, R. Chand & Co.

GE 11: Chemistry: Chemistry of Food Nutrients

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Chemistry of Food Nutrients (GE-11)	4	2		2		

Learning Objectives

The Learning Objective of this course is as follows:

- To help the students develop a basic understanding of the components of food, their source, properties and interactions as well as changes that occur during processing, storage, and utilization.

Learning Outcomes

On completion of the course, the student will be able to:

- Build a strong understanding of chemistry of food: composition of food, role of each component.
- Understand some of the reactions and changes in individual food components which occur during processing, handling and storage

SYLLABUS OF GE-11

Theory:

Unit 1: Carbohydrates (6 Hours)

Introduction, sources, functions, classification: monosaccharide, oligosaccharide and polysaccharide, structure and importance of polysaccharides in food chemistry (pectin, cellulose, starch, gums), chemical reactions of sugar: mutarotation, caramelisation; non enzymic browning and its prevention, role of carbohydrates as sweeteners in food.

Unit 2: Lipids (8 Hours)

Introduction, sources, classification (fatty acids, phospholipids, fats & oils, waxes), common fatty acids present in oils and fats, Omega- 3&6 fatty acids, trans fats, chemical properties- Reichert Meissel value, Polenski value, iodine value, peroxide value, saponification value,

effect of frying on fats, changes in fats and oils- rancidity, lipolysis, flavor reversion, auto-oxidation and its prevention.

Unit 3: Proteins (8 Hours)

Introduction, sources, classification (simple, conjugated, derived), structure of protein (primary, secondary and tertiary), physico-chemical & functional properties of proteins, protein denaturation.

Unit 4: Vitamins & Minerals (8 Hours)

Vitamins: Introduction, classification: fat-soluble vitamins & water-soluble vitamins**.**

Minerals: Introduction, classification: macrominerals (Ca, P, Mg) & microminerals (Se, Fe, I, Co, Zn, Cu, Se, Cr).
Physiological importance of vitamins and minerals, effect of food processing on vitamins and minerals.

Practicals: (60 Hours)

(Laboratory periods: 60)

1. Determination of moisture in food products by hot air oven-drying method.
2. Colorimetric determination of Iron in vitamin / dietary tablets.
4. 2, 6-Dichlorophenol indophenol method for estimation of vitamin C in a given solution/ lemon Juice/chillies.
5. Estimation of total soluble sugar content by ferricyanide method (volumetric analysis).
6. Determination of saponification value of the given fat/oil.
7. Determination of iodine value of the given fat/oil.
8. Qualitative tests for proteins and carbohydrates.
9. Qualitative estimation of cholesterol by Liebermann Burchard method.

References:

Theory:

1. deMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), **Principles o f F ood Chemistry**, 4th Edition, Springer.
2. Msagati, T.A.M. (2013), **Chemistry of F ood A dditives an d P reservatives**, Wiley-Blackwell.
3. Fennema, O.R. (2017), **Food Chemistry**, 5th Edition, CRC Press.
4. Attokaran, M. (2017), **Natural Food Flavors an d C olorants**, 2nd Ed., Wiley-Blackwell.
5. Potter, N.N., Hotchkiss, J.H, (1995) **Food Science,** 5th Ed., Chapman & Hall.

6. Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), **Food Additives**, 2nd Edition, CRC Press.
7. Coultate, T. (2016), **Food: T he C hemistry o f i ts C omponents**, 6th Edn., Royal Society of Chemistry.
8. Belitz, H. D.; Grosch, W. (2009), **Food Chemistry**, Springer.
10. Course: FOOD CHEMISTRY (iasri.res.in)

Practical:

1. Ranganna, S. (2017). **Handbook of an alysis a nd q uality c ontrol f or f ruits an d vegetable products**, 2nd Edn., McGraw Hill Education
2. Sawhney, S.K., Singh, R. (2001), **Introductory P ractical B iochemistry**, Narosa Publishing House

GE 12: Chemistry: Statistical Methods and Data Analysis

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of th e course
		Lecture	Tutorial	Practical/ Practice		
Chemistry: Statistical Methods and Data Analysis (GE-12)	**4**	**2**		**2**		

Learning Objectives

The Learning Objectives of this course are as follows:

- To give the students insight about the statistical treatment on the chemical analysis data along with illustration about the analysis of collected analytical data that will help them to take up a job of technician, scientist and laboratory manager.
- To explain the presentation of data in different form such as “Table, Graph, Bar Diagram, Pie Chart, Venn diagram” along with their reliability and validity.

Learning Outcomes

At the end of this course student will be:

- Familiar with interpretation and use of analytical data collected by different techniques, significance of different analytical techniques and their applications, reliability and presentation of data for reporting to different forum.

SYLLABUS OF GE-12

Theory:

Unit 1: Basics of Chemical Analysis (4 Hours)

Analytical Chemistry, Qualitative and quantitative analysis, Analytical methodology. Calibration of glass wares, recording laboratory data.

Unit 2: Different Methods of Chemical Analysis (8 Hours)

Titrimetric method: volumetric titremetry, standard solution, titrimetric curve, calculation; Gravimetric method: precipitation gravimetry, calculation and applications of gravimetry; and Spectrometric methods: introduction, principle and instrument, working quantitative aspects absorbance, applications in chemical analysis

Unit 3: Statistical Method of Chemical Analysis (8 Hours)

Accuracy and Precision, Comparison of precision, Errors, Distribution of random errors, propagation of errors, measurement of errors, significant figure, inter laboratory error, methods of least square analysis of variance, Q test, Z test, T test, statistical treatment of finite sample, recommendations for treating outliers. Minimising errors in analytical procedure.

Unit 4: Data Analysis and Validation (4 Hours)

Confidence interval, Testing of hypothesis, plotting of data, least square method, Figures of merit: sensitivity, detection limit, linear dynamic range, control test, upper control limit and lower control limit, Validation, reporting analytical results and significant figures

Unit 5: Sampling, Standardisation, Labelling and Calibration (6 Hours)

Analytical samples, sample size, constituent sample, real samples, sample, sample handling, preparing laboratory samples, automated sample handling, lab on chip and General laboratory principles, recording laboratory data, standards, comparison of standards, internal standard, external standards calibration, least square method, and multivariant calibration.

Practicals: (60 Hours)

(Laboratory periods: 60)

1. Calibrate the volume of laboratory glass wares i.e. volumetric flask, beaker, burette and calibration constant.
2. Demonstrate the good laboratory practices like effect of dilution, temperature, taking observation, personal and apparatus safety.
3. Determine the quantitative presence of heavy metals like copper, chromium and iron in natural and laboratory samples using volumetric and gravimetric titration.
4. Determine the presence of magnesium ion in heavy water by EDTA method and prepare calibration curve.
5. Evaluate the absolute and method errors in a set of data collected during determination of nitrogen in an organic compound.
6. Calculate the standard deviation and predict precision of analytical results.

7. Determine the concentration of pollutant in natural sample after using external standards methods.
8. Compare the inter laboratory error of a spectroscopic results.
9. Evaluate the limit of detection for colorimetric analysis of dyes and coloured metals in wastes water samples.
10. Demonstrate the control of interference by masking by complexation.
11. Report the ten analytic results in significant numbers along with standard deviation.
12. Determine the confidence limit and interval for a laboratory instrument like breath alcohol analyser
13. Demonstrate the internal standard method for calibration of metal estimation.
14. Estimate the comparative effectiveness of different types of graphs like line, pi chart and bar graph.
15. Demonstrate the working of lab on chip like glucose sensor.

References:

1. Dey, R. A. and Underwood, A. L., **Quantitative Analysis**, 6th Edition, Pearson.
2. Skoog, D. A., West, D. M., Holler, F. J., Crouch, S. R., **Fundamental an alytical chemistry**, Thomson Asia Ltd.
3. Encyclopaedia of analytical chemistry: Applications, Theory, and Instrumentation, R A Meyor (Eds) Wiley and Sons (2000).

GE 13: Chemistry: Medicines in Daily Life

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Medicines in Daily Life (GE-13)	**4**	**2**		**2**		

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students study the basic details about various medicines of general uses, which are crucial for the various diseases.
- To make students learn about the active pharmaceutical ingredient in some medicines, their synthesis; therapeutic effect and side effects on human physiology.

- To make students aware about the positive and negative effects of medicines those are essential for a healthy day-to-day life.

Learning Outcomes

By the end of the course, the students will be able to:

- Understand the role of different medicines on human physiology.
- Gain the knowledge of active pharmaceutical ingredient and their roles in different disease.
- Learn the proper use of different medicines and their effect and side effects.
- Learn the techniques of administering blood group, pulse rate, blood pressure and may other general diagnostic applications.

SYLLABUS OF GE-13

Theory:

Unit 1: General Introduction (8 Hours)

Introduction-Health, disease, drugs, chemotherapy, approaches in drug designing, classification of drugs and their origin.

Unit 2: Different class of medicines (22 Hours)

Structure of active ingredients, uses, dosage, side effects and their natural remedies:
Analgesics and antipyretics- Aspirin, paracetamol, ibuprofen, morphine, codeine
Antibiotics- Amoxicillin, norfloxacin, ciprofloxacin
Antihistamines or antiallergics- Cetrizine and Levocetrizine (role of stereoisomers)
Antiparasitic- Albendazole
Antidiabetics- Insulin, Glipizide and metformin
Antihypertensive – Amlodipine and its natural remedies- Rauwolfia.
Diuretic- Lasix
Antidepressant-Zoloft and its natural treatment
Antifungal – fluconazole, Itraconazole
Antacids- Ideal properties of antacids, combinations of antacids, Sodium 40 Bicarbonate, rantidine, milk of magnesia, aluminium hydroxide gel
Anticoagulants/antiplatelet drugs- Warfarin, heparin and Ecosprin
Anaesthetics- Atracurium, Desflurane
Poison and Antidote: Sodium thiosulphate, Activated charcoal, Sodium nitrite
Astringents: Zinc Sulphate, Potash Alum
Supplements- zinc and calcium, vitamins
Synthesis of small molecule drugs like aspirin and paracetamol

Practicals: (60 Hours)

(Laboratory periods: 60)

1. Determination of heart rate and pulse rate, blood pressure and discussion on medicines affecting them.
2. Identification test- Magnesium hydroxide, Sodium bicarbonate, Calcium gluconate.

3. Preparation of inorganic pharmaceuticals- Boric acid Potash alum
4. Determination of sugar content in the given solution.
5. Estimation of zinc and calcium in a given solution.
6. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose).
7. Qualitative tests for Proteins
8. Qualitative analysis of vitamin C.
9. Isolation of paracetamol (API) from a commercial tablet
10. Isolation of aspirin (API) from tablet and recording of melting point (synthesis needs discussion)

References:

Theory:

1. Patrick, G. L. (2001) **Introduction t o Med icinal C hemistry**, Oxford University Press.
2. Lemke, T. L. & William, D. A. (2002), **Foye's Principles of Medicinal Chemistry**, 5th Ed., USA,
3. Singh H.; Kapoor V.K. (1996), **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan.
4. Chatwal, G.R. (2010), **Pharmaceutical ch emistry**, inorganic (vol. 1), Himalayan publishing house
5. https://go.drugbank.com./

Practicals:

1. Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C. (1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.
2. Ahluwalia, V.K., Dhingra, S. (2004), **Comprehensive Practical Organic Chemistry: Qualitative Analysis**, University Press.
3. Munwar, S., Ammaji, S.(2019), **Comprehensive Practical Manual of Pharmaceutical Chemistry,** Educreation Publishing.
4. Mondal, P., Mondal, S.(2019), **Handbook of Practical Pharmaceutical Organic, Inorganic and Medicinal chemistry**, Educreation Publishing.

GE 15: Chemistry and Society

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Chemistry and Society (GE-15)	**4**	**2**		**2**		

Learning Objectives

The Learning Objectives of this course are as follows:

- To expand the literacy of chemistry, and increase general awareness, background of chemistry and its importance among the non-chemistry student even arts as well as commerce.
- To make a common student understand the importance and role of chemistry in development of civilization, societal issues related to chemistry and their expected solutions.

Learning Outcomes

At the end of this course the student will be able to:

- Increase the literacy of chemistry even in non-science students
- Understand the basic concept, principle and importance of chemistry
- Realize the importance of chemistry in daily life and future requirement

SYLLABUS OF GE-15

Theory:

Unit 1: Basics of chemistry (4 Hours)

Periodic table, Atom and molecules, chemical bonding, properties and chemical reactions with simple examples and illustration.

Unit 2: Chemistry in Heritage (8 Hours)

Extraction and uses of metals like iron and stone in ancient times, metals in ornaments, medicines, weapons and chemistry for preservatives, basics of preservation and few examples of preservatives.

Unit 3: Chemistry in Life (10 Hours)

Edible and non- edible molecules, biochemistry of foods and medicine with examples: Aspirin, Paracetamol. Ibuprofen and Penicillin, Cephalosporin, Chemistry for industry: Artificial sweeteners, Soaps and detergents and cosmetics, Polymer and Plastics: Uses and environmental issues.

Unit 4: Chemical pollution and Toxicity (2 Hours)

Chemical source of water, air and soil pollution, biomagnification and metal toxicity with example and illustrations. monitoring of air pollution.

Unit 5: Testing of chemicals (2 Hours)

Flame test, solubility test, qualitative and quantitative identification of ions in natural samples like metal copper, iron and chromium ores and adulterant in foods.

Unit 6: Future of chemistry (4 Hours)

Basics of green chemistry, Reuse and recycling of by-products, zero waste chemistry and Alternate fuel and energy providing chemicals: biodiesel, natural gas and hydrogen.

Practicals/Hands-on Training: **(60 Hours)**

(Laboratory periods: 60)

1. Determine the calcium and magnesium contents in water samples using EDTA methods.
2. Determine the organic contents and pH of soil sample.
3. Estimate the food adulterants in edible items
4. Quantify the presence metals by flame test method
5. Demonstrate the conversion of PET into bottle into value added products.
6. Determine the quantitative presence of heavy metals like copper and chromium in natural sample like ore.
7. Demonstrate the exothermic and endothermic reaction in laboratory
8. Preparation aspirin and paracetamol as well as identify.
9. Compare the fuel efficiency of biodiesel and petrol.
10. Preparation of representative compound using microwave
11. Demonstrate the biodegradability of natural and synthetic plastics.
12. Demonstrate the protection of rusting of iron after surface spray coating.
13. Estimate the protein contents in edible samples using chemical methods.
14. Small working project on heritage chemistry like bio compatibility of metals and medicinal importance of metals like iron, gold and silver.

References:

1. Lee, J. D., **Concise Inorganic Chemistry**, Wiley India Pvt. Ltd.
2. Sharma, B. K., **Industrial chemistry**, Goel Publishing House, India
3. Christian, Gary D., Dasgupta, Purnendu K., Schug, Kevin A., **Analytical chemistry**, Wiley
4. V. Subramanian, **A text book of Environmental chemistry**, Wiley

GE 19: Radio-chemistry in Energy, Medicine and Environment

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Radio-chemistry in Energy, Medicine and Environment (GE-19)	**4**	**3**		**1**		

Learning Objectives

The Learning Objectives of this course is as follows:

- To give an introduction to nuclear and radiochemical concepts to the students.
- To help students gain fundamental knowledge about the radioisotopes and their real-world applications in medicine, diagnostic techniques, energy, research and environment.

Learning Outcomes

By the end of the course, the students will:

- Learn about radioisotopes, radioactive decay
- Use of radiochemistry in various fields
- Effect of radiations on health
- Learn about nuclear energy and nuclear pollution

SYLLABUS OF GE-19

Theory:

Unit 1: Introduction (9 Hours)

Atoms, composition of nucleus, mass number, isotopes, nuclear stability, radioactive decay, radioactivity in nature: natural and artificial radioisotopes, elementary particles, radioactive decay (α, β and γ decay), half-life period, types of nuclear reactions: nuclear fission and nuclear fusion.

Unit 2: Nuclear power generation (6 Hours)

Nuclear Power generation from uranium ore (energy production and nuclear waste), introduction to nuclear reactors for energy and nuclear weapons

Unit 3: Applications of radiochemistry (15 Hours)

C 14 decay and radioactive dating, irradiation of food, radiotracers for studying chemical reactions (photosynthesis, metabolic studies of drugs, metabolism of organisms, fundamental properties of genetic material), medicinal application of radio chemicals in radiotherapy (use in cancer, hyperthyroidism, blood disorders), radio-pharmaceuticals, diagnostic procedures: CT, PET

Unit 4: Environment radioactivity (6 Hours)

Natural radioactivity, natural process that release radioactive material in environment, man-made events like Chernobyl disaster, bomb test, use of radiotracers in environmental studies.

Unit 5: Nuclear pollution and safety management (9 Hours)

Radiation protection standards, basics of radiation hazards, international guidelines on radiation protection, disposal of nuclear waste, nuclear disaster and it's managements, Effect of radiation on health: Biological effects of radiation, radiation monitors, dose limits for workers and public,

Practicals: **(30 Hours)**

(Laboratory periods: 30)

1. Study the background radiation in different places and identify the probable source. (Data to be provided).
2. Survey the diagnostic procedures involving radio-chemistry in different diagnostic laboratories.
3. Write a report on the radio isotopes used in various diagnostic procedures.
4. Write a report on safety measures taken in diagnostic labs.
5. Write a report on any two nuclear and radiation accidents focusing on their impact on human life, environment and economy.

References:

1. Nuclear and radiochemistry, Konya J., Nagy N. 2nd Edition, Elsevier
2. Radiochemistry and Nuclear Chemistry, 4th Edition, Choppin G., Lilijenzin J-O, Rydberg J., Ekberg C. Elsevier.

GE 21: Chemistry in Indology and Physical & Mental Well Being

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits		Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
			Lecture	Tutorial	Practical/ Practice		
Chemistry in Indology and Physical & Mental Well Being (GE-21)	4		3		1		

Learning Objectives

The Learning Objectives of this course is as follows:

- To illuminate the students about the scientific basis and approaches related to the practices that promote physical and mental health/balance, that includes meditation,

sports, Yoga and nutrition. The chemical/biochemical mechanisms that underscore the various states of the mind and body, which drives the general homeostasis or anomalies thereof, shall also be illustrated.

- To make students aware about role of metals in ancient and medieval India
- To make students aware of how Alchemists used metals, chemicals, compounds and ores in medicines
- To make students aware of the different types of instruments used in the ancient and medieval India
- To make students aware of the life and work of ancient and medieval scientists/chemists.

Learning Outcomes:

By the end of the course, the students will:

- Understand about the scientific basis and approaches that promote physical and mental health.
- Know about the chemical/biochemical mechanisms that underline the states of the mind and body
- Understand the role of metals in ancient and medieval India
- Understand how alchemists used metals and chemical compounds in medicines
- Know about the life and contributions of ancient scientists and chemists

SYLLABUS OF GE-21

Theory:

Unit 1: Physical Health Practices (9 Hours)

Principles of Physical Education, Body composition with respect to health and fitness and different methods of body composition analysis, Calculation of energy expenditure (at rest and during exercise), VO_2 and calculation of VO_2 max, respiratory exchange ratio, blood pressure, Means of fitness development- aerobic and anaerobic exercises, yoga and physical fitness, Exercises and their intensities related to heart rate zone, Different fitness levels for different age groups and gender, Kinesiology, Physiology of Exercise

Unit 2: Mind-body Practices (6 Hours)

States of mind and types of brain waves, mindfulness meditation in clinical psychology and psychiatry, Desbordes' recent studies on brain activities (Harvard's studies), MRI & functional MRI studies.

Types of meditations- focused attention meditation (FA), open monitoring meditation (OM), transcendental meditation (TM), loving–kindness meditation (LKM), mindfulness meditation (MM) and body–mind meditation (B-M).
Biochemical alterations, such as changes in activity/production of hormones, cytokines, chemokines, interferons, etc., oxygen saturation/desaturation, redox-condition and oxidative balance, progression/regression of certain diseases/health conditions, in response to various states of physical and mental well-being.

Unit 3: Nutrition for Mind/body Homeostasis (6 Hours)

Role of nutrition in physical and mental health. Nutrients: carbohydrates, Protein, Fat, Vitamins, Minerals, Water-their functions, role of hydration (water balance) during exercise, daily caloric requirement and expenditure.
Metabolism: An overview of ATP release in glycolysis, TCA cycle, electron transport chain. basic concept of balanced diet vs. fad diet (Atkins, ketogenic etc.), Concept of BMI (Body mass index) and BMR (Basal metabolic rate), Obesity and its hazard, Dieting versus exercise for weight control.

Unit 4: Concepts of Atoms, Molecules and Laws of Motion (3 Hours)

Concepts of atoms and molecules, properties and categories of atoms and molecules, Laws of motion.

Unit 5: Metallurgy (6 Hours)

Gold, Silver, Copper, Bronze and other alloys; Copper smelting blast furnace and copper extraction; Tron and Steel; Iron smelting blast furnaces from Southern India; Ironworks in Ancient and medieval India; Delhi Iron Pillar; Dhar and Kodachadri Iron pillars; Wootz steel; Zinc and its extraction.

Unit 6: Chemicals (3 Hours)

Drugs, dyes, pigments, glass, cosmetics and perfumes, etc.

Unit 7: Drugs (6 Hours)

Eight categories of Gandhasara; Compounds of mercury (Hg) made and used by the Indian Alchemists for medicinal purposes; Use of chemical, compounds and ores in medicines.

Unit 8: Life and work of Ancient Indian Scientists/Chemists (6 Hours)

(i) Maharshi Kanada (Ancient text and manuscripts), (ii) Nagarjuna (Ras Ratnakar, Kakshaputtantra, Arogya Manjari, Yog Saar, Yoasthak), (iii) Vaagbhatt (Rasratna Samuchchay), (iv) Govindacharya (Rasarnava), (v) Yashodhar (Ras Prakash Sudhakar), (vi) Ramachandra (Rasendra Chintamani), (vii) Somdev (Rasendra Chudamani)

Practicals: (30 Hours)

(Laboratory periods: 30)

1. Extraction of essential oil from rose petal.
2. Extraction of casein from milk.
3. Determination of pulse rate/blood pressure/oxygen saturation before and after exercise.
4. Determination of acid value of given oil sample.
5. Isolation of piperine from black pepper.
6. Determination of Copper in a brass turnings.
7. Extraction of Butea monosperma (Palash) dye for its use in coloration of cloth.
8. Determination of mass loss in mild steel in acidic/basic media.
9. **Project on (Do any one):**
   Ayurveda as alternate medicine system,
   Homeopathy in India,
   Yogic Practices for mental wellness
   Ancient Chemists of India
   Other titles can also be suggested by the teacher.
10. **Visit to**
    Iron Pillar, the metallurgical marvel and prepare a brief report.
    Industries like Dabur India Ltd.

References:

1. Baer cites Kabat-Zinn, J. (1994): **Wherever you go, there you are: Mindfulness meditation in everyday life.** New York: Hyperion, p.4.
2. Buchholz L (October 2015). "**Exploring the Promise of Mindfulness as Medicine**". JAMA. 314 (13): 1327–1329. doi:10.1001/jama.2015.7023. PMID 26441167.
3. Harrington A, Dunne JD (October 2015). "**When mindfulness is therapy: Ethical qualms, historical perspectives**". The American Psychologist. 70 (7): 621–631. doi:10.1037/a0039460. PMID 26436312.
4. Blanck P, Perleth S, Heidenreich T, Kröger P, Ditzen B, Bents H, Mander J (March 2018). "**Effects of mindfulness exercises as stand-alone intervention on symptoms of anxiety and depression: Systematic review and meta-analysis**". Behaviour Research and Therapy. 102: 25–35. doi:10.1007/s12671-014-0379-y. PMID 29291584.
5. Khoury B, Sharma M, Rush SE, Fournier C (June 2015). "**Mindfulness-based stress reduction for healthy individuals: A meta-analysis**". Journal of Psychosomatic Research. 78 (6): 519–528. doi:10.1016/j.jpsychores.2015.03.009. PMID 25818837.
6. Jain FA, Walsh RN, Eisendrath SJ, Christensen S, Rael Cahn B (2015). "**Critical analysis of the efficacy of meditation therapies for acute and subacute phase treatment of depressive disorders: a systematic review**". Psychosomatics. 56 (2): 140–152. doi:10.1016/j.psym.2014.10.007. PMC 4383597. PMID 25591492.
7. Reangsing C, Punsuwun S, Schneider JK (March 2021). "**Effects of mindfulness interventions on depressive symptoms in adolescents: A meta-analysis**". International Journal of Nursing Studies. 115: 103848. doi:10.1016/j.ijnurstu.2020.103848. PMID 33383273. S2CID 229940390.

8. Sharma M, Rush SE (October 2014). "**Mindfulness-based stress reduction as a stress management intervention for healthy individuals: a systematic review**". Journal of Evidence-Based Complementary & Alternative Medicine. 19 (4): 271–286. doi:10.1177/2156587214543143. PMID 25053754.
9. Hofmann SG, Sawyer AT, Witt AA, Oh D (April 2010). "**The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review**". Journal of Consulting and Clinical Psychology. 78 (2): 169–183. doi:10.1037/a0018555. PMC 2848393. PMID 20350028.
10. Chiesa A, Serretti A (April 2014). "**Are mindfulness-based interventions effective for substance use disorders? A systematic review of the evidence**". Substance Use & Misuse. 49 (5): 492–512. doi:10.3109/10826084.2013.770027. PMID 23461667. S2CID 34990668.
11. Garland EL, Froeliger B, Howard MO (January 2014). "**Mindfulness training targets neurocognitive mechanisms of addiction at the attention-appraisal emotion interface**". Frontiers in Psychiatry. 4: 173. doi:10.3389/fpsyt.2013.00173. PMC 3887509. PMID 24454293.
12. Sancho M, De Gracia M, Rodríguez RC, Mallorquí-Bagué N, Sánchez-González J, Trujols J, et al. (2018). "**Mindfulness-Based Interventions for the Treatment of Substance and Behavioral Addictions: A Systematic Review**". Frontiers in Psychiatry. 9 (95): 95. doi:10.3389/fpsyt.2018.00095. PMC 5884944. PMID 29651257.
13. Paulus MP (January 2016). "**Neural Basis of Mindfulness Interventions that Moderate the Impact of Stress on the Brain**". Neuropsychopharmacology. 41 (1): 373. doi:10.1038/npp.2015.239. PMC 4677133. PMID 26657952.
14. Dunning DL, Griffiths K, Kuyken W, Crane C, Foulkes L, Parker J, Dalgleish T (March 2019). "**Research Review: The effects of mindfulness-based interventions on cognition and mental health in children and adolescents - a meta-analysis of randomized controlled trials**". Journal of Child Psychology and Psychiatry, and Allied Disciplines. 60 (3): 244–258. doi:10.1111/jcpp.12980. PMC 6546608. PMID 30345511.
15. Sharman, J. R. (1964). **Introduction to physical education**. New York: A.S. Barnes & Co.
16. William, J. F. (1964). **The principles of physical education. Philadelphia**: W.B. Saunders Co
17. Bucher, C. A. (n.d.) **Foundation of physical education.** St. Louis: The C.V. Mosby Co.
18. Sharkey, B. J. (1990). **Physiology of fitness**, Human Kinetics Book
19. Giam, C.K & The, K.C. (1994). **Sport medicine exercise and fitness**. Singapore: P.G. Medical Book.
20. Kenney, W.L., Wilmore, J.H., Costill, D.L. (six edition) **Physiology of sport and exercise.**
21. Vedas: (i) Rig Veda, (ii) Yajur Veda, (iii) Atharva Veda, (iv) Sama Veda
22. Deb, B. M., **The Peacock in Splendour**, Visva Bharti University.
23. Ray, P. C., **A History of Hindu Chemistry: from the Earliest Times to the Middle of the Sixteenth Century A.D.**, Volume 1 – 1902, Volume 2 – 1908, The Bengal Chemical and Pharmaceutical Works Ltd

24. "**History of Chemistry in Ancient and Mideaval India**" (Edited volume of Acharya Ray's "History of Hindu Chemistry"), Indian Chemical Society, Calcutta, 1956.
25. Harsha, N. M., Nagaraja, T. N., **The History of Hindu Chemistry**, Ancient Science of Life, 2010, 30, 58 – 61.
26. Ray, P. C., **Life and experiences of a Bengali chemist,** Two Volume Set. Calcutta: Chuckervertty, Chatterjee & Co. 1932 and 1935.
27. Ray, P. R., **Chemistry in Ancient India**, Journal of Chemical Education, 1948, 25 (6), 327.
28. Seal, B. N.(1915), **The Positive Sciences of the Ancient Hindus**, Longman Greens and Co., Kolkata.

BHASKARACHARYA COLLEGE OF APPLIED SCIENCE
B.Sc. (HONOURS) POLYMER SCIENCE

Category I

DISCIPLINE SPECIFIC CORE COURSE -1 (DSC-1) – : INTRODUCTION TO POLYMER SCIENCE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
INTRODUCTION TO POLYMER SCIENCE	4	3	0	1	PCM	PCM

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize with the structure of polymers.
- To acquaint students with knowledge of molecular weight determination and polymersolubility.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand physical state of polymers
- Develop fundamental knowledge of thermal transitions of temperature
- Understand structure-property relationship of polymers
- Apply mathematical formulae to depict polymer solution properties

SYLLABUS OF DSC-1
UNIT – I (9 hours)

INTRODUCTION TO POLYMER SCIENCES

Introduction and history of polymeric materials, classification of polymers, configuration and conformation of polymers, nature of molecular interaction in polymers, cumulative interaction, entanglement, random chain model and RMS end-to-end distance, Various structures of copolymers such as linear branched and cross-linked copolymers and their types.

UNIT – II (6 hours)
POLYMER CRYSTALS

Crystal morphologies, extended chain crystals, chain folding, lamellae, spherulites, crystallization, crystallinity, crystallizability & orientation, crystalline melting point, crystallization kinetics, effect of orientation and crystallinity on polymer properties, determination of crystallinity.

UNIT – III (9 hours)
PROPERTIES OF POLYMERS

Physical properties, introduction of mechanical properties (stress–strain curves, tensile, flexural, impact, fatigue, hardness, creep and abrasion), electrical properties (dielectric strength, volume resistivity and power factor)

UNIT – IV (9 hours)
POLYMER MOLECULAR WEIGHT
Nature and structure of polymers: structure-property relationships, molecular weight of polymers (Mn, Mw, MV and MZ), polydispersity, molecular weight distribution and determination of molecular weight by solution viscosity and end group analysis,

UNIT – V (6 hours)
SOLUTION PROPERTIES OF POLYMERS
Polymer solutions, solubility parameter, athermal solvents, theta solvents, solution viscosity, thermodynamics of polymer solutions, Flory-Huggins theory

UNIT – VI (6 hours)
GLASS TRANSITION BEHAVIOUR OF POLYMERS
Glass transition temperature (Tg) and measurement of Tg, factors affecting the glass transition temperature, WLF equation

Practical component – (30 hours)

1. Chemical identification of polymers- • Unsaturation • Testing of functional groups(associated with polymers).
2. Measurement of glass transition temperature (Tg).
3. To determine the melting point of crystalline polymers.
4. To check the solubility of the given polymeric sample in different solvents.
5. Determination of molecular weight by solution viscosity.
6. Determination of number average molecular weight by end group analysis.
7. To find out the acid number and hydroxyl number of a given polymer.
8. To measure volume resistivity of polymer samples.

Essential/recommended readings

1. Odian, G., (2004) Principles of Polymerization, Wiley-interscience.
2. Gowarikar V.R., (2019) Polymer Science, New Age International Publishers Ltd, 3rdEdition.
3. Billmeyer F.W., (2007) Textbook of Polymer Science, Wiley, India.
4. Shah V., (1998) Handbook of Plastics Testing Technology, Wiley Interscience.

5. Seymour R.B., Carraher C.E., (2003) Polymer Chemistry, Marcel Dekker.
6. Teraoka, I. (2002). Polymer solutions: an introduction to physical properties.
7. Hiemenz, P. C., & Lodge, T. P. (2007). Polymer chemistry. CRC press.

Suggestive readings

1. Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition.
2. Schultz J.M., (2001) Polymer Crystallization, American Chemical Society.
3. Ghosh P., (2010) Polymer Science and Technology: Plastics, Rubbers, Blends andComposites, Tata McGraw Hill.
4. Shah V., (2006) Handbook of Plastics Testing and Failure Analysis,John Wiley & Sons,Inc., 3rd Edition.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2):
RAW MATERIALS FOR POLYMERS

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
RAW MATERIALS FOR POLYMERS	4	3	0	1	PCM	

Learning Objectives

The Learning Objectives of this course are as follows:

- To learn about the resources of polymers
- To learn about basic concepts of polymer latex
- To gain knowledge of properties of monomers and their synthesis XXX

Learning outcomes

The Learning Outcomes of this course are as follows:

- Apply the knowledge of latex manufacturing and compounding
- Apply the knowledge of techniques used in monomer production

SYLLABUS OF DSC- 2

UNIT – I (6 hours)

INTRODUCTION TO CRUDE OIL AND IT'S REFINING

Petroleum oil, natural gas, coal: capabilities and limitations. general consideration of petrochemicals, an overview of petroleum refining, desalting, distillation, cracking and its types

UNIT – II (15 hours)

SYNTHESIS OF MONOMERS FROM PETROCHEMICALS

Ethylene, vinyl acetate, vinyl chloride, ethylene oxide and ethylene glycol, acrylonitrile, methyl methacrylate, isoprene, phenol, styrene, terephthalic acid, adipic acid, caprolactam, hexamethylenediamine

UNIT – III (6 hours)

LATEX

Natural rubber latex: collection process, composition, concentration and stabilization of latex

UNIT – IV (9 hours)

LATEX ADDITIVES AND IT'S COMPOUNDING

Vulcanizing agents, fillers, accelerator, coagulating agent, wetting, dispersing and emulsifying agents, stabilizers, thickening agents and other additives, compounding formulations for product manufacturing

UNIT –V (9 hours)

LATEX PRODUCT MANUFACTURING TECHNIQUES

Latex compound formulation, process of manufacturing, finishing and applications of spreading, casting and dipping (Dipping-principle and procedure of dipping process- different types of dipping –after treatment of latex deposits -Manufacture of dipped goods with formulation and flow chart-defects and remedies . latex casting – principle and procedure of casting-production of cast articles –mould preparation, latex thread and latex foam

Practical component- (30 hours)

1. Analysis of formalin/phenol/epichlorohydrin/Plasticizer
2. Determination of hydroxyl value/carboxyl value/ester value/epoxy value
3. Determination of colour and viscosity by gardner's tube method
4. Fractional distillation of crude oil.
5. To calculate dry rubber content (DRC) of latex.
6. To determine the coagulation strength of latex.
7. Preparation of balloon by dipping process.
8. Latex compounding for preparation of gloves & balloons.
9. Synthesis of adipic acid from cyclohexanol using Conc. HNO3.
10. To prepare monomers from C4 hydrocarbons.
11. Determination of percentage purity of phenol.

Essential/recommended readings

1. Kumar D., Chandra R., (2001) Latex Technology, Dhanpat Rai & Co.
2. Rao B.K.B., (2007) Textbook on Petrochemicals, Khanna Publishers.

3. Blackley, D.C., “High Polymer Latices”, Vol 1 and 2, Chapman and Hall, 1997
4. Mausser,R.F., “The Vanderbilt Latex Hand book” 3rd edn.R.T. Vanderbilt Company,1987.

Suggestive readings

1. Rao B.K.B., (2007) Modern Petroleum Refining Processes, Oxford and IBH
2. Maiti S., (2002) Introduction to Petrochemicals, Oxford & IBH Publ. Co.
3. Speight J.G., (2006) Chemistry and Technology of Petroleum, CRC Press.
4. Martin J. M., Smith W.K., (2007) Handbook of Rubber Technology, CBS Publishers.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3): UNIT OPERATIONS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title& Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
UNIT OPERATIONS	4	3	0	1	PCM	PCM

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand concepts of unit operations and their importance in polymer industries
- To learn about the concepts of separation equipments used in the process industry XXX

Learning outcomes

The Learning Outcomes of this course are as follows:

- Select suitable criteria for solving material and energy balance problems
- Illustrate energy and material balance equations for open and closed systems

SYLLABUS OF DSC-3

UNIT – I (6 hours)

INTRODUCTION TO UNIT OPERATIONS

Unit operations: concept and requirement, material and energy balances (with and without chemical reactions), energy transport in non-isothermal systems

UNIT – II (9 hours)

MECHANICAL OPERATIONS

Mechanical Operations: Size reduction and its equipment (ball mill, jack crusher, end and

edge roller mill), filtration: theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc., factors affecting filtration

UNIT – III (15 hours)

HEAT TRANSFER

Conduction (Fourier law, Reynolds number), convection, radiation, heat exchangers (tube shell, shell plate)

UNIT – IV (15 hours)

MASS TRANSFER MECHANISM

Mass diffusion, factors affecting diffusion, gas absorption (Henry's Law, Langmuir Absorption Isotherm, BET equation), types of distillation, drying

Practical component (30 hours)

1. Handling of jaw crusher, ball mill for crushing and grinding.
2. Calculate the rate of evaporations of different volatile liquids.
3. Distillation of various liquid mixtures.
4. To evaluate diffusion percentage of a plasticizer in a PVC.
5. Filtration of solids from slurry.
6. Calculation of pressure drop and pipe size.
7. Heat Transfer through different materials like glass and plastics.
8. Analysis of different adsorption isotherms.

Essential/recommended readings

1. Mccabe W., Smith J., Harriott P., (2005) Unit Operations in Chemical Engg., McGraw-Hill Education.
2. Chattopadhaya P., (2003) Unit Operations in Chemical Engg., Vol. 1 & Vol. 2, KhannaPublishers.
3. Coulsan J.M., Richardson J.F., (2010) Chemical Engg., Vol. 1, Elsevier.

Suggestive readings

1. Kumar D. S., (2009) Heat and Mass Transfer, S K Kataria & Sons.
2. Rao G. K., (2002) Solved Example in Chemical Engg., Khanna Publishers.
3. Treybal R., (2012) Mass Transfer Operations, Tata McGraw Hill.

COMMON POOL OF GENERIC ELECTIVE COURSES OFFERED BY BHASKARACHARYA COLLEGE OF APPLIED SCIENCES IN POLYMER SCIENCE

GENERIC ELECTIVES (GE-1): BASICS OF POLYMER SCIENCE

Category-IV

Credit distribution, Eligibility and Pre-requisites of the Course

Course title &Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering t he course
		Lecture	Tutorial	Practical/ Practice			
BASICS OF POLYMER SCIENCE	4	2	0	2	All Science Streams	NIL	Polymer Science

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize with the structure of polymers will be introduced to students.
- To acquaint students with knowledge of molecular weight determination and polymersolubility

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand concept of crystalline and amorphous states of polymers
- Correlate flexibility with the glass transition temperature
- Understand structure-property relationship of polymers
- Apply mathematical formulae to depict polymer solution properties

SYLLABUS OF GE-1

UNIT – I (10 hours)

INTRODUCTION TO POLYMERS

Introduction and classification of polymers, configuration and conformation of polymers,

nature of molecular interaction in polymers, entanglement, various structures of copolymers such as linear branched and cross-linked copolymers, Polymer solutions, solubility parameter, solution viscosity, polymer solubility, thermodynamics of polymersolutions

UNIT – II (10 hours)

PROPERTIES OF POLYMERS

Physical properties, stress–strain behaviour, mechanical properties (tensile, flexural, impact, fatigue, hardness, creep, abrasion), introduction to flow & glass transition temperature (*T*g) and its measurement of *T*g, factors affecting the glass transition temperature

UNIT – III (10 hours)

MOLECULAR WEIGHT OF POLYMERS

Nature and structure of polymers – structure-property relationships, Molecular weight of polymers (*M*n, *M*w etc.), polydispersity, molecular weight distribution and determination of molecular weight by viscosity, end group analysis, cryoscopy, ebulliometry, light scattering & ultracentrifugation methods

Practical component (60 hours)

1. Chemical identification of polymers: Functional groups (associated with polymers).
2. Determination of molecular weight by solution viscosity/end group analysis.
3. To check the solubility of the given polymeric sample in different solvents.
4. To determine the melting point of crystalline polymers.
5. Determination of heat deflection temperature & vicat softening point of polymers.
6. Acid value of acrylic acid
7. Estimation of hydroxyl value by PVA and Cyclohexanol
8. Determination of epoxy equivalent weight of the epoxy resin.
9. Determination of saponification value of oil.
10. Study of three component systems.

Essential/recommended readings

1. Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition.
2. Ghosh P., (2010) Polymer Science and Technology: Plastics, Rubbers, Blends andComposites Tata McGraw-Hill.
3. Gowarikar V.R., (2019) Polymer Science, New Age International Publishers Ltd, 3rd Edition
4. Billmeyer F.W., (2007) Textbook of Polymer Science, Wiley, India.
5. Shah V., (1998) Handbook of Plastics Testing Technology, Wiley interscience publications

Suggestive readings

1. Schultz J.M., (2001) Polymer Crystallization, American Chemical Society.
2. Seymour R.B., Carraher C.E., (2000) Polymer Chemistry, Marcel Dekker.

GENERIC ELECTIVES (GE-2): ADVANCED ANALYTICAL TECHNIQUES

Credit distribution, Eligibility and Pre-requisites of the Course

Course title& Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisiteof the course
		Lecture	Tutorial	Practical/ Practice		
ADVANCED ANALYTICAL TECHNIQUES	**4**	**2**	**0**	**2**	**All Science Streams**	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To acquaint the students with the advanced instrumental techniques and theirapplications in characterization of polymeric materials

Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn the electronic microscope for characterization of morphology of polymeric materials
- Elucidate crystallinity of various polymers and their characterization on the basis of theirthermal stability and glass transition temperature

SYLLABUS OF GE-2UNIT – I (6 hours)

INTRODUCTION

Basic principle of spectroscopy, molecular and atomic spectra, Lambert-Beer's law, Frank-condon principle, electromagnetic radiation and it's properties, interaction of radiation with matter, statistical method of analysis

UNIT – II (6 hours)

SPECTROSCOPIC TECHNIQUES

Principles and applications in structural determination of polymers (functional group, tacticity, molecular structure, purity, unsaturation etc.): Infra-red spectroscopy, UV-Vis spectroscopy, electron spin resonance, raman, nuclear magnetic resonance spectrometer

UNIT – III (8 hours)

CHROMATOGRAPHY TECHNIQUES IN POLYMER

Thin layer chromatography, high performance liquid chromatography, gel permeation chromatography (GPC), gas chromatography.

UNIT – IV (10 hours)

MICROSCOPIC AND X-RAY TECHNIQUES

Optical microscopy, electron microscopy (SEM, TEM, AFM) and XRD: basics and applications (size, morphology, crystallinity etc.) in polymers characterization

Practical component- (60 hours)

1. Study of UV stabilization of polymer samples by UV-visible spectrophotometer.
2. Calculate weight percentage of inorganic and organic ingredients in polymeric compounds.
3. Determination of K-value of PVC.
4. Quantitative determination of impurities by UV-Vis. spectrophotometer.
5. Characterization of Filler Content /Ash Content of common polymers byThermogravimetric Analysis, (TGA).
6. Dentification of additives in a processed polymer by chromatography.
7. Interpretation of FTIR, NMR and Raman spectra of polymers

Essential/recommended readings

1. Willard H.H., Merritt L.L., Dean J.A. (1988) Instrumental method of analysis, Wads worth Publishing Company.
2. Skoog D.A, (1997) Principle of Instrumental Analysis, Harcourt College Pub.
3. Shah V., (2007) Handbook of Plastic Testing, Technology, Wiley-Inter science.
4. Banwell C.N., McCash E.M., (2008) Fundamentals of Molecular Spectroscopy,Fourth Edition, Tata McGraw-Hill.

Suggestive readings -

1. Tanaka T., (1999) Experimental Methods in Polymer Sciences, Academic Press.
2. Silverstein R.M., (1991) Spectrometric identification of organic compounds, JohnWiley.
3. Macomber R.S., (2008) A complete introduction to NMR spectroscopy, Wiley-interscience.

GENERIC ELECTIVES (GE-3): POLYMERS AND ENVIRONMENT

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
POLYMERS AND ENVIRONMENT	**4**	**2**	**0**	**2**	**All Science Streams**	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To give understanding of basics of care to be taken while handling polymer products.
- To know the Safety and hazardous of their manufacturing processes.
- To impart Knowledge of the subject will help students to see the environmental impact of plastic and resin.
- To understand the current benefits and concerns surrounding the use of plastics and look to future priorities, challenges and opportunities.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand basics of environmental and safety issues in the chemical industry.
- Understand safety in handling monomer and resins
- Impact of final product of polymer on environment after use and its waste management

SYLLABUS OF GE-3

UNIT – I (8 hours)
ENVIRONMENTAL APPROACH OF PLASTIC WASTE
Health and safety, Plastics in the society, Plastics in the environment, Plastic waste management, Plastic waste in the marine and terrestrial environment, Plastic material degradation, regulations for hazardous chemicals in articles/plastic products, coated articles. Separation techniques of plastic wastes (density, float sink and froth floatation methods, optical, spectroscopic, sorting by melting temperature etc.).

UNIT – II (8 hours)
PLASTIC SEGREGATION
Thermoplastic waste management: 4 R's approach (reduce, reuse, recycle (mechanical and chemical), recover), recycling classification- - primary - secondary - tertiary - quaternary recycling with examples.

UNIT – III (14 hours)
RECYCLING
Disposal processes and Various waste treatment methods – controlled tipping, pulverization, compositing, Energy from waste – (incinerators- pyrolysis, factors affecting incineration), new developments in thermal disposal of refuse, on-site disposal methods, compacting and baling. Recycling of Polyolefins, PVC, PET, Polystyrene, Polyamides (Nylon-6 and Nylon- 6,6). Recycling of Thermosets –reclaiming of rubber –pyrolysis, depolymerization of scrap rubber, tyre retreading, uses of recycled rubber.

Practical component- (60 hours)

1. Primary recycling of plastic waste collected from the environment.
2. Secondary recycling of MSW by incorporating and blending the recyclable waste with virgin polymers.
3. To study composting of natural/biopolymers.
4. Separation of polymer mixture by sink flotation technique.
5. Separation of polymer mixture by selective dissolution technique.
6. Recovery of BHET from PET by chemical recycling process
7. Recovery of Adipic Acid from Nylon 66 by chemical recycling technique
8. To study the effect of vulcanized rubber at varying ratio (in powder form) on mechanical properties of rubber vulcanizate
9. Preparation of plasticizer from polyester waste.
10. Preparation of reclaim from tyre waste.

Essential/recommended readings

1. Chandra, R., & Adab, A. (1994). Rubber & Plastic Waste: Recycling, Reuse and Future Demand. CBD Publishers.
2. Scheirs, J., & Long, T. E. (Eds.). (2005). Modern polyesters: chemistry and technology of polyesters and copolyesters. John Wiley & Sons.

Suggestive readings

1. Blow, S. (1998). Handbook of Rubber Technology.
2. Brandrup, J., Bittner, M., Michaeli, W., & Menges, G. (1996). Recycling and Recovery of Plastics, Hanser. Gardner, München.
3. Goodship, V. (2007). Introduction to plastics recycling. iSmithers Rapra Publishing.
4. Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8th Edition

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Sri Venkateswara College

COURSES OFFERED BY DEPARTMENT OF
BOTANY, BIOCHEMISTRY, ZOOLOGY, CHEMISTRY AND PHYSICS

B.Sc. (Hons.) Biological Science

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 01: Basic concepts of Biomolecules

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/ Practice		
Basic concepts of Biomolecules	**DSC-101**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biotechnology Biology/**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- to develop a basic understanding of the structure, bonding,stability, stereochemistry and reactivity of organic molecules with focus on biomolecules.
- This basic knowledge will empower the students to develop an understanding about chemistry and biology of biomolecules such as proteins and nucleic acids. This course also provides a basic understanding of the chemistry of carbohydrates and lipids.
- This knowledge will help students to better understand the biological applications of these biomolecules.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand and apply the fundamental principles of chemistry which include bonding, electronic effects, molecular forces and stability of reactive intermediates tobiomolecules.
- Gain an insight into the influence of chemical bond polarization on a molecularstructure and its reactivity.
- Identify the type of metabolic reaction and draw reaction mechanisms for keymetabolic processes.
- Recognize stereochemistry of a biomolecule and give a rational explanation of itsbiological reactivity based on stereochemistry.
- Understand the chemistry and biological functions of carbohydrates and lipids

SYLLABUS OF DSC-1

Unit I: Basic Concepts (6 hours)

Electronic displacements and their applications: Inductive, electromeric, resonance and hyperconjugation. Dipole moment, acidity and basicity. Types, shape and relative stability of carbocations, carbanions and free radicals. Electrophiles and nucleophiles, Intramolecular and intermolecular molecular forces including hydrophobic, hydrophilic interactions and hydrogen bond (emphasis on effect of these forces on the stability of biomolecules),

Unit II: Stereochemistry (8 hours)

Stereochemistry and its importance to biological systems, Stereoisomerism: Optical activityand optical isomerism, asymmetry, chirality, enantiomers, diastereomers. Mesomers, specificrotation; Resolution of racemic modification, Configuration and projection formulae: Newmann, Sawhorse, Fischer projections and their interconversion. Chirality in molecules with one and two stereocentres; CIP rules: Erythro/Threo, D/L andR/S designations.; Relative and absolute configuration; thalidomide case and chiral drugs; Geometrical isomerism: cis-trans, syn-anti and E/Z nomenclature.; Cis-trans isomerism in vision.

Unit III: Biologically significant chemical reactions (6 hours)

Aldol condensation (Glucogenesis), Retro-aldol (Glycolysis), Benzoin condensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (Synthesis of fatty acids), Michael addition (Dehydrases), Cannizzaro (Sugar metabolism), Baeyer Villiger reaction (FAD dependent ketone synthesis), Pinacole-pinacolone rearrangement (1,2-carbon carbon shift), Isomerisation(Glycolysis), Redox reaction(Lactate dehydrogenase).

Unit IV: Carbohydrates (6 hours)

Classification of carbohydrates, reducing and non-reducing sugars, biological functions, linkage between monosaccharides, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, configuration, cyclic structure (exclude structure elucidation) and Haworth projection formulae of glucose and fructose: structure of disaccharides (sucrose, maltose, lactose); polysaccharides- classification, structure of important members, storage polysaccharides (Glycogen, Starch) and structural polysaccharides (Cellulose, chitin, peptidoglycans and glycosaminoglycans)

Unit V: Lipids **(8 hours)**

Introduction, classification, biological importance of triglycerides, phospholipids, glycolipids, eicosanoids and steroids (cholesterol). Oils, Fats and Waxes: Common fatty acids present in oils and fats, essential fatty acids, characteristics of fatty acids and fats (saponification, iodine, acid, acetyl and peroxide values). Rancidity and reversion of fats; waxes, trans-fats and their biological significance.

Practical component: (60 hours)

1. Purification of organic compounds by recrystallization using the following solvents:
   i. Water
   ii. Water-Alcohol
   iii. Alcohol
2. Criterion of purity of organic compound- melting point, mixed melting point and boiling point of organic compounds.
3. Estimation of saponification value of fat/oil.
4. Estimation of iodine value of fat/oil.
5. Qualitative tests for carbohydrates and lipids
6. Chromatography

a) To separate a mixture of sugars by circular paper chromatography
b) To separate a mixture of lipids in a sample by Thin Layer Chromatography.

Essential/recommended readings

- A Guidebook to mechanism in organic chemistry (2003) 6 th ed., Sykes, P. New York: John Wiley & Sons. Inc
- Organic Chemistry (2014) 7 th ed., Morrison, R.T., Boyd, R.N., Bhattacharjee, S. K., Pearson Education
- Stereochemistry of Organic Compounds (1994), Eliel, E. L., Wilen, S. H. John Wiley& Sons.
- Stereochemistry: Conformation and Mechanism (2015) 8 th ed., Kalsi, P. S. New Age International
- Organic Chemistry (2013), Madan, R. L. Tata McGraw Hill Education PrivateLimited, New Delhi
- Organic Chemistry (2020) 8th Edn., Bruice, P. Y., Pearson

Suggestive readings: Nil

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: Photobiology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/ Practice		
Photobiology	**DSC-102**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biotechnology Biology/**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course explores the physical properties of light and its interplay with living organisms. Lightas a source of energy and information has shaped life on earth over the last 3.6 billion years. We see the world around us because the light reflected to the retina is processed to our brain (Photoreception), we breathe in oxygen because it has been evolved by the plants around us due to the light dependent Photosynthesis. Where there is no natural light, some organisms produce their own (Bioluminescence). Maintaining coordination with the changing light regime with changing seasons is fundamentally important to various aspects of living organisms across latitudes (Photoperiodism). Every part of the spectrum is used in one way or the other by different life forms. In this paper students will be able to appreciate the delicate processes of life that are dependent on light.

Learning outcomes

A student studying this course can:

- Understand and appreciate the dual nature of light.
- Comprehend the impact of light on biodiversity from pole to pole.
- Gain knowledge about the various photoreceptors in plants and animals and will appreciate and understand the mechanism of photosynthesis.
- Understand bioluminescence, photoperiodism and biological rhythms.
- Gain knowledge about the ecological and physiological responses to light.

SYLLABUS OF DSC-2

Unit 1: Introduction to Light and Life (6 hours)

Latitudinal Diversity gradient. Altitudinal and latitudinal variations in light intensity and photoperiod. Light as an ecological factor affecting distribution, physiological processes of plantsand animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems.

Unit 2: Bioluminescence and Photoreception (6 hours)

Discovery, diversity and functions of Bioluminescence. Comparative account of chemistry and functional roles of photoreceptors in plants: chlorophylls, carotenoids, phycobiliproteins, bacteriochlorophylls, etc. Photoreception in animals, evolution of eyes, color vision and visual processing in the human eye.

Unit 3: Photosynthesis (6 hours)

History, Spectrum of autotrophs, Photosynthetic equation, Photosynthetic electron transport (cyclic and non-cyclic), photolysis of water, oxygen-evolving complex (OEC), concept of Reaction centers, Q-cycle, Dark Reactions in Photosynthesis, C3, C4, CAM cycle, photorespiration (C2 cycle).

Unit 4: Photoperiodism (6 hours)

Phytochrome mediated responses in Plants, Animal responses to changing photoperiodism. Morphological, Anatomical, Physiological and behavioral adaptations to extreme light conditionsin plants and animals.

Unit 5: Ecological and physiological responses to Light (6 hours)

Morphological and physiological color change in animals. Light as an inducer for biosynthesis/activation of biomolecules (Vitamin D, Melatonin, Thymine dimer formation, RuBisCo. Three rythmn domains, Biological clocks and circadian rythmns, night shift disorders and jet lag.

Practical component: (60 hours)

1. To study light penetration in water using Secchi disc.
2. To demonstrate the effect of light on soil fauna using Berlese funnel setup.
3. To study the effect of light and darkness on the chromatophores of fish.
4. To test / survey for color blindness using Ishihara charts.
5. To study various Bioluminescent organisms using photographs- *Photinus pyralis, Aequorea victoria* , Vampire squid, Anglerfish, Lanternfish, Viperfish, Black dragonfish, *Omphalotus nidiformes*
6. Diel vertical migration using photographs
7. Measurement of light using Luxmeter under various conditions
8. To study structure of chloroplast- through photographs
9. Separation of Chloroplast pigments by Paper Chromatography/ Chemical Separation of

Chloroplast pigments

10. To study the effect of Light intensity and CO_2 concentration on the rate of Photosynthesis
11. Demonstration of Hill's Reaction and study the effect of Light intensity (any 2 light conditions).
12. Demonstration of Etiolation and de-etiolation.

Essential/ recommended Readings:

- Björn, L. O. (2015) 3rd Ed. *Photobiology: Science of Light and Life,* L.O. Bjorn.,Springer
- Buchanan, B. B., Gruissem, W., and Jones, R. L. (2000). *Biochemistry and molecular biology of plants.* Rockville, Md.: American Society of Plant Physiologists.
- Huner, N. and Hopkins, W. (2013). *Introduction to Plant Physiology.* In: 4th ed. John Wiley & Sons, Inc.
- Kohen E., Santus R., Hirschberg J.G. (1995) 1st Ed., *Photobiology* Academic Press
- Randall D., Burggren W., & French k. (2001) 5th Ed. *Eckert, Animal Physiology Mechanisms*
- *and Adaptations.* W.H. Freeman and Co.

Suggested Readings:

- Gross M. (2003). Light and Life. Oxford University Press
- Shimomura O., (2012) Bioluminescence: Chemical Principles and Methods, World Scientific,
- Taiz, L., & Zeiger, E. (1991). Plant physiology. Redwood City, Calif: Benjamin/Cummings Pub. Co.

Note: **Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

DISCIPLINE SPECIFIC CORE COURSE – 3: Diversity in lifeforms I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Diversity in L ife forms I	**DSC-103**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biotechnology Biology/**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- The course will acquaint students with variations and variability in the living world and the objectives of biological classification. The course covers important aspects of biodiversity and its components with emphasis on understanding the features of Kingdom Animalia and Plantae and systematic organization of the same based on their evolutionary relationships. Studentswill also understand the importance of taxonomy and structural organization of animals from Protista to Echinodermata to appreciate the diversity of non-chordates living in varied habitats. They will study about the general characteristics and significance of Algae, Fungi, Bryophytes and Pteridophytes

Learning outcomes

After studying this course the student will be able to:

- Understand characteristic features of different plant and animal life forms.
- Identify, classify and differentiate diverse non-chordates based on their morphological, anatomical and systemic organization.
- Understand similarities and differences in life functions among various non-chordates.
- Appreciate and understand the relevance of wild relatives of cultivated plants, their domestication and green revolution.
- Understand the general characteristics, classification, economic importance, morphology, asexual and sexual reproduction of Algae, Fungi, Bryophytes and Pteridophytes

SYLLABUS OF DSC-3

Please provide weekly distribution

Unit I: Algae and Fungi (6 hours)

Importance of biodiversity in daily life. Biodiversity crisis and biodiversity loss,
Five kingdom classification and the position of Algae, Fungi, Bryophytes and Pteridophytes.
Algae: Study of general characteristics, Outline Classification, Economic Importance, Thallus Organization and Reproduction in Nostoc, Polysiphonia, Ectocarpus.
Fungi – General Characteristics, Outline Classification, Economic Importance, Thallus Organization and Reproduction in Rhizopus and Puccinia, Lichens (crustose, foliose and fruticose), Mycorrhiza (ectomycorrhiza and endomycorrhiza,VAM)

Unit II: Bryophytes and Pteridophytes (6 hours)

Bryophytes: General Characteristics; Outline Classification; Ecological and Economic Importance; Morphology, Structure and Reproduction (comparative) in *Marchantia* and *Anthoceros*
Pteridophytes: General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in *Selaginella*

Unit III Introduction to Animal Life Forms (6 hours)

Introduction to animal diversity, Basic Taxonomy (Linnaean system of classification, Whittaker's five kingdom classification, ICZN Rules), General Characteristics of Non-Chordata and Chordata.

Unit IV: Non-Chordata Taxonomy and Diversity (10 hours)

Study of General Characteristics and Classification up to classes (Protista, Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata)

Practical component: (60 hours)

FLORA

1. Study of Vegetative and Reproductive Structures through Temporary Preparations and Permanent Slides- *Nostoc, Oedogonium, Polysiphonia; Chlamydomonas* (Through Photograph/Electron photomicrograph)
2. Study of Asexual Stage from Temporary/ Tease Mounts- *Rhizopus Albugo; Puccinia* - WM uredospores, teleutospores, Section of Leaf through pustules to show conidia
3. *Marchantia*-Morphology of Thallus, W.M. Rhizoids, V.S. Thallus through Gemma Cup, Antheridiophone (Permanent slide), Archegoniophore (Permanent Slide)), *Funaria*-Morphology of Gametophyte bearing Sporophyte, W.M. Rhizoids, W.M. Leaf, W.M. Operculum, W.M. Peristome, W.M. Spores (all Temporary Slides), L.S. Capsule (Permanent Slide).
4. *Selaginella*- Morphology, T.S. Stem, W.M. Strobilus, W.M. Microsporophyll and Megasporophyll (all Temporary Slides), L.S. Strobilus (Permanent Slide*)*, *Pteris*-Morphology,
   V.S. Sporophyll, W.M. Sporangium, W.M. Spores (all Temporary Slides), W.M. Prothallus withSex Organs (Permanent Slide).

FAUNA

5. **Study of following specimens:** *Euglena, Paramecium, Sycon, , Tubipora,Taenia solium, Ascaris Phertima, Hirudanaria, Peripatus, Scolopendra, Julus, Cancer, Daphnia, Apis, Pila,Dentalium, Octopus, Asterias*
6. **Dissections / Virtual demonstration:** Nervous system of Cockroach, Salivary apparatus andOvary of Cockroach.
7. Study of adult *Fasciola hepatica*, *Taenia solium* and their life stages (Slides/micro-
   photographs).
8. Study of following permanent Slides.

a. T.S. and L.S. of *Sycon*.
b. Crustacean larvae (W.M. Mysis, W.M. Megalopa, W.M. Zoaea).

9. To study faunal composition of water samples (Lucky drop method).
10. Field trip on: Biodiversity park/reserve/ NBPGR. (Botany + Zoology)

Essential/ recommended readings:

- Barnes, R.D. (1982). *Invertebrate Zoology*, 5th. Edition
- Campbell N. A., (2008).*Biology* 8th Edition, Pearson
- Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers
- Singh, V. (2010). *A text book of botany*. Rastogi Publications.
- Ennos, R., & Sheffield, E., (2000). *Plant Life*. UK: University Press, Cambridge.

Suggested readings:

- Ingrowille, M., (1992).*Diversity and Evolution of land plants*. Chapman and Hall
- Wilson, E. O., (1998). *Biodiversity*.National Academic Press.
- Barnes, R.D. (2006). Invertebrate Zoology, VII Edition, Cengage Learning, India.

Note: **Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

DEPARTMENT OF ANTHROPOLOGY

BSc (Hons.) Anthropology
Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1: Introduction to Biological Anthropology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Biological Anthropology	**4**	**3**	**0**	**1**	**Class XII pass with biology**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
1. In order to acquaint the students with the fundamental concepts of Biological Anthropology
2. To introduce the student a foundational understanding of human variation and evolution of human and non-human primates

Learning outcomes

The Learning Outcomes of this course are as follows:
1. The students will comprehensively learn the scope and focal theme of biological anthropology along with its implications.
2. They will also learn the emergence of mankind in the context of human evolution and variation.
3. Further, this paper will help them in learning the role of evolutionary forces in bio-cultural human adaptations in the context of changing environment.

SYLLABUS OF DSC-1

UNIT – I History, Concepts, Aims and Scope (9 hours)
1. History and development of Biological Anthropology
2. Basic concepts of human evolution and variation
3. Scope and relationship of biological anthropology with other disciplines

UNIT – II Theories of Evolution (12 hours)
1. Pre-Darwinian Theories of Evolution
2. Darwinism and Synthetic theory of evolution

UNIT – III The primates (12 hours)
1. Classification and characteristics of living primates, Primate radiation

2. Primate Locomotion, Comparative anatomy and behaviour of human and non-human primates
3. Significance of non-human primate study in biological anthropology

UNIT – IV Human Variation and Concept of Race (12 hours)
1. Traditional and modern methods of studying human variation
2. Racial Classification of Mankind
3. Indian Racial classifications: Risley, Guha and Sarkar
4. UNESCO statement on Race and Current understanding of Race

Practical component (if any) - (30 hours)

Somatometry
1. Height/ Stature; Sitting height; Body weight
2. Maximum Head Length; Maximum Head Breadth; Minimum Frontal Breadth; Maximum Bizygomatic Breadth; Bigonial Breadth; Head Circumference
3. Physiognomic Facial Height; Morphological Facial Height; Physiognomic Upper Facial Height; Morphological Upper Facial Height
4. Nasal Height; Nasal Length; Nasal Breadth; Cephalic Index; Nasal Index

Somatoscopy
1. Head form; Facial form; Nose form; Eye form; Hair form
2. Skin colour; Hair Colour; Eye Colour

Essential/recommended readings

1. Campbell, G. (2016). The Ethnology of India. Wentworth Press.
2. Ember, C, R., Ember, M. Peregrine, P.N (2015). Anthropology (Twelfth Edition). Pearson Education Inc. Boston, USA [Unit-1: Chapter-1 and 2; Unit-2; Chapter -3 and 4; Unit-3: Chapter-5 and 6]
3. Eugenia Shanklin (1993). Anthropology and Race: The Explanation of Differences. Cengage Learning: 1 edition [Unit-4].
4. Jurmain R., Kilogre L., Trevathan W., Ciochon R.L. (2012). Introduction to Physical Anthropology. Wadsworth Publications, USA. [Unit-1: Page-3-23; Unit-2: Page 25-113; Unit-3: Page-143-225].
5. Statement of Race: Annotated Elaboration and Exposition of the Four Statements on Race (1972). Issued by UNESCO. Oxford University Press. 14.
6. Trudy R. Turner (2005). Biological Anthropology and Ethics: From Repatriation of Genetic Identity. State University of New York Press [Unit-3; Page 27-64].
7. Winfried Henke and Ian Tattersall (Eds.) (2007). Handbook of Paleoanthropology (Volume II). Springer.
8. Winfried Henke and Ian Tattersall (Eds.) (2007). Handbook of Paleoanthropology (Volume III). Springer

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2:
Society and Culture: Concepts and Approaches

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Society and Culture: Concepts and Approaches	**4**	**3**	**0**	**1**	Class XII pass with biology	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
1. The course introduces concepts of Society and Culture and their role in shaping human lives
2. Raises awareness about ethnocentrism and cultural relativism
3. Outlines some basic concepts and approaches to social and cultural changes

Learning outcomes

The Learning Outcomes of this course are as follows:
The students will be able to:
1. Critically interrogate who we are and what we do.
2. Understand the basic concepts and methods of social and cultural Anthropology.
3. Understand how social and cultural differences operate in the world.

SYLLABUS OF DSC-2

UNIT – I Concept of Society (12 hours)
Concept of Society, Status and Role, Group, Association, Community and Institutions Social Fact, Social Action, Social Conflict

UNIT – II Concept of Culture (12 hours)
Culture and its attributes, Enculturation, Ethnocentrism, Cultural Relativism, Paradoxes of Culture, Cultural Change, Culture Trait, Culture Complex, Culture Area Tangible and Intangible Culture

UNIT – III Emergence and Historical Development of Social Anthropology (12 hours)
Early writings: Colonial accounts of travelers and administrators; Ethnography, Ethnology and Social Anthropology; Scope and Relevance; Relationship with other disciplines.

UNIT – IV Approaches to Culture and Society (9 hours)
Evolutionism, Diffusionism, and Historical Particularism

Practical component (if any) – (30 hours)
Research projects based on everyday life experiences from different walks of life in different cultures. Students will be required to operationalize various concepts, identify the variables and examine their relationships in small field settings.

Essential/recommended readings

1. De Annemarie Waal Malefijt (1916) Images of Man: A History of Anthropological Thought. Random House.
2. Barnard, A. (2021). History and theory in anthropology (Second Edition). Cambridge: Cambridge University Press (Selected Chapters).
3. Davis, K. (1973). Human society. New York: Macmillan. (Page: 289-391).
4. Durkheim, E. (2013). The Rules of Sociological Method and Selected Texts on Sociology and its Method Edited by Steven Lukes (Second Edition). Houndmills: Palgrave Macmillan. (Page: 20-49, 78-100).
5. Eriksen, T. H. (2015). Small Places, Large Issues: An Introduction to Social and Cultural Anthropology (Fourth Edition). London: Pluto Press (Selected Chapters).
6. Gluckman, M. (1956). Custom and Conflict in Africa. Oxford: Basil Blackwell. (Page: 1-26, 27-53).
7. Marx, K. and F. Engels. (2008). The Communist Manifesto (with an introduction by David Harvey). London: Pluto. (Page: 31-82)
8. Michael Wesch. 2018. The Art of Being Human (First Edition). Manhattan, Kansas: New Prairie (Whole book).
9. Linton R (1936) Study of Man; Manchester: D Appleton-Century.
10. Rapport N. and Overing J. (2004). Key Concepts in Social and Cultural Anthropology. London: Routledge. (Page: 333-343, 92-102).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 3: Introduction to Archaeological Anthropology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Archaeological Anthropology	**4**	**3**	**0**	**1**	Class XII pass with biology	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
1. The course will enhance students understanding of human prehistory in the light of human origins.
2. The course will help students to develop concepts pertaining to the fundamentals of archaeological anthropology

Learning outcomes

The Learning Outcomes of this course are as follows:

Students will learn on evolutionary relationships of different extinct/hominids in the context of emergence of various stone tool types and settlements.

SYLLABUS OF DSC-3

UNIT – I Introduction (9 hours)

1. Definition and scope of archaeological anthropology
2. Relation with other disciplines
3. Methods of studying archaeological anthropology

UNIT – II Methods of Estimation of Time and Reconstruction of the Past **(12 hours)**

1. Absolute dating methods
2. Relative dating methods
3. Geochronology of Pleistocene Epoch
4. Glacial and Interglacial
5. Pluviation and Inter Pluviation
6. Different types of geoclimatic events.

UNIT – III Understanding Culture **(12 hours)**

1. Technique of tool manufacture and estimation of their relative efficiency
2. Classification of tools: primary and combination fabrication techniques
3. Typology and cultural nomenclature

UNIT – IV Earliest Evidence of Culture in the World **(12 hours)**

Konso, Olorgesailie, Olduvai Gorge, Pirro Nord, Dmanisi, Attirampakkam, Isampur

Practical component (if any) (30 hours)
Typo-technological Analysis of Prehistoric Tools: Identification, Interpretation and Drawings of the tool Types
1. Core Tool Types
2. Flake Tool Types
3. Blade Tool Types

Essential/recommended readings

1. Renfrew Colin and Bahn Paul (2012) Archaeology: Theories, Methods and Practice. New York: Thames & Hudson, 6th Edition.

2. Fagan Brian M. and Nadia Durrani (2014). In the Beginning: An Introduction to Archaeology, London: Routledge, 14th Edition.
3. Champion Timothy, Clive Gamble, Stephen Shenan & Alasdair Whittle (2009) Prehistoric Europe, London: Routledge
4. Allchin, Bridget and Allchin, Raymond F. (2003) The Rise of Civilization in India and Pakistan. Cambridge: Cambridge University Press.
5. Phillipson D. W. (2005). African Archaeology. Cambridge: Cambridge University Press.
6. Whittaker, J.C. (2009) Flintknapping: Making and Understanding Stone Tools. Austin: University of Texas Press.
7. Odell, George H. (2003). Lithic Analysis. New York: Springer.
8. Moloney and Shott, M.J. (2016). Lithic Analysis at the Millennium, New York: Routledge.
9. Bhattacharya, D.K: An outline of Indian Prehistory (2006) Palaka prakashan Delhi
10. Bhattacharya, D.K. (1979). Old Stone Age Tools: A Manual of Laboratory Techniques of Analysis. Calcutta: K. P. Bagchi and Company.
11. Inizan, M.L.; M. R. Ballinger; H. Roche and J. Tixier. (1999). Technology and terminology of Knapped Stone. Nanterre: CREP.
12. Oakley, K.P. (1972). Man the Tool Maker. London. Trustees of the British Museum Natural History.
13. Sankalia, H.D. (1982). Stone Age Tools: Their techniques, Names and Probable Functions. Poona: Deccan College.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

COMMON POOL OF GENERIC ELECTIVE COURSES
OFFERED BY DEPARTMENT OF ANTHROPOLOGY

Category-IV

GENERIC ELECTIVES (GE-1)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Forensic and Criminal investigations	**4**	**3**	**0**	**1**	**Class X II pass with biology**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- Give exposure of Forensic Science to students which focus on the investigation process of a crime.
- Enhance understanding of forensic applications and criminal investigations by teaching and research.
- Develop skills in forensic identification and problem solving methods.
- Keep up to date knowledge about all recent developments and emerging trends in Forensic science and criminal investigation.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the aim, concept and significance of Forensic Science and Criminal Investigation.
- To make aware about recent techniques and developments of Forensic Science and Criminal Investigation.

SYLLABUS OF GE-1

UNIT – I: Forensic Science, Crime Scene Management and criminal investigation **(9 hours)**

- Introduction, history, development, laws and branches of Forensic Science.
- Organizational set-up of Forensic science laboratories.
- Crime scene protection, isolation, documentation, sketching, field notes and photography.
- Definition, concept, types and scope of crime, various control and prevention methods of crime.
- Criminology, criminal anthropology and criminal law

UNIT – II Forensic Ballistics and Explosives (9 hours)

- History, background, classification and characteristics of Firearms
- Internal, External, Terminal (wound) ballistics

- Classification, synthesis and characteristics of explosives.
- Examination and identification of firearms and explosives evidences.

UNIT – III Forensic Chemistry and toxicology (9 hours)

- Introduction, sampling, presumptive, screening and analytical techniques in Forensic Chemistry.
- Definition, classification and extraction of poisons.
- Toxicological techniques used in poisoning cases.
- Classification of drugs, Field and laboratory tests of drugs of abuse.

UNIT – IV Questioned Documents and fingerprint examination (9 hours)

- Classification of forensic documents, importance of natural variation and disguised writing
- Class and individual characteristics of handwriting and documents examination.
- History and classification of fingerprints, Conventional and modern methods of developing latent fingerprint.
- Automated Fingerprint Identification System (AFIS).

UNIT – V Forensic anthropology, Serology and DNA profiling (9 hours)

- Personal identification of living and non- living individual through various anthropological techniques.
- Forensic morphometric techniques of skeleton remains, Human and non-human identification.
- Sex determination, stature and age estimation from skeleton remains
- History, biochemistry and genetics of ABO, Rh, MN and other blood systems. Blood pattern analysis and blood stains ageing.
- DNA profiling and its application in criminal and civil investigations.

Practical component (if any) -

1. Descriptive study of organizational structure of a forensic science laboratory.
2. Interpretation of crime scene notes, photos, sketches, crime scene reconstruction and mock crime scene investigation.
3. Linkage of suspected bullet and cartridge case with the class and individual characteristics of firearms.
4. TLC and spot test for different toxic and drugs substances
5. Forensic identification of class and individual characteristics of handwriting
6. Examination of passports and currency notes
7. Various powder and chemical methods used for latent fingerprints.
8. Ridge characteristics, counting, and fingerprint comparison
9. Morphometric examination of skeleton remains
10. Sex determination, age and stature estimation from skeleton remains.
11. Examination of blood groups from fresh and dried blood stains
12. Preliminary and confirmatory tests for blood stains.

Essential/recommended readings

1. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
2. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
3. Swansson, C.R, Chamelin, N.C, &Territ, L; Criminal Investigator, McGrawhill, New York, 2000.
4. The Indian Evidence Act,(1872), Amendment Act (2002); Universal Law Publishing Co., 2003.
5. The Code of Criminal Procedure (1973) Amendment Act, (2001); Universal Law Publishing Co., 2002.
6. Rattan Lal &DhirajLal; The Indian Penal Code, 28th Ed. Wadhwa& Co. Nagpur, 2002.
7. Clark E.G.C; Isolation and Identification of drugs, Academic Press, London, 1986
8. Feigl, F; Spot Test in Inorganic Analysis, Elsevier Publ. New Delhi, 2002
9. Sharma, B.R.; Firearms in Criminal Investigation & Trials, 4th Ed, Universal Law Publishing Co Pvt Ltd, New Delhi, 2011.
10. Hilton, O; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, New York, 1982.
11. Singh, I.P. & Bhasin M.K; A manual of biological Anthropology, Kamla Raj Enterprises, New Delhi, 2004.
12. Eveleth, P.B. & Tanner, J.M; Worldwide Variation in Human Growth, Cambridge University Press, London, 1976.
13. Seigel, J.A, Sukoo, R.J, &Knupfer, G.L; Encyclopaedia of Forensic Science, Academic Press, London, 2000.
14. Pickering, R. & Bachman D; The use of Forensic Anthropology, CRC Press, Costa Rica, 2009.
15. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
16. Cummins, H., &Midlo, C. (1961). Finger Prints, Palms and Soles. New York: Dover Publications.

GENERIC ELECTIVES (GE-2)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Anthropology of Sustainable Development	**4**	**3**	**0**	**1**	**Class X II pass with biology**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
The objective of the paper is to understand the discourse around the idea of sustainable environment along with relevant issues and emerging challenges in managing the planetary crisis and the problems due to environmental degradations.

Learning outcomes

The Learning Outcomes of this course are as follows:
By studying the paper, the students will be able to:
• Understand the nature and scope of sustainable development, basic concepts in it.
• Know the importance of traditional ecological knowledge in sustainable development
• Contemporary issues and challenges in sustainable development and environmental degradation, biodiversity and conservation.

SYLLABUS OF GE-2

UNIT – I (9 hours)
Notion of Sustainable Development Genesis and Approaches; Economy, Equity and Environment: Idea of Triple Bottom-line
UNIT – II (12 hours)
United Nation's Sustainable Development Goals, Interconnections and Integration,
Cultural diversity and Execution of SDG: Ethnographic Cases, Frameworks of Assessment
UNIT – III (12 hours)
Issues of planetary Crisis and idea of sustainable livelihood, Alternative and Sustainable use of natural resources: water, energy, mines and materials
UNIT – IV (12 hours)
Environmental Issue: Biodiversity, Indigenous Knowledge, Traditional Practices associated with sustainable nature

Practical component (if any) - (30 hours)
I. Prepare an evaluative study/ a project based on any contemporary issue in India by employing various sources viz. books, journals, magazines, government reports newspaper articles, etc.
2. Presentation of the project and group discussion

Essential/recommended readings

1. Brightman, Marc. and Lewis, Jerome. (2021).Anthropology of Sustainability: Beyond development and progress. Palgrave Macmillan
2. Carroll, Bryce. (2017). An Introduction to Sustainable Development. Larsen & Keller Education.
3. Corsi, Patrick. (2017). Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter. John Willey & Sons Inc.
4. Elliott, Jennifer A. (2013). An introduction to sustainable development. New York: Routledge.
5. Eversole, Robyn. (2018). Anthropology for Development: From Theory to Practice. Routledge.

6. Meadows, Donella H; Meadows, Dennis L; Randers, Jorgen; and William, W. Behrens III. (1972). The Limits to growth: A report for the Club of Rome's project on the predicament of mankind. New York: Universe Books.
7. Sachs, Jeffrey. D. (2015). The age of sustainable development. New York. Columbia University Press

GENERIC ELECTIVES (GE-3)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
Biodiversity and indigenous Knowledge	**4**	**3**	**0**	**1**	**Class X II pass with biology**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
The course will help the students in understanding how indigenous knowledge and biodiversity are complementary phenomena essential to human development. Students will recognize indigenous knowledge as an important national resource and understand the collective knowledge of biodiversity and its use

Learning outcomes

The Learning Outcomes of this course are as follows:
I. Students will learn basic concepts of biodiversity and indigenous knowledge along with the rich traditional resources in management and conservation of biological diversity.
2. The course will help students to understand concepts pertaining to conservation of biodiversity and protection of indigenous knowledge including the indigenous management strategies of farmers.
3. They will also learn policies and laws relating to biodiversity conservation including protection of intellectual property rights relating to indigenous knowledge.

SYLLABUS OF GE-3

UNIT – I (9 hours)
Biodiversity: basic concept, UN Convention on biodiversity, health implications of biological diversity; conservation of biological diversity- policies and law.

UNIT – II (12 hours)
Human-animal interface- interface between human and animal world; Zoonotic diseases types, etiology and prevention, biodiversity and genetic resources.

UNIT – III (12 hours)
Indigenous Knowledge: basic concept, critique of western scientific knowledge, historical context of the emergence of indigenous knowledge, contemporary relevance of indigenous knowledge, indigenous knowledge in biodiversity conservation.

UNIT – IV (12 hours)
Problems of Indigenous Knowledge: issues pertaining to transfer of indigenous knowledge, debates for making indigenous knowledge universal, politics of indigenous knowledge, notion of identity and property; Intellectual Property Rights related to biodiversity and indigenous knowledge, protection of plant varieties.

Practical component (if any) -

Project Report on Indian Cases pertaining to Indigenous Knowledge, Intellectual Property Rights and Biodiversity

Essential/recommended readings

1. Antweiler, C. (2004). Local Knowledge Theory and Methods: An Urban Model from Indonesia. *In Investigating Local Knowledge: New Directions, New Approaches* (eds.) Alan Bicker, Paul Sillitoe& John Pottier. Ashgate. 1-34
2. Ellen, R. (2003). Variation and Uniformity in the Construction of Biological Knowledge across Cultures. In *Nature Across Cultures: Views of Nature and Environment I Non Western Cultures* (eds.) H. Selin, Great Britain: Kluwer Academic Press.
3. Eldredge, N. (2002). What Is Biodiversity? In *Life on Earth: An Encyclopedia of Biodiversity, Ecology, and EvolutionVolume 1 A–G*. ABC-CLIO, Inc. Santa Barbara, California. 1-30
4. Gadgil, M., Berkes, F &Folke, C. (1993). Indigenous Knowledge for Biodiversity Conservation. AMBIO, Springer, 22 (2/3): 152-156
5. Leveque, C. &Mounolou, J. (2003). Brief History of a Concept: Why be concerned by Biological Diversity? In *Biodiversity*. John Wiley & Sons Ltd. 5-12
6. Leveque, C. &Mounolou, J. (2003). The Dynamics of Biological Diversity and the Consequences of Human Activities. In *Biodiversity*. John Wiley & Sons Ltd. 131-164
7. Leveque, C. &Mounolou, J. (2003). The Dynamics of Biological Diversity and Implications for Human Health. In *Biodiversity*. John Wiley & Sons Ltd. 165-184
8. Leveque, C. &Mounolou, J. (2003). Genetic Resources and Biotechnology. In *Biodiversity*. John Wiley & Sons Ltd. 185-206
9. Leveque, C. &Mounolou, J. (2003). The Conservation of Biodiversity. In *Biodiversity*. John Wiley & Sons Ltd. 225-248
10. Mandal, M. (2009). Internal Displacement in India: Status, Condition & Prospects of Return. *Refugee Watch*, 33: 33-47
11. Marselle, M. R. (2021). Pathways linking biodiversity to human health: A conceptual framework. *Environment International, Elsevier.* 150: 106420
12. Murray Li, T. (2007). Articulating Indigenous Identity in Indonesia: Resource Politics and Tribal Slot. In *Environmental Anthropology: A Historical Reader* (eds.) Michael Dove & Carol Carpenter. Blackwell.

13. Palsson, G. (2007). Bio-value: Appropriating Genomes. In *Anthropology and the New Genetics*. Cambridge University Press.
14. Posey, D. (2008). Indigenous Management of Tropical Forest Ecosystem: The Case of the Kayapo Indians of the Brazilian Amazon. In *Environmental Anthropology: A Historical Reader* (eds.) Michael Dove & Carol Carpenter. Blackwell.
15. Sillitoe, P. (1988). The Development of Indigenous knowledge: A New Applied Anthropology. *Current Anthropology* 19 (2):
16. United Nations, (1992). Convention on Biological Diversity (1992). 1-17
17. Wadehra, B.L. (2012). Protection of Plant Varieties and Farmers' Rights. In *Law Relating to Intellectual Property***5** (eds.) Universal Law Publishing Co. New Delhi. 517-528
18. Vayda, A. P., Walters, B.B. &Setyawati, I. (2004). Doing and Knowing: Questions about Studies of Local Knowledge. In *Investigating Local Knowledge: New Directions, New Approaches* (eds.) Alan Bicker, Paul Sillitoe& John Pottier. Ashgate. 35-58

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-4)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
Health Systems, Promotion and Management	**4**	**3**	**0**	**1**	Class XII pass with biology	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:
1. To understand basic idea of health systems, health promotion
2. To assess the health care management strategies
3. To understand the public health value of health promotion in different health systems

Learning outcomes

The Learning Outcomes of this course are as follows:
The students will learn the basic concepts of health system research, creatively design health promotion strategies and understand various challenges of health care management.

SYLLABUS OF GE-4

UNIT – I (9 hours)

Introduction to the basic concepts of health systems, health promotions and health management

UNIT – II (12 hours)
Models, Contexts and Agents of health promotion; practice framework of health promotion: lifestyle, diet, and physical activity

UNIT – III (12 hours)
Health system of (India vs International), health system framework: private and state functioning, health system spending and financing

UNIT – IV (12 hours)
Health care institutes/centre management: health care resource, clinical and technological challenges, cost containment, hospital waste management, health care emergency management

Practical component (if any) -

Project report based on activity related health promotion, or data collection related to health systems or management

Essential/recommended readings
Josep Figueras, Martin McKee, Jennifer Cain&; Suszy Lessof. Health Systems in Transition: Learning from Experience. World Health Organization, 2003.
- Bruce R. Schatz, Richard B. Berlin Jr. (auth.). Healthcare Infrastructure: Health Systems for Individuals and Populations [led.]. Springer-Verlag London, 2011
- Pruss, E. Giroult, Philip Rushbrook. Safe management of wastes from health-care activities. World Health Organization, 1999

Michael J. Reilly, David S. Markenson. Health Care Emergency Management: Principles and Practice [1 ed.], 2010

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-5)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Anthropology and Fieldwork	**4**	**3**	**0**	**1**	Class XII pass with biology	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

The objective of the course is to introduce the students to the technique of fieldwork, a highly sophisticated qualitative research method developed in the discipline over a century. The students shall learn the innovative ways of designing and doing fieldwork in different anthropological settings.

Learning outcomes

The Learning Outcomes of this course are as follows:
The students will learn how to design and undertake fieldwork using anthropological tools of research. They will also learn the intellectual trajectory of the field work tradition affecting various disciplines.

SYLLABUS OF GE-5

UNIT – I Fieldwork Tradition in Anthropology **(9 hours)**
The Beginning: Reports of travellers, administrators and missionaries Invention of the 'non-western others' and the colonial agenda

UNIT – II Designing Field Research **(12 hours)**
Conceiving the universe of study
Identifying techniques of data collection
Pre-testing and Pilot study
Community immersion and researchers' identity

UNIT – III The Changing notion of Anthropological Field **(12 hours)**
Anthropological field in the era of globalisation Mobility and interconnection: multi-sited ethnography

UNIT – IV Data Analysis and Report Writing **(12 hours)**
Qualitative and thematic analysis, content analysis
Analysis of metaphors and narratives
Language of representation and persuasion

Practical component (if any) – (30 hours)
The students shall prepare a project report using fieldwork as a method of data collection.
Practical exercises will include task such as identification of units and universal study, designing tools of field research and to pre-test it for ensuring reliability and validity.

Essential/recommended readings

Madan & Beteille. (1975). Encounter and Experience: Personal Accounts of Fieldwork. University Press of Hawaii.
• Brewer, D. John. (2000). Ethnography. McGraw Hill Companies.
•Malinowski, B. (1922). Agronauts of Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea. London: Routledge & Kegan Paul Ltd.
• Okley, J. (2012). Anthropological Practice: Fieldwork and Ethnographic Method. Routledge.
• Spradley, J.P. (2016). Participant observation. Waveland Press.
• Evans- Pritchard, E.E. (1994). Social Anthropology. New Delhi: Universal Book Stall

• Srivastava, V. K. Edited (2005). Methodology and Fieldwork. New Delhi: Qxford University Press.
• Patnaik, S. M. (2011). Culture. Identity and Development: An Account of Team Ethnography among the Bhil of Jhabau. Jaipur: Rawat Publications.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-6)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Genetic Research in Anthropology	4	3	0	1	Class XII pass with biology	NIL

Learning Objectives

The Learning Objectives of this course are as follows:
1. To introduce human genetics through anthropological perspectives where impetus will be laid on building an understanding of biochemical and molecular markers and their relevance in anthropology.
2. The course focuses on application of anthropological genetics in mendelian populations and molecular basis of complex diseases.
3. The course also focuses on aspects of field work, data collection, ethical, legal and social issues in genetic research in anthropology.

Learning outcomes

The Learning Outcomes of this course are as follows:
1. The students will be trained to use biochemical markers with respect to disease profile.
2. The students can be better equipped to understand the importance of mendelian populations in genetic research that can be applied to disease genetics.
3. The students will be skilled with basic laboratory techniques for molecular markers.
4. The students will be better equipped to comprehend fieldwork and data collection along with an understanding of ethical and legal aspects of genetic research.

SYLLABUS OF GE-6

UNIT – I Basic concepts (9 hours)

History and relevance of genetic research in anthropology, evolution of genetic markers as a tool in human research, concept of Hardy-Weinberg Equilibrium principle.

UNIT – II Methods of genetic research in anthropology (9 hours)

Twin studies, genetic linkage studies, pedigree analysis, candidate gene studies, cohort studies, cross-sectional studies, hypothesis and technology driven research

UNIT – III Data collection in human genetic studies (9 hours)

Field work and data collection strategies, quantitative and qualitative data collection in field

UNIT – IV Techniques in human genetics (9 hours)

Agglutination, electrophoresis, PCR, sequencing techniques

Unit-V: Ethical, legal and social issues in genetic research (9 hours)

Ethical guidelines and practices in genetic research, legal and social issues in genetic research, Indian national guidelines for collaborative research in genetics.

Practical component (if any) - (30 hours)

1. ABO blood group
2. DNA extraction
3. Identification of genetic mutation through specific technique

Essential/recommended readings

1. Speicher, M. R., Motulsky, A. G., &Antonarakis, S. E. (Eds.). (2010). Vogel and Motulsky's human genetics. Berlin, Heidelberg: Springer Berlin Heidelberg.
2. Crawford, M. H. (Ed.). (2007). Anthropological genetics: theory, methods and applications. Cambridge University Press.
3. Mange, E. J., & Mange, A. P. (1999). Basic human genetics. Sinauer Associates Inc.,U.S.
4. Reich, D., Thangaraj, K., Patterson, N., Price, A. L., & Singh, L. (2009). Reconstructing Indian population history. Nature, 461(7263), 489-494.
5. DePristo, M. A. (2010). The $1,000 genome: The revolution in DNA sequencing and the new era of personalized medicine. The American Journal of Human Genetics, 87(6), 742.
6. Jaworski, E., Routh, A., Head, S. R., Ordoukhanian, P., & Salomon, D. R. (2018). Next Generation Sequencing: Methods and Protocols. Springer New York.
7. Indian Council of Medical Research. (2017). National ethical guidelines for biomedical and health research involving human participants. National Ethics Guidelines for Biomedical and Health Research involving Human Participants.
8. Kumar, M., Sandhu, H., & Roshan, R. (2020). Indian Council of Medical Research's International Collaboration & Partnerships; Health Ministry's Screening Committee: Facts, figures & procedures. The Indian Journal of Medical Research, 151(6), 550.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DEPARTMENT OF ENVIRONMENTAL SCIENCE

B.Sc. (H) ENVIRONMENTAL SCIENCE
Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1: ENVIRONMENTAL AND EARTH SURFACE PROCESSES

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course (if any)
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENTAL AND E ARTH SURFACE PROCESSES	4	2	0	2	Class X II pass	NIL

Learning Objectives

•Introduce students to the basic structure and composition of the Earth
•Explore various surface processes and their impact on and role in living systems
•Analyse interactive processes in the inner as well as outer Earth's surface

Learning outcomes

After this course, students will be able to learn the following skills.
•Acquire environmental field mapping skills to identify rocks, landforms, soils, and minerals
•Analyse surface and near-surface processes and products;
•Develop the current status of earth's processes while correlating it with global changes through time.
•Correlate landform and environmental conditions based on the evolution of the earth
•Relate and interpret the geological history of an area based on rock analyses
•Use satellite data to interpret Earth's geology or landscape

SYLLABUS OF DSC-1

UNIT – I HISTORY OF EARTH (6 hours)
Solar system formation and planetary differentiation; formation of the Earth: formation and composition of core, mantle, crust, atmosphere and hydrosphere; Geological time scale and major changes on the Earth's surface; Holocene and the emergence of humans, role of humans in shaping landscapes; development of cultural landscapes.

UNIT – II EARTH SYSTEM PROCESS (8 hours)
Movement of lithosphere plates; mantle convection and plate tectonics, major plates and hot spots; sea floor spread; earthquakes; volcanic activities; orogeny; isostasy; gravitational and

magnetic fields of the earth; continental drift and present-day continents, paleontological evidences of plate tectonics; continental collision and formation of the Himalaya and mountains.

UNIT – III MINERALS AND ROCKS (8 hours)

Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks; weathering: physical, biogeochemical processes; erosion: factors and agents of erosion; rivers and streams, glacial and aeolian transportation and deposition of sediments by running water, wind and glaciers

UNIT IV– EARTH SURFACE PROCESSES (8 hours)

Atmosphere: evolution of earth's atmosphere, composition of atmosphere, physical and optical properties, circulation; interfaces: atmosphere–ocean interface, atmosphere land interface, ocean–land interface; land surface processes: fluvial and glacial processes, rivers and geomorphology; types of glaciers, glacier dynamics, erosional and depositional processes and glaciated landscapes; coastal processes

Unit V: IMPORTANCE OF BEING A MOUNTAIN (8 hours)

Formation of Peninsular Indian Mountain systems - Western and Eastern Ghats, Vindhyas, Aravallis, etc. Formation of the Himalaya; development of glaciers, perennial river systems and evolution of monsoon in Indian subcontinent; formation of Indo-Gangetic Plains, arrival of humans; evolution of Indus Valley civilization; progression of agriculture in the Indian subcontinent in Holocene.

Practical component (if any) - (60 hours)

1. Field survey and learning what and how are to be collected, observed, and recorded as a young field environmental geologist.
2. Field visit to identify natural agents derived landform and geomorphic features.
3. Field surveys and learning indicators of geomorphology, external features, texture, colour, mineral composition, and minerals to identify the rock types
4. Mapping of igneous, sedimentary, and metamorphic rocks and drawing sketches to highlight important features of different rock types
5. Megascopic identification of mineral samples: bauxite, calcite, chalcopyrite, feldspar, galena, gypsum, hematite, magnetite, mica, quartz, talc, tourmaline;
6. Estimate the relative density of soil and conduct sedimentation analysis using hydrometer method.
7. Determine plastic limit of soil and determine soil permeability
8. Study any glacier, its flow direction, identification of glacial erosional and depositional landforms, and analysis.
9. Read, prepare and interpret geological maps to analyze petrographical and structural features.
10. Read and interpret topographical maps, aerial photographs, satellite imagery, and digital elevation models for the earth's surface features
11. Locate the epicenter of an earthquake
12. Interpret earth's history using igneous and sedimentary rock

Suggestive readings

- Bridge, J., & Demicco, R. 2008. Earth Surface Processes, Landforms and Sediment Deposits. Cambridge University Press.
- Cronin, V.S., 2018. Laboratory Manual in Physical Geology. Pearson.
- Keller, E.A. 2011. Introduction to Environmental Geology (5th edition). Pearson Prentice Hall.
- Leeder, M., Arlucea, M.P. 2005. Physical Processes in Earth and Environmental Sciences. Blackwell Publishing.
- Ludman, A. and Marshak, S., 2010. Laboratory manual for introductory geology (p. 480). WW Norton & Company.
- McCann, T., 2021. Pocket Guide Geology in the Field. Springer, Bonn, Germany.
- Pelletier, J. D. 2008. Quantitative Modeling of Earth Surface Processes (Vol. 304). Cambridge: Cambridge University Press. Chicago.
- Rutford, R.H., and Carter, J.L., 2018. Zumberge's Laboratory Manual for Physical Geology, Sixteenth Edition, Mc-Graw-Hill Education, New York, USA.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: ENVIRONMENTAL PHYSICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENTAL PHYSICS	4	2	0	2	Class X II pass	NIL

Learning Objectives

- Build conceptual understanding of the environment by understanding the underlying principles of physics governing environmental processes
- Develop perspective on the concepts of physics associated with the movement of particles,
- chemicals, and gaseous across the environmental compartments
- Gain insights into physics of plant-soil-water interface determining ecosystem processes

Learning outcomes

After this course, students will be able to

• Apply principles of physics to manage soil, water, and plant growth, especially in extreme environment

• Acquire skills to predict and manage pollutant movement across the environmental phases using concepts of physics
• Assess the impact of change in soils properties and field data at the microscale on tracking environmental contaminants
• Analyse soil particle size fractions and determine their impact on the movement of water and other solutes
• Correlate environmental processes in the ocean and terrestrial ecosystems on weather and climate 16
• Use satellite data to interpret radiation data and its impact on living organisms and ecosystems

SYLLABUS OF DSC-2

UNIT – I Environmental spectroscopy (6 hours)
Basic concepts of light and matter; quantum mechanics (relation between energy, wavelength and frequency), black body radiation, Kirchhoff's law, Boltzmann equation, Introduction to the concept of absorption and transmission of light, Beer–Lambert law, photovoltaic and solar cells.

UNIT – II Ocean and Atmosphere (6 hours)
Oceanic waves and circulation, Atmospheric temperature, pressure, circulation, precipitation and other features, Lapse rate (dry and moist adiabatic), Scattering of light, Rayleigh and Mie scattering, Electromagnetic radiations and spectrum, Greenhouse effect.

UNIT – III Soil and Water Physics (6 hours)
Phase transition of water and its consequences for marine and freshwater life, and rock structures, Clausius–Clapeyron equation of thermodynamics and liquid–vapor phase transition, Soil temperature and heat flow, Aggregation of soil particle size fractions, Stress, strain and strength of soil bodies, Diffusion and dispersion in soils and water. Redistribution, retention and evaporation of soil moisture and gaseous components

UNIT – IV Movement of pollutants in environment (6 hours)

Diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, mixing heights, hydraulic potential, Darcy's equation, types of flow, turbulence

UNIT – V: Eco-physics (6 hours)
Soil–Plant–Water Relations, Water entry into soil, Water and energy balance, Plant up take and water use efficiency; Open or closed ecosystems, Macroscopic flows of matter or energy, Disturbance or catastrophe and phase space changes in ecosystems, Thermodynamic entropy, Ecosystem efficiency, Simulated landscapes.

Practical component (if any) – (60 hours)
1. Analyze the variations in hydraulic conductivity of different soil types
2. Determine the soil temperature and thermal conductivity in different soil particle size fractions
3. Find association between heat transfer ability and the soil types
4. Estimate radon released by different materials with time
5. Monitor the health of green plants and variations in photosynthesis with varying fluorescence

6. Interpret the Gaussian plume model for the movement of pollutants in the environment.
7. Analyze the principle and applications of black body radiation and Beer–Lambert law.
8. Simulate the meteorogram of any geographical region and interpret it.

Suggestive readings

- Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley.
- Borghese, F., Denti, P. and Saija, R., 2007. Scattering from Model Nonspherical Particles:Theory and Applications to Environmental Physics. Springer Science & Business Media.
- Forinash, K. 2010. Foundation of Environmental Physics. Island Press.
- Monteith, J. and Unsworth, M., 2013. Principles of Environmental Physics: Plants, Animals, and the Atmosphere. Academic Press.
- Smith, C., 2004. Environmental Physics. Routledge.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 3: ENVIRONMENTAL CHEMISTRY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENTAL CHEMISTRY	4	2	0	2	Class X II pass	NIL

Learning Objectives

• Design strategies based on principles of environmental chemistry to The Learning Objectives of this course are as follows:
•Develop concepts of environmental chemistry as a fundamental principle of various environmental processes
•Link pollutant chemistry as a basis of pollution potential of contaminants
•Gain insights into chemical reactions that govern the movement of chemical contaminants across the environmental compartments and develop solutions that influence pollutant chemistry.

Learning outcomes

The Learning Outcomes of this course are as follows:

• Synthesize knowledge on the structure and functions of environmental compartments based on the principles of environmental chemistry
• Acquire analytical and technical skills to recognize and estimate different environmental chemicals
• Apply concepts of environmental chemistry to develop low-cost methods to treat potable and industrial wastewater and manage the quality of water, soil, and air
• Relate and interpret the contaminants exposure and its adverse impacts on living organisms and the health of ecosystems
influence the environmental fate of contaminants
• Discuss global environmental issues in the background of the chemistry of pollutants

SYLLABUS OF DSC-3

UNIT – I Fundamentals of environmental chemistry (10 hours)
Atomic structure, electronic configuration, periodic properties of elements (ionization potential, electron affinity and electronegativity), types of chemical bonds (ionic, covalent, coordinate and hydrogen bonds); mole concept, molarity and normality, quantitative volumetric analysis.

Thermodynamic system; types of chemical reactions; acids, bases and salts, solubility products; solutes and solvents; redox reactions, concepts of pH and pE, electrochemistry, Nernst equation, electrochemical cells.

Basic concepts of organic chemistry, hydrocarbons, aliphatic and aromatic compounds, organic functional groups, polarity of the functional groups, synthesis of xenobiotic compounds like pesticides and dyes, synthetic polymers.

UNIT – II Atmospheric chemistry (8 hours)
Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; chemistry of acid rain, case studies; reactions of NO2 and SO2; free radicals and ozone layer depletion, role of CFCs in ozone depletion.

UNIT – III Water chemistry (6 hours)
Chemical and physical properties of water; alkalinity and acidity of water, hardness of water, calculation of total hardness; solubility of metals, complex formation and chelation; colloidal particles; heavy metals in water

UNIT – IV Soil chemistry (6 hours)
Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil; phenolic compounds in soil.

Practical component (if any) - (60 hours)

1. Prepare buffers/solutions of different molarity and normality using the given stocks solutions

2. Determine the variations in pH of different soils and water samples using various methods.
3. Estimate hardness of given water samples
4. Determine cation exchange capacity of given soils samples
5. Determine the suitability of water for use for agriculture, industrial and domestic purposes based on selected water parameters
6. Estimate contents of selected heavy metals in given water and soil samples and identify their possible sources
7. Analyse variations in air quality index of different regions and correlate with anthropogenic or natural factors
8. Estimate organic matter contents in different soil types
9. Assess soil health based on the concentration of selected macro elements

Suggestive readings

- Beard, J.M. 2013. Environmental Chemistry in Society (2nd edition). CRC Press.
- Connell, D.W. 2005. Basic Concepts of Environmental Chemistry (2nd edition). CRC Press.
- Girard, J. 2013. Principles of Environmental Chemistry (3rd edition). Jones & Bartlett.
- Harnung, S.E. & Johnson, M.S. 2012. Chemistry and the Environment. Cambridge University Press.
- Hites, R.A. 2012. Elements of Environmental Chemistry (2nd edition). Wiley Sons.
- Manhan, S. E. 2000. Fundamentals of Environmental Chemistry. CRC Press.
- Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Common Pool of Generic Electives (GE) Courses
Offered by Department of Environmental Studies

Category - IV

GENERIC ELECTIVES (GE-1)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENT AND SOCIETY	4	2	0	2	12th Pass	NIL

Learning Objectives

- Examine the relationship between the environment and society
- Enable students to understand and appreciate the role played by environment, society, and, their interface in shaping environmental decisions
- Think critically on environmental issues and different solutions
- Learning outcomes

Learning outcomes

The Learning Outcomes of this course are as follows:

.

SYLLABUS OF GE-1

UNIT – I Introduction (4 hours)

Social and cultural construction of 'environment'; environmental thought from historical and contemporary perspective in light of the concepts of Gross Net Happiness and Aldo Leopold's Land Ethic

UNIT – II Issues in Environmentalism (4 hours)

Significant global environmental issues such as acid rain, climate change, and resource depletion; historical developments in cultural, social and economic issues related to land, forest, and water management in a global context; interface between environment and society.

UNIT – III Development -Environment Conflict (4 hours)

Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs).

UNIT- IV Urbanization and environment (4 hours)

Production and consumption oriented approaches to environmental issues in Indian as well as global context; impact of industry and technology on environment; urban sprawl, traffic congestion and social-economic problems; conflict between economic and environmental interests.

UNIT – V Environment and Social Inequalities (4 hours)
Inequalities of race, class, gender, region, and nation-state in access to healthy and safe environments; history and politics surrounding environmental, ecological and social justice; environmental ethics, issues and possible solutions.

UNIT – VI Regulatory Framework (4 hours)
Brief account of Forest Conservation Act 1980 1988; Forest Dwellers Act 2008; Land Acquisition Act1894, 2007, 2011, 2012; Land Acquisition Rehabilitation and Resettlement Act 2013

UNIT- VII Community participation (6 hours)
State, corporate, civil society, community, and individual-level initiatives to ensure sustainable development; case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan); corporate responsibility movement; appropriate technology movement; environmental groups and movements, citizen groups; role played by NGOs; environmental education and awareness.

Practical component (if any) - (60 hours)
1. Analyse the cultural construction of the environment in a country of your choice
2. Compare and contrast the perception of the environment in countries with varying levels of environmental quality
3. Critically evaluate the developmental status and type of environmental issues across societies from regu within a country and different countries.
4. Determine the socio-demographic and industrial characteristics of a region and correlate them with the environmental issues of that region?
5. Identify the relationship between societies varying in cultures and environment and analyse the role of economic factors in changing the relationship over time
6. Show any relationship between natural resource use and changing population dynamics of the community
7. Evaluate the pattern of natural resource use by people and their likelihood of participating in the conservation of natural resources
8. Demonstrate any pattern between the resources use and population dynamics, industrial activities, and employment generation in a given region
9. Analyse attitudes, knowledge, and values towards an environmental resource of a population or stakeholder and what trade-off is the public willing to make for conservation of the resource.
10. Determine access to resources across members of a society and suggest measures for equitable sharing of resources or associated benefits, if required.
11. Select an environmental policy/regulation and identify its impact on society over time.

Suggestive readings

1. Cárdenas, J.C., 2009. Experiments in environment and development. Annual Review of Resource Economics, 1(1), pp.157-82.
2. Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. Understanding Environment. Sagar Publication India Pvt. Ltd., New Delhi.
3. Elliot, D. 2003. Energy, Society and Environment, Technology for a Sustainable Future. 30 Routledge Press.
4. Ioris, A.A.R. ed., 2021. Environment and Development: Challenges, Policies and Practices. Springer Nature.
5. Leopold, A. 1949. The Land Ethic. pp. 201-214. Chicago, USA.

6. National Research Council (NRC). 1996. Linking Science and Technology to Society'sEnvironmental Goals. National Academy Press.
7. Stanton, C.Y., 2014. Experiments in Environment and Development. Stanford University.

GENERIC ELECTIVES (GE-2)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
HUMAN WILDLIFE CONFLICT AND MANAGEMENT	**4**	**2**	**0**	**2**	**12th Pass**	**NIL**

Learning Objectives

- Analyze causal factors determining conflicts between humans and wildlife
- Gaining insights into complexity of habitat sharing between wildlife and human societies Acquire deeper understanding of causal factors of habitat shrinkage and its impact on wild life dynamics and threats and benefits to human societies
- Reveal the nexus between humans-culture-economy-wildlife
- Develop scientific and social perspective of wildlife conservation.

Learning Outcomes

After successful completion of this course, students will be able to:

- Develop clear perspective on human-wildlife conflict by defining and examining its historical & present-day status
- Discriminate the underlying factors associated with successful & unsuccessful efforts on providing solutions to human-wildlife conflicts
- Demonstrate the relevance of cultural factors in understanding the issues and providing acceptable and practical solutions
- Critically evaluate different case studies for identifying factors that may have major impact in resolving human-wildlife conflicts

SYLLABUS OF GE-2

UNIT – I Introduction to wildlife management (4 hours)

Need of environmental management; wildlife conservation: moral obligation? philosophy of wildlife management; why is it necessary to worry about human wildlife conflicts? What is the role of government, wildlife biologists and social scientists, concept of deep and shallow ecology.

UNIT – II Evolution of the concept of wildlife management (6 hours)

Journey of mankind from predator to conservator; prehistoric association between wildlife and humans: records from Bhimbetka wall paintings; conservation of wildlife in the reign of king Ashoka: excerpts from rock edicts; Bishnoi community; understanding wildlife

management, conservation and policies regarding protected areas in 21st century; positive values provided by wildlife conservation (monetary, recreational, scientific and ecological benefits)

UNIT – III Wildlife conservation laws in India (4 hours)
Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; concept of core and buffer area in a protected range, brief introduction to Wildlife Protection Act of 1972, Forest act 1927, Environmental Protection Act 1986, and Forest conservation Act 1920; introduction of Tiger task force, Status of current protected areas in India.

UNIT – IV Socio-economic and legal basis of conflicts (6 hours)
Concepts of development and encroachment, who is the intruders: human or animal? Impact of conflict on humans and wildlife, impact of habitat fragmentation, social inequality in terms of forest conservation: luxury hotels within protected areas vs. displacement of native tribes, forest produce as a need vs. forest exploitation, introduction to tribal rights in India, demographic profile of tribes in India, importance of forest produce to tribal populations, Scheduled tribes and other traditional Forestdwellers (Recognition of forest right) Act, 2006.

UNIT – V Wildlife conflicts (4 hours)
Insight into the important conflicts: Keoladeo National park conflict of Bharatpur, Human and elephant conflicts of Kerala, Fisherman and tiger conflict of Sundarbans forest, shifting cultivation in North east India.

UNIT—VI Human wildlife coexistence (6 hours)
Symbiotic relationship between tribals and forest, forest and development, focus on the inclusive growth of tribes: community participation in forest management, case study of Chipko movement, sacred groves forests, India's Bishnoi community and their conservation practices; ecological- economic welfare and development: conservation of indigenous culture and traditions, role of international organizations: Man and biosphere programmes; concept of conservation reserves and community reserves, importance of wildlife corridors in minimizing the conflicts and conservation.

Practical component (if any) -

1. Prepare a case study that has potential to develop as a human-wildlife conflicts in the area of your choice.
2. Write a case study describing different aspect of human-wildlife conflict and depict all associated factors in a schematic diagram
3. Using a case study, demonstrate the importance of historical facts in providing solutions in the present day
4. Evaluate merits and demerits of multistage sampling technique while collecting information on human-wildlife conflicts
5. Develop a questionnaire to identify the causal factors of human-wildlife conflicts emerging in a target regions
6. Analyze the roles of psychological factors in development of human-wildlife conflicts
7. Evaluate the relationship between resource scarcity and abundance in determining humanwildlife conflicts
8. Correlate the success and failure in resolving human-wildlife conflicts with existence of institutional framework

9. Use methods of triangulating information, field observations, photography and Problem Animal Control Report as complementary methods to focused interviews to understand the problem and suggest the solution
10. Understanding the significance of mediation among different policies on societal benefits and wildlife conservation to resolve human-wildlife conflicts

Suggestive readings

1. Angelici, F.M. and Rossi, L., 2020. Problematic Wildlife II. Springer International Publishing.
2. Conover, M. 2001. Resolving Human Wildlife Conflicts, CRC Press.
3. Conover, M.R. and Conover, D.O., 2022. Human-Wildlife Interactions: From Conflict to Coexistence. CRC Press.
4. Dickman, A. J. 2010. Complexities of conflict: the importance of considering social factors foreffectively resolving human–wildlife conflict. Animal Conservation 13: 458-466.
5. Hill, C.M., Webber, A.D. and Priston, N.E. eds., 2017. Understanding conflicts about wildlife: A Biosocial Approach (Vol. 9). Berghahn Books.
6. Manfred, M.J., 2008. Who Cares About Wildlife? Social Science Concepts for Exploring Human-wildlife Relationships and Conservation Issues.
7. Messmer, T. A. 2000. The emergence of human–wildlife conflict management: Turning challenges into opportunities. International Biodeterioration & Biodegradation 45: 97-102.
8. Nyhus, P.J., 2016. Human–wildlife conflict and coexistence. Annual Review of Environment and Resources, 41, pp.143-171.
9. Warrier, R., Noon, B.R. and Bailey, L.L., 2021. A framework for estimating human-wildlife conflict probabilities conditional on species occupancy. Frontiers in Conservation Science, p.37.
10. Woodroffe, R. 2005. People and Wildlife: Conflict and Coexistence. Cambridge.

GENERIC ELECTIVES (GE-3)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
GENDER AND ENVIORNMENT	**4**	**2**	**0**	**2**	**12th Pass**	**NIL**

Learning Objectives

The paper is designed to expose students to the concept of gender in society and its relevance in the environmental context. The principal objective of the course is to enable students to examine environmental issues from a gender-sensitized perspective

Learning outcomes

After the course, students will be able to:

- Identify causal factors of making woken more vulnerable to environmental calamities and issues
- Reveal the reality of gender inequalities across the countries, challenging the development of risk resilient individuals and communities
- Demonstrate significant contributions of women as stakeholders while decisions making, educating, and evolving action plans across sectors to provide long-term solutions to environmental problems.
- Show the women's role as a leader in transitioning toward equitable and sustainable societies and industries

SYLLABUS OF GE-3

UNIT – I Introduction (4 hours)
The socially constructed 'gender' concept

UNIT – II Gender and society (6 hours)
Gender existence in society; gender: matriarchy and patriarchy as means of social exclusion (case studies in an Indian context); gender equity issues in rural and urban settings.

UNIT – III Gender and the environment (4 hours)
Relevance of the concept in an environmental context; evolution of gender hierarchies in historical and contemporary perspective; gendered division of roles in cultural, social and economic perspective; gender inequalities

UNIT – IV Gender, resources and the environment (4 hours)
Knowledge about the environment among men and women; differential dependencies on environmental resources; implications of gendered responses to environmental degradation.

UNIT – V Gender and environmental management (6 hours)
Women's participation in environmental movements and conservation; historical and contemporary case studies; role of women in environmental education, awareness and sustainable development.

UNIT – VI Strategies for change (6 hours)
Need for gender equity; Instruments for change: education, media, action groups, policy and management; equity in resource availability and consumption for a sustainable future

Practical component (if any) -

1. Using a case study, demonstrate the value of a gender-inclusive approach in the success of the environmental protection programme
2. Develop a context and show the importance of women's role in environmental conservation by emphasizing gender gaps in access to (a) power, (b) education, (c) markets, and (d) cultural practices.
3. Analyze the national gender policy or laws restricting or promoting women's participation in resolving environmental issues
4. Critically evaluate the national environmental policies for their gender sensitivity by taking an example of climate change-related policies across the sectors, including agriculture, forestry, and water.

5. Identify the gender gaps in policies related to climate change, energy access, natural resource access, and ecosystem services benefits
6. Determine the gender gaps in livelihood activities depend on ecological resources, such as agriculture, fisheries, and forestry, access to new technologies, and capacity-building in STEM (science, technology, engineering, or mathematics) for resolving environmental issues
7. Examine the impact of environmental awareness programmes involving or targeting women, especially to reduce vulnerability to climate change, access to renewable energy, sill development in energy entrepreneurship
8. Find out the variations in perspectives of women and men on environmental security across the societies within and outside country
9. Focused survey in neighbourhood community to gain insights into perception and solution to same environmental issues locally, nationally, and globally
10. Develop an action plan to address an environmental issue selected in practical 9 by incorporating livelihood strategies and economic and decision-making empowerment for women
11. Collect sex-disaggregated data and analyze the success of different environmental conservation programme based on the role of gender while focusing on involvement in decision making, participation in the action plan, the target of information dissemination, avenues of communication, major beneficiaries, and marginalized groups.

Suggestive readings

1. Agarwal, B. 2001. Participatory exclusions, community forestry, and gender: An analysis forSouth Asia and a conceptual framework. World Development 29: 1623-1648.
2. Agarwal, B., 2019. The gender and environment debate: Lessons from India. In Population and environment (pp. 87-124). Routledge.
3. Buckingham, S., 2005. Gender and Environment. Routledge.
4. Gaarder, E., 2011. Women and the animal rights movement. In Women and the Animal Rights Movement. Rutgers University Press.
5. Jackson, C. 1993. Doing what comes naturally? Women and environment in development.World Development 21: 1947-63.
6. Leach, M. 2007. Earth Mother myths and other ecofeminist fables: How a strategic notion roseand fell. Development and Change 38: 67-85.
7. MacGregor, S. ed., 2017. Routledge Handbook of Gender and Environment. Taylor & Francis.
8. Miller, B. 1993. Sex and Gender Hierarchies. Cambridge University Press
9. Oswald Spring, Ú., 2008. Gender and disasters: human, gender and environmental security. UNU-EHS.
10. Rodríguez-Labajos, B. and Ray, I., 2021. Six avenues for engendering creative environmentalism. Global Environmental Change, 68, p.102269.
11. Stein, R. (ed.). 2004. New Perspectives on Environmental Justice: Gender, Sexuality, and Activism. Rutgers University Press.
12. Stephens, A., Lewis, E.D. and Reddy, S., 2018. Towards an inclusive systemic evaluation for the SDGs: Gender equality, environments and marginalized voices (GEMs). Evaluation, 24(2), pp.220-236.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES (GE-4)

Credit distribution, Eligibility and Pre-requisites of the Course

Course t itle & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
GREEN TECHNOLOGIES	**4**	**2**	**0**	**2**	**12th Pass**	**NIL**

Learning Objectives

- Gain insights into interdisciplinary aspects of green systems and the environment, and sustainability
- Develop a new perspective on product life cycles for improving efficiency and promoting environmental conservation
- Understand product formulation, process complexity, and infrastructure design to promote sustainability
- Integrate technical and scientific skills for environmental security and industrial sustainability for nation's development

Learning outcomes

Apply principles of green chemistry for environmentally safe products

- Design processes that rely on using environmentally benign chemicals and developing economically viable products
- Minimize environmental hazards by improved design for developing industrial products
- Using biotechnology to improve industrial methods and chemical processes as less or non hazardous, green, safe, and economically acceptable.
- Implement a combination of technical and scientific skills to understand environmental problems better, use resources, manage waste, and develop green infrastructure

SYLLABUS OF GE-4

Unit I: Green technologies (6 hours)

Definition and concepts: green technology, green energy, green infrastructure, green economy, and, green chemistry; sustainable consumption of resources; individual and community level participation such as small-scale composting pits for biodegradable waste, energy conservation; encouraged use of public transport instead of private transport; 3 R's of green technology: recycle, renew and reduce;
paradigm shift from 'cradle to cradle' to 'cradle to grave'

Unit II: Green infrastructure, planning and economy (6 hours)

Green buildings; history of green buildings, need and relevance, construction, costs and benefits; LEED certified building; Eco-mark certification: importance and implementation;

Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities,
role of informal sector in waste management, public transportation for sustainable development, green belts. ; Introduction to UNEP's green economy initiative, inclusive economic growth of the society, REDD+ initiative, and cap and trade concept; green banking.

Unit III: Applications of green technologies (6 hours)

Increase in energy efficiency: Energy efficient fume hoods, motion detection lighting, or programmable thermostats. Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, purchase and use of carbon offsets, alternative forms of transportation for employees, such as carpools, fuel efficient vehicles, and mass transit, methane emissions reduction and/or reuse).Pollution reduction and removal: Physico-chemical and biological methods

Unit IV: Green chemistry (6 hours)

Introduction to green chemistry; principles and recognition of green criteria in chemistry; bioAnnexure-VII38 degradable and bio-accumulative products in environment; green nanotechnology; reagents, reactionsand technologies that should be and realistically could be replaced by green alternatives;photodegradable plastic bags**.**

Unit V: Green future (6 hours)

Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies; green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.); emphasis on waste reduction instead of recycling, emphasis on innovation for green future; role of advancement in science in developing environmental friendly technologies.

Practicals/Hands-on Exercise

1. Analyze practices of an industry of your choice from India and outside country that has adopted green technology for brand image and economic edge
2. Identify, explain and discuss the ecological principles adopted by the industry selected in practical 1 and analyze their importance
3. Select an industry of your choice where cleaner production is required to improve quality of life and weight its economic, social, and environmental costs
4. Recommend clean development mechanisms and methods of converting waste into wealth in an industry that plays a significant role in your native area or the nation's GDP.
5. Develop a plan for carbon credit and carbon trading where it is not prevalent so far and compare it with a similar plan from a developing or developed country
6. Conduct a Life Cycle Assessment and its elements of a product widely used in your family or residential complex and recommend methods/processes that can help achieve a green tag.
7. Compare and contrast the use of conventional and non-conventional energy sources in your state or country and devise a method for transitioning completely to complete green energy
8. Assess the types and quantity of biomass used as an energy source in your country and evolve a plan to switch towards greener methods in the next 5 years

9. Develop a feasibility status of developing and integrating solar, wind, tidal, and geothermal energy in your nation
10. Evolve an action plan for water recycling for your residential complex by considering the quantity available, type of usage, and existing infrastructure
11. Analyze a case study of commercial green building in your state and discuss the ecological principle(s) adopted for this purpose.

Suggested Readings

1. Allen, D.T., 2012. Sustainable Engineering: Concepts, Design, and Case Studies. Pearson
2. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford UniversityPress.
3. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw Hill Publications.
4. Baker, S. 2006. Sustainable Development. Routledge Press.
5. Floyd. A., 2011. Green Building: A Professional's Guide to Concepts, Codes and Innovation. Delmar Cengage Learning
6. Hrubovcak, J., Vasavada, U. & Aldy, J. E. 1999. Green technologies for a more sustainable agriculture (No. 33721). United States Department of Agriculture, Economic Research Service.
7. Striebig, B., Ogundipe, A.A. and Papadakis, M., 2015. Engineering applications in sustainable design and development. Cengage Learning.
8. Thangavel, P. & Sridevi, G. 2015. Environmental Sustainability: Role of Green Technologies. Springer Publications.
9. Vallero, D.A. and Brasier, C., 2008. Sustainable Design: The Science of Sustainability and Green Engineering. John Wiley & Sons.
10. Woolley, T. & Kimmins, S. 2002. Green Building Handbook (Volume 1 and 2). Spon Press

DEPARTMENT OF HOME SCIENCE

BSc. (Hons.) Home Science

Category-II

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-HH101) Human Development I: The Early Years

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Human Development I: The Early Years	4	3	0	1	Class XII with Science	-

Learning Objectives

1. To develop an understanding about the discipline of Human Development
2. To gain an insight of development in different domains from conception to early childhood

Learning outcomes

After completing this course, students will be able to:

1. Develop an understanding about the discipline of Human Development
2. Acquire knowledge of development in different domains from conception through infancy and early childhood.
3. Understand the salient features of human development by getting acquainted with various methods of studying children.

SYLLABUS

Unit I: Introduction to Human Development (9 hours)

Unit Description: The unit presents the student with an overview of the discipline of Human Development. The student will develop an understanding of basic ideas and terms that are central to the study of Human Development.

Subtopics: ● Human Development: Definitions, nature and scope ● Domains and stages of development ● Principles of development ● Contexts of development

Unit II: Prenatal development and childbirth (9 hours)

Unit Description: The unit describes the process of development from conception to birth and elaborates on the hereditary and environmental influences that play a role in prenatal development

Subtopics: ● Conception and stages of prenatal development ● Influences on prenatal development ● Prenatal care ● Childbirth: Methods and birth complications

Unit III: Neonate and infant development (12 hours)

Unit Description: The unit draws focus to the first two years of life and provides an understanding of the physical-motor, socio-emotional, cognitive and language development of infants.

Subtopics: ● Capacities of the neonate ● Infant care practices ● Physical motor development ● Socio-emotional development ● Language development ● Cognitive development

Unit IV: Development during early childhood (12 hours)

Unit Description: The unit traces the progression in development that occurs from 2-6 years of life.

Subtopics: ● Physical Motor Development ● Socio-Emotional Development ● Language Development ● Cognitive Development

PRACTICAL (30 hours)

Unit 1 ● Narrative method: recalling and recording an event ● Exploring cultural practices and traditions during - Pregnancy - birth - Infant care

Unit 2 ● Observation method: - observing infants and preschool children in everyday settings - recording the observations ● Neonatal assessment (APGAR scale and Neonatal reflexes) ● Multi-media resources to study prenatal development, infancy, early childhood

Essential readings

1. Berk, L. (2013). Child development. 9th ed. Boston: Pearson.
2. DECE-1 Organising Child Care Services (IGNOU Study Material) https://www.egyankosh.ac.in/handle/123456789/32288
3. Dixit, A. (2019). Baal Vikas (1st ed.). Doaba House.
4. Journey of the first 1000 days: Rashtriya Bal Swasthya Karyakram (2018) Ministry of Health and Family Welfare.
5.https://nhm.gov.in/images/pdf/programmes/RBSK/Resource_Documents/Journey_of_The_Fi rst_1000_Days.pdf
6. Patni, M. (2020). Baal Vikas (3rd ed.). Star Publications.
7. Santrock, J.W. (2011). Life-span development. New York: McGraw-Hill.
8. Singh, A. (Ed.) 2015. Foundations of Human Development. New Delhi: Tata McGraw
9. Hill. Chapter 2,
10. Snow, C.W. (1997). Infant Development. New Jersey, Prentice-Hall Inc.

Suggested Readings

1. Joshi, P. & Shukla, S. (2019). Child development and education in the twenty-first century. Singapore: Springer International
2. Khalakdina, M. (2008). Human development in the Indian context: A socio - cultural focus: 1. India: Sage.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-HH 102) Food Science and Nutrition

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Food Science and Nutrition	**4**	**3**	**0**	**1**	Class XII With Science	**-**

Learning Objectives

1. To understand the relationship between food, nutrition and health.
2. To describe the function of various nutrients and list their sources.
3. To understand the nutritional contribution of and effect of cooking on different food groups.
4. To describe ways of reducing nutrient losses during cooking and methods of enhancement of nutritional quality of foods.
5. To be able to prepare dishes using principles of food science.

Learning outcomes

After completing this course, students will be able to:

1. Understand the relationship between food, nutrition and health.
2. Describe the digestion, absorption and function of various nutrients and list their sources.
3. Understand the nutritional contribution of and effect of cooking on different food groups.
4. Understand ways of reducing nutrient losses during different methods of cooking and methods of enhancement of nutritional quality of foods.
5. Prepare dishes using principles of food science and assess serving size and nutritional contribution.

SYLLABUS OF DSC- 2

Unit I: Basic Concepts in Food and Nutrition (5 hours)

Unit Description: An introduction to the sciences of food and nutrition and their relationship to health and disease.

Subtopics: ● Basic terms used in study of food and nutrition ● Understanding relationship between food, nutrition and health ● Functions of food-Physiological, psychological and social

Unit II: Nutrients (15 hours)

Unit Description: Functions, dietary sources and clinical manifestations of deficiency/ excess of the nutrients

Subtopics: ● Energy, Carbohydrates, lipids and proteins ● Fat soluble vitamins ● Water soluble vitamins ● Minerals

Unit III: Food groups (15 hours)

Unit Description: Structure, composition, products, nutritional contribution, selection and changes during cooking of various food groups

Subtopics: ● Cereals and Pulses ● Fruits and vegetables ● Milk & milk products ● Eggs ● Meat, poultry and fish ● Fats and Oils ● Spices and herbs ● Beverages

Unit IV: Methods of Cooking and Enhancing the Nutritional Quality of Foods (10 hours)

Unit Description: Different methods of cooking and ways to improve nutrient retention or improve nutritional quality

Subtopics: ● Dry, moist, frying and microwave cooking ● Advantages, disadvantages and the effect of various methods of cooking on foods ● Preventing losses of nutrient during cooking ● Improving nutritional quality of diets by Food synergy, Germination, Fermentation, Fortification and Genetic Modification of foods

Practical component – 30 Hours

Unit I ● Weights and measures; preparing market order and table setting

Unit II Food preparation, understanding the principles involved, nutritional quality and portion size- ● Cereals: Boiled rice, pulao, chapati, paratha-plain/stuffed, poori, pastas ● Pulses: Whole, dehusked, pulse curry ● Vegetables: Dry preparation, vegetable curry ● Milk preparations: Kheer, porridge, custard ● Egg preparations: Boiled, poached, fried, scrambled, omelettes, egg pudding ● Soups: Plain and cream soups ● Baked products: cakes, biscuits/cookies ● Snacks and Breakfast Cereals: pakoras, cutlets, samosas, cheela, upma/poha, sandwiches ● Salads: salads and salad dressings

Essential readings

1. Chadha R and Mathur P (eds)(2015). Nutrition: A Lifecycle Approach. Hyderabad: Orient Blackswan.
2. Rekhi T and Yadav H (2014). Fundamentals of Food and Nutrition. New Delhi: Elite Publishing House Pvt Ltd.
3. Srilakshmi B (2014). Food Science, 6th Edition. Delhi: New Age International Ltd.
4. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T (2004). The Art and Science of Cooking: A Practical Manual, Revised Edition. New Delhi: Elite Publishing House Pvt Ltd.
5. Raina U, Kashyap S, Narula V, Thomas S, Suvira, Vir S, Chopra S (2010). Basic Food Preparation: A Complete Manual, Fourth Edition. Hyderabad: Orient Black Swan

Suggestive readings (if any)

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2016). Textbook of Human Nutrition, 4th edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
2. Byrd-Bredbenner C, Moe G, Beshgetoor D, Berning J. (2013). Wardlaw's Perspectives in Nutrition, International Edition, 9th edition, New York: McGraw- Hill.
3. Sethi P, Lakra P. Aahar Vigyan, Poshan evam Suraksha (Hindi); First Ed; 2015; Delhi: Elite Publishing House (P) Ltd.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3) COMMUNICATION CONCEPTS AND THEORIES

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Communication Concepts and Theories	4	3	0	1	Class XII pass with Science	

Learning Objectives

1. To learn about the concept, nature, and scope of communication.
2. To understand the process of communication with the help of theories, models, and elements of communication.
3. To recognize and appreciate the role of Perception, Empathy, Persuasion, Culture and Listening in communication.
4. To be able to comprehend the various communication transactions and their role in day-to day life with special reference to public communication.
5. To understand the relationship between culture and communication and its applications in real life settings.

Learning outcomes

The students would be able to:

1. Develop a clear understanding of the concepts of human communication.
2. Comprehend the elements and models governing the process of effective communication.
3. Gain understanding about the related concepts of communication such as Perception, Empathy, Persuasion and Listening
4. Understand the various communication transactions as well as the qualities and skills required of an effective public speaker.
5. Appreciate the role and application of factors for effective communication.

SYLLABUS OF DSC-3

Unit I: Communication: Core Concepts (10 Hours)

Unit Description: The Unit 1 explores the fundamentals of Human Communication tracing the history of communication from the olden times to the present times. It highlights the concept, nature, types, scope, and postulates of communication and discusses the functions performed through communication

Subtopics: ● Historical background, concept, nature, functions, and scope of communication ● Types of Communication – Formal and informal communication; Verbal and Non-verbal communication; Digital and Non-digital communication ● Verbal communication- Principles, types, effective use of verbal messages for communication ● Non-verbal communication-functions, types, skills, channels of non-verbal communication, inter-relationship between culture and non-verbal skills ● Elements of communication - Source, Message, Channel, Receiver, Feedback, Context, Noise & Effects

Unit II: Communication Models and Theories (10 Hours)

Unit Description: The Unit II emphasizes the models and theories of the communication process. The further delves on the importance of these models and theories for understanding the effectiveness of communication as a process.

Subtopics: ● Models of Communication: Types of models- Linear, Interaction and Transaction models, (Models by Aristotle, Harold Laswell, Shannon &Weaver, Charles Osgood, Wilbur Schramm, Helical model) ● Theories of Communication: Mass Society, Propaganda, Limited Effects, Individual Difference and Personal Influence

Unit III: Factors for Effective Communication (13 Hours)

Unit Description: The Unit delves with intricate concepts such as Empathy, Persuasion, Perception and Listening that are associated with communication. The unit also discusses the relationship between culture and communication.

● Factors for effective communication: Definitions, goals and principles of Empathy, Perception, and Persuasion ● Empathy: Concept and Theories ● Perception: Concept and Theories ● Listening in Human Communication-Listening process, significance of good listening, styles of listening, barriers to listening, culture and listening, listening theories ● Culture and communication- Relationship between culture and communication, signs, symbols and codes in communication

Unit IV: Communication Transactions and Learning (12 Hours)

Unit Description: The Unit III elucidates upon the various levels of communication transactions. This Unit in particular lays thrust on the Public communication and 'need and importance' of communication for learning. The unit also highlights the concept of communication for development.

Subtopics: ● Levels of communication transactions ● Public communication- Concept, types, techniques and skills in public speaking, qualities of an effective public speaker, overcoming speaker apprehension ● Communication, and Learning: Learning as Communication Process, Domains of Learning. Theories of learning ● Audio-Visual Aids in communication- definitions, functions, classification including Edgar Dale's Cone of Experience ● Communication for Development- Concept and approaches

Practical components – 30 Hours

● Exercises to understand visual communication: Elements of Art and Principles of Design
● Exercises to explore dimensions of non-verbal communication
● Hands on practice with different types of public speaking
● Exercises in effective listening skills
● Exercises on building empathy for effective communication
● Analysis and designing of IEC materials

Essential readings

Devito, J. (2012). Human Communication. New York: Harper & Row.

Barker, L. (1990). Communication, New Jersey: Prentice Hall, Inc; 171.

Anand, S. & Kumar, A. (2016). Dynamics of Human Communication. New Delhi: Orient Black Swan.

Vivian, J. (1991). The Media of Mass Communication. Pearson College Div; 11th edition (19 March 2012).

Punhani & Aggarwal (2014). Media for Effective Communication. Elite Publishers, New Delhi.

Suggestive readings

Patri, V. R. and Patri, N. (2002). Essentials of Communication. Greenspan Publications

Baran, S. (2014). Mass Communication Theory. Wadsworth Publishing.

Stevenson, D. (2002). Understanding Media Studies: Social Theory and Mass Communication, Sage Publications.

McQuail, D. (2000). Mass Communication Theories. London: Sage Publications.

Zeuschner, R. (1997). Communicating Today. California State University, USA.

BSC. (HONS.) FOOD TECHNOLOGY

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-FT01) Fundamentals of Food Technology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Fundamentals of Food Technology	**4**	**3**	**0**	**1**	**Class XII with PCM/PCB**	**-**

Learning Objectives

1. To understand the basic principles of food science and technology.
2. To understand the structure, composition, nutritional value, changes during processing and storage of various plant and animal foods.

Learning outcomes

1. Appreciate the principles of food science and technology.
2. Attain knowledge of the structure, composition, nutritional quality and post-harvest changes in various plant foods
3. Comprehend the structure and composition of various animal foods. 4. Understand the fundamentals of various plant and animal food processing

SYLLABUS OF DSC-1

Unit I: Introduction to Food Science and Technology (4 Hours)

The unit presents the student with an overview of the food science and technology.

Unit II: Structure, Nutritional Composition and Technological aspects of Plant foods (12 Hours)

Unit Description: Cereals, Millets and Pulses

Subtopics: Introduction to cereals, nutri-cereals (millets), pseudo cereals. ● Wheat- Structure and composition, types of wheat, Diagrammatic representation of longitudinal structure of wheat grain. ● Malting, dextrinization, gelatinization, types of browning Maillard & caramelization. ● Rice- types of rice, parboiling of rice- advantages and disadvantages. ● Pulses- Introduction to pulses and legumes. ● Naturally occurring toxic constituents in pulses, types of processing- soaking, germination, decortication, cooking and fermentation.

Unit III: Structure, Nutritional Composition and Technological aspects of Plant foods (13 Hours)

Unit Description: Edible Oils, Fruits and Vegetables

Subtopics: Fats & Oils- Classification of lipids, saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids. ● Refining of oils-different methods, hydrogenation ● Rancidity –Types- hydrolytic and oxidative rancidity and its prevention. Fruits & Vegetables- Classification of fruits and vegetables, composition, pigments, types of fibre. ● Enzymatic browning and its prevention, ● Post-harvest

changes in fruits and vegetables – Climacteric and non-climacteric, ripening, physicochemical changes-physiological and horticultural maturity, pathological changes, during the storage of fruits and vegetables.

Unit IV: Nutritional Compositional and Technological aspects of Animal foods

(16 Hours)

Unit Description: Flesh Foods - Meat, Fish, Poultry and Milk and Milk products

Subtopics: ● Meat – Definition of carcass, composition of meat, post-mortem changes in meat- rigor mortis, tenderization of meat, curing and ageing of meat. ● Fish - Classification and composition of fish, aquaculture, characteristics of fresh fish, Types of spoilage in fish- microbiological, physiological, biochemical. ● Poultry - Structure and composition of egg, egg proteins, characteristics of fresh egg, deterioration of egg quality. difference between broiler and layers. ● Milk & Milk Products- Definition of milk, composition of milk and types of market of milk, milk processing- homogenization, pasteurization.

Practical component – 30 Hours

1. To study enzymatic browning in fruits & vegetables.
2. To study different types of non-enzymatic browning.
3. To study gelatinization behavior of various starches.
4. To study the concept of gluten formation of various flours.
5. To study germination.
6. To study dextrinization in foods.
7. To perform quality inspection of egg.

Essential readings

1. Bawa. A.S., Chauhan, O.P, Raju. P.S. (2013) ed. Food Science. New India Publishing Agency
2. Potter, N. N., & Hotchkiss, J. H. (2012). Food science. Springer Science & Business Media.
3. Srilakshmi, B. (2018). Food science. New Age Publishers. 7th edition.

Suggestive reading

1. De, Sukumar. (2007). Outlines of Dairy Technology. Oxford University Press
2. Kent, N.L.(2018). Kent's Technology of Cereals: An introduction for students of food science and agriculture. Elsevier. 5th edition.
3. Meyer. (2006). Food Chemistry. CBS publishers and distributors.
4. Stewart, G.F., &Amerine, M.A.(2012). Introduction to Food Science and Technology. Elsevier, 2nd Edition.
5. Rao, E.S. (2019) Fundamentals of Food Technology and Preservation, Variety Books, New Delhi.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-FT02) Principles of Food Science

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Principles of Food Science	**4**	**3**	**0**	**1**	Class XII with **PCM/PCB**	**-**

Learning Objectives

1. To impart basic concepts of food science, food chemistry and food sanitation.
2. To introduce the concept of food microbiology, sensory science and food packaging.

Learning outcomes

Understand the basic concepts of

1. Structure and composition, food science and food sanitation.
2. Food microbiology, sensory science and food packaging

SYLLABUS OF DSC- 2

Unit I: Surface Chemistry and Structural properties of foods (12 Hours)

Unit Description: Surface Chemistry and Structural properties of foods

Subtopic: Introduction to engineering properties of food and biomaterials, structure and chemical composition of foods, physical properties and surface chemistry (colloids, emulsions, foam, sols, gels, pectin gels) and application

Unit II: Sensory properties of foods (10 Hours)

● Basic description of taste, flavour, odour, colour and texture. ● Theories of gustation, olfaction, colour and texture. ● Techniques of sensory evaluation (Descriptive and Discriminative tests)

Unit III: Basic Food Microbiology (8 Hours)

Introduction to types of microorganisms, Food as a substrate for microorganism, bacterial growth curve, Factors affecting growth of microbes : Intrinsic and Extrinsic

Unit IV: Waste management and sanitation (9 Hours)

Properties of Waste water, hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, detergents and sanitizers used in food industry, CIP and COP system with reference to food industry

Unit V: Introduction to Food Packaging (6 Hours)

Objectives of packaging, types of packaging materials (paper, glass, plastic, metal and wood, rigid and flexible packaging) and properties

Practical component – 30 Hours

1. Preparation and standardization of reagents
2. Determination of moisture content of food samples
3. Demonstration of fat/ protein estimation
4. Preparation of degree brix solution
5. Application of colloidal chemistry to food preparation
6. To perform sensitivity / threshold tests for basic taste
7. Introduction to microscopy and study of morphology of bacteria, yeast and mold using permanent slides.
8. Determination of alkalinity/ hardness of water
9. Determination of BOD/COD and total dissolved solids of water samples
10. Identification and testing (Thickness, GSM) of different types of packaging materials

Essential readings

- Coles, R., McDowell, D., & Kirwan, M. J. (Eds.). (2003). Food packaging technology (Vol. 5). CRC press.
- De, S. (1996). Outlines of dairy technology. Oxford University Press.
- DeMan, J. M., Finley, J. W., Hurst, W. J., & Lee, C. Y. (2018). Principles of food chemistry, 4th ed. Springer.
- Frazier, W.C. and Westhoff, D.C.(2004). Food Microbiology.New Delhi. TMH Publication
- Shadaksharaswamy, M., & Manay, N. S. (2011). Food, facts and principles. 4 th ed. New Age international publisher. New Age International.
- Meyer LH.(2006). Food Chemistry, CBS Publication, New Delhi.
- Potter N.N., Hotchkiss J.H. (2007). Food Science,5th ed. CBS Publication, New Delhi
- Ranganna, S. (2002). Handbook of Analysis of quality control for fruit and Vegetables products 2nd Ed. Tata Mcgraw Hill pub. Co. Ltd. New Delhi

Suggestive readings (if any)

- Jenkins, W.A. and Harrington, J.P. (1991). Packaging Foods with Plastics, Technomic Publishing Company Inc., USA.
- Norman, G. Marriott. and Robert, B. Gravani. (2018). Principles of Food Sanitation,6th ed. New York, Springer

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-FT03) MILK & MILK PRODUCTS TECHNOLOGY

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/ Practice		
MILK & MILK PRODUCTS TECHNOLOGY	**4**	**3**	**0**	**1**	**Class XII pass** with **PCM/PCB**	

Learning Objectives

1. Processing of milk and milk products at industry level
2. To know the compositional and technological aspects of milk
3. To study processed milk products

Learning outcomes

1. Understand the importance of Dairy industry
2. Understand the various properties and composition of milk.
3. Understand the technology of manufacturing of various products like Butter, ghee, Yoghurt, Dahi, Shrikhand, Ice-cream, Milk powder, channa, Paneer, Cheese (cheddar), Khoa
4. Understand market milk industry stages of milk processing and working of a few Dairy equipment's

SYLLABUS OF DSC-3

Unit I: Physical properties of milk (7 Hours)

• Color • Taste • pH and buffering capacity • Refractive index • Viscosity • Surface tension • Freezing & boiling point • Specific heat and electrical conductivity

Unit II: Composition of milk (16 Hours)

Unit Description: Macro nutrients and micronutrients of milk; milk sugar, fat and protein.
Subtopics: • Lactose (alpha and beta forms and their differences) • Significances of lactose in dairy industry • Composition and structure • Fat constants (Saponification value, Iodine value, RM value, Polenske value, peroxide value) • Difference between casein and serum protein • Different types of casein (acid and rennet) • Uses of casein

Unit III: Market milk industry and milk products (22 Hours)

Processing of milk and milk products
Subtopics: • Systems of collection of milk reception • Platform testing • Various stages of processing; Filtration, Clarification Homogenization, Pasteurization • Description and working of clarifier, cream separator, homogenizer and plate heat exchanger • Principle of processing of following milk products -Butter, ghee, yoghurt, dahi, shrikhand, ice-cream, milk powder, channa, paneer, cheese (cheddar), khoa

Practical components – 30 Hours

1. To determine specific gravity of milk
2. To determine acidity of milk
3. To perform COB test in milk
4. To estimate milk protein by Folin method
5. To estimate milk fat by Gerber method
6. To prepare casein and calculate its yield
7. To perform MBRT test in milk
8. Schematic diagram of pasteurization of milk in dairy industry
9. Study energy regeneration in dairy industry
10. Study and schematic diagram of CIP in dairy industry

Essential readings

● De, Sukumar. (2007). Outlines of dairy technology. Oxford University Press.
● Webb B.H.and Alford (2005). Fundamentals of dairy chemistry. CBS Publisher.

Suggestive readings

● P.F. Fox, T. Uniacke-Lowe and J.A.O' Mahony (2005). Dairy Science and Technology. Taylor & Francis.
● P. Walstra, Jan T.M. Wouters and Tom J. Geurts (2015). Dairy chemistry and Biochemistry. Springe.

BSC. (PROG.) HOME SCIENCE
Category-II

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-1) –: INTRODUCTION TO RESOURCE MANAGEMENT

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Resource Management	**4**	**3**	**-**	**1**	**Class XII pass**	**-**

Learning Objectives

The Learning Objectives of this course are as follows:

1. To comprehend the fundamentals of resource management, their purpose and utilization in today's context and conservation approaches.
2. To understand the functions and processes of management in a scientific manner for optimum use of resources.

Learning outcomes

The Learning Outcomes of this course are as follows:

The students will be able:

1. Comprehend the concept and fundamentals of resource management in a changing scenario.
2. Acquaint themselves with the available resources, their uses and conservation approaches.
3. Utilize resources in an efficient and judicious manner.
4. Understand the functions and processes of management in a scientific manner for the optimum use of resources.

SYLLABUS OF DSC-1

UNIT – I Basics of Management **(9 Hours)**

This unit will develop understanding regarding the concept of management and role of motivation in management.

Subtopics:

- Concept, nature, universality and scope of management
- Theories and Approaches to Management
- Ethics in management
- Motivation in management

UNIT – II Functions of Management **(12 Hours)**

Students will be able to develop complete understanding of different management functions and their importance in the process of management.

Subtopics:

- Decision Making: Concept, significance and steps involved in decision-making process.
- Planning: Nature and characteristics, classification of plans & steps in planning.
- Organizing: Concept, significance and steps involved in organizing process.
- Supervision: Types of supervision (directing & guiding), factors of effective supervision.

● Controlling: Types of control, steps in controlling, requirements of effective control.
● Evaluation: Types and steps of evaluation.

UNIT – III Time and Energy Management (12 Hours)

This unit will orient the students towards application of management processes to time and energy as important resources.

Subtopics:

- Time Management: Concept, Tools of time management, types of time plans, Steps in making a time plan.
- Energy Management: Concept, principles of body mechanics, types of fatigue.
- Work Simplification: Techniques, Classes of Change.

UNIT – IV Prenatal Development (12 Hours)

Students will gain understanding of prenatal through presentations on stages of prenatal development and factors which have an impact.

Subtopics:

● Stages of prenatal development
● Factors affecting prenatal development

Practical component

Unit I: Identification and Development of managerial competencies

Activities:

● Micro Lab and Who am I
● SWOT analysis
- Self
- Case studies: Individuals
- Case studies: Organizations
● Building Decision making abilities
● Team building management games
● Decision Making through Case Analysis

Unit II: Time and Energy Management

Activities:

● Time Management:
- Evaluation of time plans through case analysis:
o Case Study - 1
o Case study - 2
- Analysis of time use pattern of self
- Preparation and evaluation of time plans
● Work improvement using time and motion study techniques
- pathway chart or travel chart / process chart - observe, record, and analyze an activity.
- pathway chart or travel chart / process chart - observe, record, and analyze an activity with improvement.

Essential readings

1. Goel, S. Ed. (2016). Management of resources for sustainable development. New Delhi: Orient Blackswan Pvt. Ltd.
2. Moore, T. J. (2021). Family resource management (4th ed.), ISBN-13: 978-1544370620.
3. Chhabra, T.N. (2020) Business Organization & Management. ISBN: 9789385071102
4. Griffin, R. W. (2016). Fundamentals of Management. Cengage Learning.

5. Griffin, R. W. (2013). Management: Principles and practices (11th ed.). South-Western Cengage Learning.
6. Rao, V.S. P. (2008). Principles & practice of management. Konark Publishers Pvt. Ltd.
7. Koontz, H., & O' Donnel, C. (2005).Management: A systems and contingency analysis of managerial functions. New York: McGraw-Hill Book Company.

Suggestive readings:

1. Kreitner, R. (2009). Management Canada: Houghton Miffin Harcourt Publishing Company.
2. Robbin, S.P. (2009). Fundamentals of management. Pearson Education.
3. Steidl, R. & Bratton, E. (1968). Work in the Home. USA: John Wiley & Sons, Inc.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2): FASHION CONCEPTS

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
FASHION CONCEPTS	4	3	-	1	Class XII pass	-

Learning Objectives

The Learning Objectives of this course are as follows:

1. To understand the basics of fashion and the fashion industry.
2. To impart knowledge about functions and theories of clothing.
3. To develop sensitivity towards selection of garments and garment design.

Learning outcomes

The Learning Outcomes of this course are as follows:

1. Identify the role and functions of clothing and recognize the factors affecting the selection and evaluation of clothing.
2. Explain the concept of fashion, its terminology, sources and factors affecting it.
3. Being aware of global fashion centers.
4. Apply the knowledge of elements and principles in design interpretation.

SYLLABUS OF DSC- 2

UNIT – I Clothes and Us (12 Hours)

This unit introduces the student to key concepts of how and why people started to wear clothes, and what factors are at play in the current times for selecting clothing for the individual.

- Clothing functions and theories of origin
- Clothing terminology
- Individuality and conformity, conspicuous consumption and emulation
- Body shapes
- Selection and Evaluation of quality of ready-made garments
- Selection of clothes for self

UNIT – II Understanding Fashion (12 Hours)

This unit will deal with the basic concepts in understanding fashion, from key terms to the why and how of fashion and more contemporary knowledge of fast and slow fashions.

- Fashion cycle
- Terminology
- Theories of fashion adoption
- Sources of fashion research

- Factors favouring and retarding fashion
- Role of a Designer
- Fast Fashion: Characteristics of Fast Fashion, Fast Fashion and Consumer
- Slow Fashion: Characteristics, Slow Fashion as a process, importance of changing from fast to slow fashion.

UNIT – III Design in Garments (9 Hours)

This unit orients the student from a design perspective in garments; the various elements that comprise a garment and the various principles that govern and guide in developing a good design.

UNIT – IV Fashion (12 Hours)

This unit will apprise the student on the forecasting process for fashions, functioning of the industry and various garment categories for production

● Structure and Functioning of Fashion Industry
● Forecasting: Fashion seasons
● Garment Categories
● Fashion Centres
● Careers in Fashion

Practical component – 30 Hours

Unit I: Hand stitches

This unit will impart hands-on skill for making small products using upcycling of used articles of clothing or home textiles and how value addition may be achieved in garments by using popular embroidery stitches.

● Prepare samples of -
- Basic hand stitches for creating a seam and edge finishing.
- Decorative Hand Stitches

Develop an upcycled product.

Unit II: Elements & Principles of Design

This unit will train the students to identify the various elements of a design that a garment uses and the principles that create an aesthetic design. Eventually a student will be able to effectively use these elements and principles of design to create well designed garments.

● Create a collection of garments for analysis from print and visual media.
● Analyze the various elements that comprise the garments.
● Identify the various principles of design used in the selected garments

Essential readings

1. Brown, Patty, Rice J., 1998, Ready to Wear Apparel Analysis. Prentice Hall.
2. Marshall S G, Jackson H O, Stanley MS, Kefgen M & Specht T, 2009, Individuality in
3. Clothing & Personal Appearance, 6th Edition, Pearson Education, USA.
4. Tate S.L., Edwards M.S., 1982, The Complete Book of Fashion Design, Harper and Row Publications, New York.
5. Fringes G.S., 1994, Fashion From Concept to Consumer, 6th edition, Prentice Hall, New Jersey.

Suggestive readings

1. R. Andrew, 2018, Key Concepts for Fashion Industry, Bloomsbury Publishing, India.
2. Reader's Digest (Eds.). 2002, New Complete Guide to Sewing, (Canada) Ltd. Montreal.

DISCIPLINE SPECIFIC CORE COURSE – 3 (DSC-3): INTRODUCTORY LIFE SCIENCES FOR HOME SCIENCE

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
INTRODUCTORY LIFE SCIENCES FOR HOME SCIENCE	4	2	-	2	Class XII pass	-

Learning Objectives

The Learning Objectives of this course are as follows:

1. To introduce students to animal and plant diversity, and its significance for human life.
2. To make students aware of the fundamentals of cell structure, physiology and growth.
3. To enable students to appreciate the interdependence of ecosystems and its environmental underpinnings.
4. To make students aware of basics of immunology, genetics and biotechnological applications.

Learning outcomes

The Learning Outcomes of this course are as follows:

1. The students would be able to identify animals and plants of human concerns and ecological importance.
2. The students would be able to appreciate the existential link between plants, microbes, animals and humans.
3. The students would develop hands-on experience on plant propagation methods along with a functional understanding of plant physiology.
4. The students would understand the importance of prenatal screening, and biotechnology.
5. The student would be able to make a pedigree chart of a family and identify the inheritance pattern of a character.

SYLLABUS OF DSC- 3

Section A – Botany

UNIT – I Introduction to the Plants: Cytology, Morphology and Economic Botany (8 Hours)

Fundamentals of Plant diversity, Plant morphology and Plant Resource Utilization

Subtopics

- Introduction to Plant Diversity
- Types of a cell: Prokaryotes and Eukaryotes
- Plant cell- An Overview, Types, Structure and Function
- Angiosperm plants: Morphology (Parts of plants with modifications and Life cycle)
- Plant Nutrition and Soil: Essential Elements and Functions, Nutrient cycles, Biofertilizers, Bio-enzymes
- Introduction to Economically important plants: Fibre Crops, Medicinal Plants, Oil Crops, Timber Plants, Food Crops

UNIT – II Plant Physiology, Propagation of Plants and Gardening (7 Hours)

Basics of plant physiology, Plant propagation and Gardening
Subtopics

- Important physiological processes (Diffusion, Osmosis and plasmolysis)
- Brief account of transpiration, photosynthesis and respiration in plants
- Seed Propagation
- Vegetative Propagation: Cuttings – stem leaf and root, Layering, Grafting
- Gardening: Concept and Types with example of Kitchen Garden, Community gardens, and Maintenance of Plants
- Role of Plants in Air pollution Control
- Introduction to Organic farming, Climate smart agriculture

Section B – Zoology
UNIT – III Animal Diversity and Human needs (8 Hours)
Animal diversity and importance in human life
Subtopics

- Types, Structure and Function of Animal Cell and its Components
- Animals and their ecosystem services (role of animals in pollination, seed dispersal, soil health, food security, domestic animals)
- Animal diversity in human environment: threats and conservation, human-animal conflict
- Economic importance and control of common household pests e.g. cockroach, housefly, mosquitoes and termites
- Identification and control of important stored grain pests
- Zoonotic disease: Transmission, Prevention and Control (Taeniasis, Ascariasis, Malaria, COVID-19, Bird flu, Rabies, Tuberculosis)

UNIT – IV Genetics, Immunity and Biotechnology (7 Hours)
Basics of genetics, birth defects, immunity and biotechnology
Subtopics

- Structure and Function of Genes and Chromosome
- Laws of Heredity and sex linked inheritance
- Case Studies: Inheritance of Thalassemia, Sickle Cell Anaemia and Phenylketonuria (PKU)
- Overview of Birth defects: Types and Causes with example like Down's syndrome etc.
- Basics of Human Immunity
- Introduction to Biotechnology: Application in Animal Improvement and Medicines

Practical component – 30 Hours
SECTION A- BOTANY

1. Study the role of sunlight during photosynthesis
2. Study the rate of transpiration on both the surfaces of leaves
3. Assessment of soil quality: determination of soil pH, test for nitrates, nitrites
4. Preparation of soil mixture, potting and re-potting
5. Raising of healthy seedlings in a nursery bed
6. Propagation of plants through stem cutting , air layering and underground layering
7. Propagation of plants by approach grafting and veneer grafting
8. Identification and classification of economically important Food Crops, Medicinal, Fibre crops, Timber Plants and Oil Crops
9. Identification, care and maintenance of important plants in controlling air pollution
10. Preparation of temporary mount of onion peel

11. Preparation of temporary mount of epidermis of Rhoeo plant to study distribution of stomata on upper and lower surface of leave

SECTION B- ZOOLOGY

1. Study of cell structure through temporary slides: Blood Cells
2. Study of cell structure through temporary slides: Neurons
3. Study of cell cycle stages through permanent slides: Mitosis
4. Study of cell cycle stages through permanent slides: Meiosis
5. Identification of few common animal and birds in the human environment
6. Estimation of species richness and abundance of animal/ birds in the human environment using point count method
7. Estimation of species richness and abundance of animal/ birds in the human environment using transect method
8. Identification of life cycle stages of two common household pests: Termite and Mosquito
9. Methods of pest control and its application in houses (through audio/ visual/ seminar/visit)
10. Pedigree chart preparation & analysis
11. Demonstration of vermicomposting: preparation and monitoring of the setup at home
12. Case study of a zoonotic/ parasitic disease: COVID-19 pandemics/ bird flu

Essential readings

1. Jordan E. L. and Verma P. S. 2009. Invertebrate Zoology, S. Chand and Co. Ltd, New Delhi.
2. Raven P. and Johnson G. 2010. Biology. Tata McGraw Hill Publication, New Delhi.
3. Soni N. K. and Soni V. 2010. Fundamentals of Botany. Tata McGraw Hill Publication, New Delhi.
4. K. Park. 2016. Textbook of preventive and social medicine. Banarsidas Bhanot Publishers.
5. Singh J. S., Singh S. P. and Gupta S. R. 2017. Ecology, Environment Science and Resource Conservation. S.Chand (G/L) & Company Ltd, India.

Suggestive readings

1. Chadha K. L. 2012. Handbook of Horticulture. ICAR Publication, New Delhi.
2. Gopalaswamiianger K.S. 1991. Complete gardening in India. Messers Nagaraj and Co., Madras.
3. Magurran, A.E. 1988. Ecological Diversity and Measurement. Croom Helm Limited, Australia.
4. Gupta R. 2015. Fundamentals of Zoology: Theory and Practice. Elite Publishing House Pvt. Ltd., New Delhi.
5. Hartman H. T and Kester D. 1986. Plant Propagation: Principles and Practices Prentice Hall of India Pvt. Ltd., New Delhi.
6. Kotpal, R. L. 2000. Modern Textbook of Zoology. Rastogi Publications, Meerut.
7. Upadhyay R. 2017. Elements of Plant Science. Elite Publishing House, New Delhi.
8. Vij, U and Gupta, R. 2011. Applied Zoology. Phoenix Publishing House, New Delhi.

B.A (Prog.) with Nutrition and Health Education (NHE) as Major

Category-II

DISCIPLINE SPECIFIC CORE COURSE – DSC-1-NHE: FUNDAMENTALS OF NUTRITION

Credit distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Fundamentals of Nutrition	4	3	1	-	Class XII Pass	NIL

Learning Objectives:

1. To familiarize students with fundamentals of nutrition and their relation to health.
2. To study the functions, dietary sources and clinical manifestations of deficiency or excess of nutrients.
3. To create awareness about enhancing nutritional quality of food.

Learning Outcomes:

After completion of the course, the students will be able to:

1. Understand basic concepts in nutrition and interpret relation between food, nutrition and health.
2. Describe functions, dietary sources and clinical manifestations of deficiency or excess of important nutrients.
3. Understand healthy cooking practices and minimizing nutrient losses.
4. Describe various methods of enhancing nutritional quality of food.

SYLLABUS OF DSC-1

Theory:

Unit 1: Basic Concepts in Nutrition **(7 Hours)**

- *Unit Description*: This unit will introduce the basic terms in nutrition
- *Subtopics:*
  - Basic terms used in study of nutrition – food, health, nutrients, nutritional status, malnutrition.
  - Macronutrients, micronutrients, nutraceuticals, phytochemicals, antioxidants and balanced diet.
  - Understanding relationship between food, nutrition and health.

Unit 2: Energy, Macronutrients and Water **(13 Hours)**

- *Unit Description:* This unit will introduce the students to energy components, macronutrients and water.
- *Subtopics:*
  - Energy- Components of energy expenditure and factors affecting energy requirement.

- Classification, functions, dietary sources and clinical manifestations of deficiency/excess of the following:
  - Carbohydrates including dietary fibre.
  - Dietary fat and fatty acids; introduction to lipoproteins (LDL & HDL)
  - Protein including protein quality

Unit 3: Micronutrients (18 Hours)

- *Unit Description:* This unit will introduce the various vitamins and minerals present in foods.
- *Subtopics:*
  - Functions, dietary sources and clinical manifestations of deficiency /excess of the following:
    - Fat soluble vitamins – A, D, E and K.
    - Water soluble vitamins – thiamine, riboflavin, niacin, pyridoxine, folic acid, vitamin B_{12} and vitamin C.
    - Minerals – calcium, iron, iodine, zinc, sodium and potassium.

Unit 4: Enhancing Nutritional Quality of Food (7 Hours)

- *Unit Description*: This unit will explain ways to minimize nutrient losses and enhance nutritional quality of food
- *Subtopics:*
  - Minimizing nutrient losses during food preparation.
  - Enhancing nutritional quality by supplementation, germination, fermentation and fortification.

Essential/recommended readings:

1. Rekhi, T., & Yadav, H. (2015). *Fundamentals of Food and Nutrition.* Delhi: Elite Publishing House Pvt. Ltd.
2. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy*; (6th ed.). Delhi: New Age International (P) Ltd.
3. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.
4. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient Blackswan.
5. Srilakshmi, B. (2018). *Food science* (7th ed.) Delhi: New Age International (P) Ltd.

Suggested readings:

1. Roday, S. (2013). *Food science and nutrition*. (2nd ed.). Oxford University Press.
2. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition.* (11th ed.). New York, NY: McGraw Hill.
3. Agarwal, A., & Udipi. S. (2014). *Textbook of human nutrition*, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-NHE: INTRODUCTION TO FOODS

Credit distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Introduction to Foods	4	3	-	1	Class XII Pass	NIL

Learning Objectives:

1. To introduce students with the functions of food.
2. To explain the nutritional contribution, selection, changes in cooking and storage of different food groups.
3. To generate awareness about various methods of cooking.

Learning Outcomes:

After completion of the course, the students will be able to:

1. Understand various functions of food and factors affecting food choices.
2. Acquaint themselves to select, purchase and store food safely.
3. Describe various methods of cooking and principles underlying them.

SYLLABUS OF DSC-2

Theory:

Unit 1: Basic Concepts of Food **(8 Hours)**

- *Unit Description:* This unit will introduce the concept of food, functions of food and factors affecting food choices.
- *Subtopics:*
    - Definition of food including organic food, genetically modified foods, convenience foods, health foods.
    - Functions of food.
    - Factors affecting food choices.

Unit 2: Plant Based Food Groups **(15 Hours)**

- *Unit Description:* This unit will introduce nutritional contribution, selection, changes in cooking and storage of the plant-based food groups.
- *Subtopics:*
    - Nutritional contribution, selection, changes in cooking and storage of the following:
        - Cereal and cereal products
        - Pulses
        - Vegetable and fruits
            - Sugars
            - Oils and fats

Unit 3: Animal Based Food Groups **(8 Hours)**

- *Unit Description:* This unit will introduce nutritional contribution, selection, changes in cooking and storage of the animal-based food groups.

- *Subtopics:*
    - Nutritional contribution, selection, changes in cooking and storage of the following:
        - Milk and milk products
        - Eggs and flesh foods

Unit 4: Methods of Cooking Foods **(14 Hours)**

- *Unit Description:* This unit will introduce advantages and principles of cooking and various cooking methods.
- *Subtopics:*
    - Advantages of cooking
    - Principles of cooking
    - Preliminary steps in food preparation
    - Cooking methods:
        - Moist heat methods
        - Dry heat methods
        - Methods using fat as a medium
        - Others – microwave, solar cooking

Practical:

Unit 1: Cooking methods I (16 Hours)

- *Subtopics:*
    - Cooking employing dry heat methods
    - Cooking employing moist heat methods

Unit 2: Cooking methods II **(14 Hours)**

- *Subtopics:*
    - Cooking using frying as a cooking method
    - Cooking using microwave

Essential/recommended readings:

1. Rekhi, T., & Yadav, H. (2015). *Fundamentals of Food and Nutrition.* Delhi: Elite Publishing House Pvt. Ltd.
2. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy*; (6th ed.). Delhi: New Age International (P) Ltd.
3. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.
4. Srilakshmi, B. (2018). *Food science* (7th ed.) Delhi: New Age International (P) Ltd.
5. Raina, U., & Kashyap, S. (2010). *Basic Food Preparation – a complete manual* (4th ed.). Delhi: Orient Black Swan.

Suggested readings:

1. Roday, S. (2013). *Food science and nutrition*. (2nd ed.). Oxford University Press.
2. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition.* (11th ed.). New York, NY: McGraw Hill.
3. Agarwal, A., & Udipi. S. (2014). *Textbook of human nutrition*, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
4. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient Blackswan.

B.A (Prog.) with Nutrition and Health Education (NHE) as Non-Major

Category-III

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-NHE: INTRODUCTION TO FOODS

Credit distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Introduction to Foods	4	3	-	1	Class XII Pass	NIL

Learning Objectives:

1. To introduce students with the functions of food.
2. To explain the nutritional contribution, selection, changes in cooking and storage of different food groups.
3. To generate awareness about various methods of cooking.

Learning Outcomes:

After completion of the course, the students will be able to:

1. Understand various functions of food and factors affecting food choices.
2. Acquaint themselves to select, purchase and store food safely.
3. Describe various methods of cooking and principles underlying them.

SYLLABUS OF DSC-1

Theory:

Unit 1: Basic Concepts of Food (8 Hours)

- *Unit Description:* This unit will introduce the concept of food, functions of food and factors affecting food choices.
- *Subtopics:*
  - Definition of food including organic food, genetically modified foods, convenience foods, health foods.
  - Functions of food.
  - Factors affecting food choices.

Unit 2: Plant Based Food Groups (15 Hours)

- *Unit Description:* This unit will introduce nutritional contribution, selection, changes in cooking and storage of the plant-based food groups.
- *Subtopics:*
  - Nutritional contribution, selection, changes in cooking and storage of the following:
    - Cereal and cereal products
    - Pulses
    - Vegetable and fruits

- Sugars
- Oils and fats

Unit 3: Animal Based Food Groups (8 Hours)

- *Unit Description:* This unit will introduce nutritional contribution, selection, changes in cooking and storage of the animal-based food groups.
- *Subtopics:*
  - Nutritional contribution, selection, changes in cooking and storage of the following:
    - Milk and milk products
    - Eggs and flesh foods

Unit 4: Methods of Cooking Foods (14 Hours)

- *Unit Description:* This unit will introduce advantages and principles of cooking and various cooking methods.
- *Subtopics:*
  - Advantages of cooking
  - Principles of cooking
  - Preliminary steps in food preparation
  - Cooking methods:
    - Moist heat methods
    - Dry heat methods
    - Methods using fat as a medium
    - Others – microwave, solar cooking

Practical:

Unit 1: Cooking methods I (16 Hours)

- *Subtopics:*
  - Cooking employing dry heat methods
  - Cooking employing moist heat methods

Unit 2: Cooking methods II (14 Hours)

- *Subtopics:*
  - Cooking using frying as a cooking method
  - Cooking using microwave

Essential/recommended readings:

1. Rekhi, T., & Yadav, H. (2015). *Fundamentals of Food and Nutrition.* Delhi: Elite Publishing House Pvt. Ltd.
2. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy*; (6th ed.). Delhi: New Age International (P) Ltd.
3. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.
4. Srilakshmi, B. (2018). *Food science* (7th ed.) Delhi: New Age International (P) Ltd.
5. Raina, U., & Kashyap, S. (2010). *Basic Food Preparation – a complete manual* (4th ed.). Delhi: Orient Black Swan.

Suggested readings:

1. Roday, S. (2013). *Food science and nutrition*. (2nd ed.). Oxford University Press.
2. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition.* (11th ed.). New York, NY: McGraw Hill.
3. Agarwal, A., & Udipi. S. (2014). *Textbook of human nutrition*, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
4. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient B lackswan.

B.A (Prog.) with Apparel Design and Construction (ADC) as Major

Category-II

DISCIPLINE SPECIFIC CORE COURSE – DSC-1-ADC: FUNDAMENTALS OF APPAREL DESIGN AND CONSTRUCTION

Credit Distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Fundamentals of Apparel Design & Construction	4	2	-	2	Class XII Pass	NIL

Learning Objectives:

1. To familiarise the students with the terminologies and concepts related to apparel design and its construction
2. To provide the basic knowledge of the different tools and processes involved in garment design and construction
3. To familiarise the students with the concepts related to apparel finishes and quality
4. To provide an introduction to home and technical textiles

Learning Outcomes:

After completion of the course, the students will be able to:

1. Define basic apparel design and construction terminologies
2. Identify and describe the functions of tools used in garment design and pattern making
3. Describe the importance and types of fabric grain.
4. Explain the steps of garment construction such as the preparation of the fabrics, laying out the patterns, cutting and marking the fabrics
5. Explain different types of pattern layout on various fabrics.
6. Make different types of temporary, permanent and decorative stitches.
7. Finish plain seam using various techniques
8. Construct a flanged pillow cover and Petticoat
9. Identify and describe the types of home textiles and technical textiles

SYLLABUS OF DSC-1

Theory:

Unit 1: Introduction to Apparel Design (10 Hours)

- *Unit Description:* This unit introduces the students to common terminologies and concepts associated with garment design. It also deals with the aspects and factors affecting garment design and the type of trimmings that would add to the aesthetic aspects of the design.

- *Sub Topics:*

- Common terms: Apparel, Seam, Seam Finish, Seam allowance, Basic Blocks, Pattern, Grading, Stay stitching, Facing, Binding, Hem, Yoke, Gusset, Nap, Darts, Pleats, Tucks, Gathers
- Garment Design: Aspects (Function, Structure, Decoration) and types (Structural and Applied/Decorative), Application of structural and decorative design in a garment
- Trimmings – Types, selection and application of trimmings on apparels.
- Garment designing according to age, climate, occasion, occupation, fashion

Unit 2: Basics of Apparel Construction (10 Hours)

- *Unit Description:* This unit provides the basic knowledge of the tools and steps associated with apparel construction.

- *Sub Topics:*
  - Fabric grain – types, identification and importance in apparel construction
  - Common tools and equipment required for measuring, drafting, pinning, marking, cutting, sewing, pressing
  - Preparation of fabrics for clothing construction- Pre-shrinking, Grain straightening, truing
  - Steps in Clothing Construction – Pattern layout, pinning, marking, cutting and sewing
  - Pattern Layout - general guidelines, basic layouts- lengthwise, partial lengthwise, crosswise, double fold, open, combination fold

Unit 3: Application of Textiles and Garment Quality (10 Hours)

- *Unit Description:* This unit familiarises the students of the Application of textiles as apparel, at home and in the industry. It also introduces the students to the concept of readymade garment quality and the criteria for quality evaluation.

- *Sub Topics:*
  - Apparel/Garment Classification
  - Home Textiles – Categories, Standard Sizes and Fabrics used for Towels, Bed Linen
  - Technical Textiles – Medical textiles, Protective textiles, Sports textiles, Smart textiles
  - Garment Labels: Types and importance of labels with special reference to care labels
  - Evaluating the quality of readymade garments: overall appearance, fabric, fit, workmanship, finishing, price
  - Project work: Evaluation of Readymade garment Quality

Practical:

Unit 1: Hand Stitches and Basic Blocks (30 Hours)

- *Sub Topics:*
  - Hand Stitches
    i. Temporary hand stitches - even, uneven, pin, machine, diagonal basting, thread mark
    ii. Permanent hand stitches - hemming, blind hemming, back stitch, fine stitch
    iii. Decorative hand stitches – stem, chain, herringbone, running, lazy-daisy, satin
    iv. Fastener attachment – Button and buttonhole, Hook and eye, Press Button
  - Child's basic bodice and basic sleeve block.
  - Adaptation of child's basic sleeve to flared, puffed sleeve

Unit 2: Machine Sewing and Design Analysis **(30 Hours)**

- *Sub Topics:*
  - Introduction to sewing machine - Practice of running sewing machine on paper and fabric on straight lines, curved lines and corners.
  - Plain seam and seam finishes - Pinking, Turned and Stitched, Edge stitched, hand overcast, over-locked, Piped/Bound
  - Samples of pleats, tucks, gathers
  - Construction of a flanged pillow cover, petticoat
  - Analysis of the use of structural and Decorative designs in garments.

Essential/ Recommended Readings:

- Colton V. (1995). Reader's Digest- Complete Guide to Sewing. New York: The Reader's Digest Association, Inc.
- Brown, P. and Rice, J.1998, Ready-to-wear Apparel Analysis, Prentice Hall,Frings G. (1996). Fashion-From Concept to Consumer (5th Edition). USA: Prentice Hall Publications
- Kallal, M. J., 1985, Clothing Construction, Macmillion Publishing Company, New York,
- Marshall S G, et al. (2009). Individuality in Clothing & Personal Appearance (6th Edition). USA: Pearson Education,
- Vanderhoff M., Franck L., Campbell L., (1985). Textiles for Homes and People. Massachusetts: Ginn and Company.

Suggested Readings:

- Cunningham G. (1976). Singer Sewing Book. New York: The Singer Company.
- Gayatri V. (2007). Cutting and Stitching Practical. New Delhi: Asian Publishers.
- Stamper, A.A., S. H. Sharp and L.B. Donnell, 1986, Evaluating Apparel Quality, Fairchild Publications, America
- Verma P. (2003). Vastra Vigyan Evam Paridhan. Bhopal: Hindi Granth Academy

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-ADC: UNDERSTANDING FABRICS

Credit Distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Understanding Fabrics	4	3	-	1	Class XII Pass	NIL

Learning Objectives:

1. To impart knowledge regarding production, properties and usage of textile fibres and yarns
2. To apprise the learners about the various techniques of fabric production and their properties
3. To familiarise the students with the concepts related to fabric finishes and quality.

Learning Outcomes:

After completion of the course, the students will be able to:

1. Classify textile fibres based on length and origin.
2. Identify different types of textile fibres using various tests.

3. Compare and select fabrics for different end uses based on their properties
4. Describe the properties of textile yarns based on their characteristics
5. Identify different textile fabrics based on their construction
6. Refer to fabrics by their popular trade names and their characteristics
7. Select fabrics for different end uses based on their regular and functional finishes
8. Describe the desirable fabric properties for garment construction
9. Inspect the fabrics and identify the quality related problems.

SYLLABUS OF DSC-2

Theory:

Unit 1: Textile Fibres (10 Hours)

- *Unit Description:* This unit provides basic knowledge of textile fibres to create a better understanding of the properties and end use of the fabrics made from different fibres

- *Sub Topics:*
  - Textile Fibre classification based on their Origin (natural and man-made) and Length (staple and filament)
  - Identification of textile fibres through Physical examination (Visual and Feeling test), Burning test, Microscopic test, Chemical test
  - Natural and Manmade Fibres - Properties and end-uses (Cotton, Linen, Wool, Silk, Rayon, Acetate, Nylon, Polyester, Acrylic, Spandex)
  - Newer Fibres – Properties and end uses

Unit 2: Textile Yarns (10 Hours)

- *Unit Description:* This unit provides basic knowledge of the yarn making processes and yarn properties to create a better understanding the fabrics made from them.

- *Sub Topics:*
  - Yarn manufacturing process – Basic steps of Mechanical and chemical spinning
  - Types of yarn – Spun and Filament, Simple and Fancy/Novelty
  - Yarn properties – Yarn count, Yarn twist

Unit 3: Fabric Construction (15 Hours)

- *Unit Description:* This unit provides knowledge of the most common fabric construction methods to help understand the properties of the fabrics better. It also deals with the quality aspects of the fabric and the procedures for checking their required quality specifications.

- *Sub Topics:*
  - Fabric construction methods – weaving, knitting, lace, net, felt and non-woven, braiding – properties and end uses
  - Weaving : Basic loom - parts and operations
  - Basic and fancy weaves – plain, twill, satin, dobby, jacquard, pile, leno, surface figure weaves
  - Knitting: Basic Construction, Characteristics and usage
  - Blended fabrics – Reasons for blending, Properties of common Blended Fabrics

- Glossary of Common Fabrics
- Fabric characteristics - texture, hand, weight, width
- Fabric Quality -Fabric inspection systems, Common Fabric defects, Acceptable quality level
- Visit to Weavers' Service Facility and writing a report on the visit

Unit 4: Fabric Finishes **(10 Hours)**

- *Unit Description:* This unit deals with the common routine and functional finishes applied on fabrics to provide a better understanding of fabric performance properties.

- *Sub Topics*:
  - Aims and classification of Fabric finishes
  - Basic/ Routine finishes - Scouring, Bleaching, De-sizing, Singeing, Mercerisation, Tentering, Calendaring
  - Functional finishes - Crease resistant, flame retardant, Anti-microbial, moth proofing

Practical:

Unit 1: Identification of Fibres and Yarns **(10 Hours)**

- *Subtopics:*
  - Identification of fibres – Physical Examination, Burning Test, Demonstration of Chemical and Microscopic Test
  - Identification of yarns by visual examination – spun & filament yarns, ply & novelty yarns

Unit 2: Analysis of Fabric Properties **(20 Hours)**

- *Subtopics:*
  - Analysis of Fabric properties - Dimensional Stability, Thread Count, GSM
  - Calculation of Yarn Count
  - Preparation of samples of basic weaves through paper/ribbon weaving
  - Preparation of a file containing fabric swatches of various Fibres, Yarns, Fabrics, Weaves, Fabric defects.

Essential Readings:

1. Corbman P.B. (1985). Textiles-Fibre to Fabric. New York: McGraw Hill Book Co.
2. Grover E. B. & Hamby D. S., (1969), Handbook of textile testing and quality control, New Delhi: Wiley Eastern Ltd. Handbook of textile testing,
3. Rastogi, D. & Chopra, S. (Eds.) (2017). Textile Science. New Delhi, India: Orient Black Swan Publishing Limited.
4. Sekhri S. (2013). Textbook of Fabric Science: Fundamentals to Finishing. Delhi, India: PHI Learning.

Suggested Readings:

1. Allec C., Johnson I., Joseph P. (2011). Fabric Science (6th Edition). New York: Fairchild Publications.
2. Bureau of Indian standards, (1990), Testing and grading of textile fibers, Part I-III, New Delhi
3. Tortora (1992) Understanding Textiles. 4th Ed., New York Macmillan Publishing Company
4. Verma P. (2003). Vastra Vigyan Evam Paridhan. Bhopal: Hindi Granth Academy.

B.A (Prog.) with Apparel Design and Construction (ADC) as Non-Major

Category-III

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-ADC: UNDERSTANDING FABRICS

Credit Distribution, Eligibility and Pre-requisites of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Understanding Fabrics	4	3	-	1	Class XII Pass	NIL

Learning Objectives:

1. To impart knowledge regarding production, properties and usage of textile fibres and yarns
2. To apprise the learners about the various techniques of fabric production and their properties
3. To familiarise the students with the concepts related to fabric finishes and quality.

Learning Outcomes:

After completion of the course, the students will be able to:

1. Classify textile fibres based on length and origin.
2. Identify different types of textile fibres using various tests.
3. Compare and select fabrics for different end uses based on their properties
4. Describe the properties of textile yarns based on their characteristics
5. Identify different textile fabrics based on their construction
6. Refer to fabrics by their popular trade names and their characteristics
7. Select fabrics for different end uses based on their regular and functional finishes
8. Describe the desirable fabric properties for garment construction
9. Inspect the fabrics and identify the quality related problems.

SYLLABUS OF DSC-1A

Theory:

Unit 1: Textile Fibres **(10 Hours)**

- *Unit Description:* This unit provides basic knowledge of textile fibres to create a better understanding of the properties and end use of the fabrics made from different fibres

- *Sub Topics:*
    - Textile Fibre classification based on their Origin (natural and man-made) and Length (staple and filament)
    - Identification of textile fibres through Physical examination (Visual and Feeling test), Burning test, Microscopic test, Chemical test
    - Natural and Manmade Fibres - Properties and end-uses (Cotton, Linen, Wool, Silk, Rayon, Acetate, Nylon, Polyester, Acrylic, Spandex)
    - Newer Fibres – Properties and end uses

Unit 2: Textile Yarns **(10 Hours)**

- *Unit Description:* This unit provides basic knowledge of the yarn making processes and yarn properties to create a better understanding the fabrics made from them.

- *Sub Topics:*
    - Yarn manufacturing process – Basic steps of Mechanical and chemical spinning
    - Types of yarn – Spun and Filament, Simple and Fancy/Novelty
    - Yarn properties – Yarn count, Yarn twist

Unit 3: Fabric Construction **(15 Hours)**

- *Unit Description:* This unit provides knowledge of the most common fabric construction methods to help understand the properties of the fabrics better. It also deals with the quality aspects of the fabric and the procedures for checking their required quality specifications.

- *Sub Topics:*
    - Fabric construction methods – weaving, knitting, lace, net, felt and non-woven, braiding – properties and end uses
    - Weaving : Basic loom - parts and operations
    - Basic and fancy weaves – plain, twill, satin, dobby, jacquard, pile, leno, surface figure weaves
    - Knitting: Basic Construction, Characteristics and usage
    - Blended fabrics – Reasons for blending, Properties of common Blended Fabrics
    - Glossary of Common Fabrics
    - Fabric characteristics - texture, hand, weight, width
    - Fabric Quality -Fabric inspection systems, Common Fabric defects, Acceptable quality level
    - Visit to Weavers' Service Facility and writing a report on the visit

Unit 4: Fabric Finishes **(10 Hours)**

- *Unit Description:* This unit deals with the common routine and functional finishes applied on fabrics to provide a better understanding of fabric performance properties.

- *Sub Topics*:
    - Aims and classification of Fabric finishes
    - Basic/ Routine finishes - Scouring, Bleaching, De-sizing, Singeing, Mercerisation, Tentering, Calendaring
    - Functional finishes - Crease resistant, flame retardant, Anti-microbial, moth proofing

Practical:

Unit 1: Identification of Fibres and Yarns (10 Hours)

- *Subtopics:*
  - Identification of fibres – Physical Examination, Burning Test, Demonstration of Chemical and Microscopic Test
  - Identification of yarns by visual examination – spun & filament yarns, ply & novelty yarns

Unit 2: Analysis of Fabric Properties (20 Hours)

- *Subtopics:*
  - Analysis of Fabric properties - Dimensional Stability, Thread Count, GSM
  - Calculation of Yarn Count
  - Preparation of samples of basic weaves through paper/ribbon weaving
  - Preparation of a file containing fabric swatches of various Fibres, Yarns, Fabrics, Weaves, Fabric defects.

Essential Readings:

1. Corbman P.B. (1985). Textiles-Fibre to Fabric. New York: McGraw Hill Book Co.
2. Grover E. B. & Hamby D. S., (1969), Handbook of textile testing and quality control, New Delhi: Wiley Eastern Ltd. Handbook of textile testing,
3. Rastogi, D. & Chopra, S. (Eds.) (2017). Textile Science. New Delhi, India: Orient Black Swan Publishing Limited.
4. Sekhri S. (2013). Textbook of Fabric Science: Fundamentals to Finishing. Delhi, India: PHI Learning.

Suggested Readings:

1. Allec C., Johnson I., Joseph P. (2011). Fabric Science (6th Edition). New York: Fairchild Publications.
2. Bureau of Indian standards, (1990), Testing and grading of textile fibers, Part I-III, New Delhi
3. Tortora (1992) Understanding Textiles. 4th Ed., New York Macmillan Publishing Company
4. Verma P. (2003). Vastra Vigyan Evam Paridhan. Bhopal: Hindi Granth Academy.

B.A (Prog.) with Human Development and Family Empowerment (HDFE) as Major

Category-II

DISCIPLINE SPECIFIC CORE COURSE – DSC-1-HDFE: THEORETICAL FOUNDATIONS IN HUMAN DEVELOPMENT

Credit distribution, Eligibility and Pre-requisite of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Theoretical Foundations in Human Development	4	3	-	1	Class XII Pass	NIL

Learning Objectives:

1. To enable an understanding of the significance of the theoretical basis of Human Development.
2. To gain an in-depth understanding of selected theories in Human Development.

Learning Outcomes:

After completing this course, the students will be able to:

1. Gain an insight into the importance and role of theories in Human Development.
2. Develop an understanding of selected theories in Human Development.
3. Become aware of the concepts and perspectives related to Human Development.

THEORY
(Credits: 3, Periods: 45)

Unit I: Introduction to theories in Human Development (6 hours)

- *Unit Description:* The unit will introduce themes in the area of human development covering nature/nurture, heredity/environment, continuity/discontinuity, individual differences and similarities.
- *Subtopics:*
  - Key themes in the study of Human Development- Nature/nurture, heredity/environment, continuity/discontinuity, individual differences and similarities.

Unit II: Psycho-analytic perspectives on Human Development (13 hours)

- *Unit Description*: The unit will introduce the Psycho-analytical perspectives on Human Development by Sigmund Freud and Eric H. Erikson.
- *Subtopics:*
  - Psycho-sexual theory by Sigmund Freud

- Psycho-social theory by Eric H. Erikson

Unit III: Theories on Cognitive Development (13 hours)

- *Unit Description:* The unit will introduce the theoretical perspective with regard to cognitive development. This unit will be covering theories by Jean Piaget and Lev Vygotsky.
- *Subtopics:*
  - Theory of Cognitive Development by Jean Piaget
  - Socio-cultural theory of Cognitive Development by Lev Vygotsky

Unit IV: Selected Theories in Child Development (13 hours)

- *Unit Description:* The unit will introduce theories in the area of child development. This unit will be covering theories by Urie Bronfenbrenner, Albert Bandura, John Bowlby and so on.
- *Subtopics:*
  - Ecological Systems Theory by Urie Bronfenbrenner
  - Social Learning Theory by Albert Bandura
  - Attachment Theories (John Bowlby, Mary Ainsworth, Harry Harlow)

PRACTICAL
(Credit: 1; Periods: 30)

- **Unit 1: Biography of any one theorist of human development (15 hours)**
- **Unit 2: Application of any one theory in real life situations (15 hours)**

Essential / recommended readings:

1. Newman, P.R., & Newman, B.M. (2015). Theories of Human Development. New York: Routledge
2. Rice, P. (2000). Human Development: A Lifespan Approach (4th edition). (and all further editions). New Jersey, Prentice-Hall Inc
3. Srivastava, V.N., Srivastava D.N. (2020). *Adhunik vikasatmak manovigyan.* Shi Vinod Pustak Mandir.
4. Allen, B.P. (2006). Personality theories: Development, growth and diversity (5th ed.) Needham Heights, MA: Allyn and Bacon

Suggested Readings:

1. Berk, L. E. (2000). Child development. New Delhi: Prentice Hall.
2. Berk, L. E. (2017). Exploring Lifespan Development. New York: Pearson
3. Berger, J.M. (2010). Personality (8th ed.). Belmont, CA: Thomson/Wadswort. Journal of Developmental Psychology
4. Santrock, J.W. (2007). Lifespan Development (3rd ed.). New Delhi, Tata- McGraw Hill

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-HDFE: PRINCIPLES OF CHILD DEVELOPMENT

Credit distribution, Eligibility and Pre-requisite of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical / Practice		
Principles of Child Development	4	3	--	1	Class XII Pass	Nil

Learning Objectives:

1. To familiarize students with the concept of child development as a field of study.
2. To introduce students with various methods of child study
3. To create an understanding of prenatal development

Learning Outcomes:

After completing this course, the students will be able to:

1. Get familiarized with the concept of child development as a field of study.
2. Develop an understanding of prenatal development.
3. Learn about the basics of techniques of data collection.

THEORY

(Credits:3, Periods: 45)

Unit I: Introduction to Child Development (10 hours)

- *Unit Description:* This unit will introduce child development as a field of study. It also will provide insights into the historical perspective regarding development of children.
- *Subtopics:*
  - Definition, Scope and importance of child development as a field of study
  - Historical foundation of child development

Unit II: Introduction to methods of Child Study (11 hours)

- *Unit Description:* The unit will introduce the methods of child study through the examples of well framed interviews, questionnaires.
- *Subtopics:*
  - Observation
  - Interview
  - Questionnaire
  - Case study

Unit III: Aspects of Development (11 hours)

- *Unit Description:* The unit will introduce about the aspects of development through discussion on the principles of development, developmental norms.
- *Subtopics:*

- Principles of Development
- Developmental Norms

Unit IV: Prenatal Development (13 hours)

- *Unit Description:* The unit will introduce prenatal development through presentations on stages of prenatal development and factors which have an impact.
- Subtopics:
  - Stages of prenatal development
  - Factors affecting prenatal development

PRACTICAL

(Credit:1, Periods:30)

Unit I: Recording/documenting any two methods of data collection (20 hours)

Unit 2: Review of any one documentary related to prenatal development (10 hours)

Essential / recommended readings:

1. Berk, L. E. (2013). *Child development (9th edition*). New Delhi: Prentice Hall.
2. Colley, D. and Cooper, P. (Eds.) (2017). *Attachment and emotional development in the classroom*. Oxford City: Jessica Kingley Publishers
3. Verma, P., Srivastava, D. N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Agrawal Publication.
4. Singh, A. (2015). *Foundation of human development: a lifespan approach*. Hyderabad: Orient Longman.

Suggested Readings:

1. Bee, H. L. (2011). *The developing child*. London: Pearson.
2. Papilla, D.E., Olds, S. W. and Feldman, R. D. (2004). *Human development*. New York: Mcgraw Hill.
3. Singh, A. (2015). *Foundation of human development: a lifespan approach*. Hyderabad: Orient Longman.
4. Singh, V. (2007). *Bal vikas avam bal manovigyan*. Jaipur: Panchsheel Prakashan.

B.A (Prog.) with Human Development and Family Empowerment (HDFE)

as Non-Major

Category-III

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-HDFE: PRINCIPLES OF CHILD DEVELOPMENT

Credit distribution, Eligibility and Pre-requisite of the Course

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical / Practice		
Principles of Child Development	4	3	--	1	Class XII Pass	Nil

Learning Objectives:

1. To familiarize students with the concept of child development as a field of study.
2. To introduce students with various methods of child study
3. To create an understanding of prenatal development

Learning Outcomes:

After completing this course, the students will be able to:

4. Get familiarized with the concept of child development as a field of study.
5. Develop an understanding of prenatal development.
6. Learn about the basics of techniques of data collection.

THEORY

(Credits:3, Periods: 45)

Unit I: Introduction to Child Development (10 hours)

- *Unit Description:* This unit will introduce child development as a field of study. It also will provide insights into the historical perspective regarding development of children.
- *Subtopics:*
  - Definition, Scope and importance of child development as a field of study
  - Historical foundation of child development

Unit II: Introduction to methods of Child Study (11 hours)

- *Unit Description:* The unit will introduce the methods of child study through the examples of well framed interviews, questionnaires.
- *Subtopics:*
  - Observation
  - Interview

- Questionnaire
- Case study

Unit III: Aspects of Development (11 hours)

- *Unit Description:* The unit will introduce about the aspects of development through discussion on the principles of development, developmental norms.
- *Subtopics:*
  - Principles of Development
  - Developmental Norms

Unit IV: Prenatal Development (13 hours)

- *Unit Description:* The unit will introduce prenatal development through presentations on stages of prenatal development and factors which have an impact.
- Subtopics:
  - Stages of prenatal development
  - Factors affecting prenatal development

PRACTICAL

(Credit:1, Periods:30)

Unit I: Recording/documenting any two methods of data collection (20 hours)

Unit 2: Review of any one documentary related to prenatal development (10 hours)

Essential / recommended readings:

1. Berk, L. E. (2013). *Child development (9th edition*). New Delhi: Prentice Hall.
2. Colley, D. and Cooper, P. (Eds.) (2017). *Attachment and emotional development in the classroom*. Oxford City: Jessica Kingley Publishers
3. Verma, P., Srivastava, D. N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Agrawal Publication.
4. Singh, A. (2015). *Foundation of human development: a lifespan approach*. Hyderabad: Orient Longman.

Suggested readings:

1. Bee, H. L. (2011). *The developing child*. London: Pearson.
2. Papilla, D.E., Olds, S. W. and Feldman, R. D. (2004). *Human development*. New York: Mcgraw Hill.
3. Singh, A. (2015). *Foundation of human development: a lifespan approach*. Hyderabad: Orient Longman.
4. Singh, V. (2007). *Bal vikas avam bal manovigyan*. Jaipur: Panchsheel Prakashan.

B.A. (Prog.) with Food Technology (FT) as Major
Category-II

DISCIPLINE SPECIFIC CORE COURSE – DSC-1-FT: BASICS IN FOOD AND NUTRITION

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basics in Food and Nutrition	4	3	0	1	Class XII Pass	NIL

LEARNING OBJECTIVES:

1. To familiarize students with the relationship between food, nutrition, nutrients and health
2. To describe the functions, sources, deficiencies and excess of various nutrients
3. To make students understand the principles and methods of conserving and enhancing nutrients during cooking food
4. Prepare dishes using basic principles of food science and nutrition.

LEARNING OUTCOMES:

After completion of the course, the students will be able to:

1. Understand the basic concepts related to of the vibrant field of nutrition
2. Gain theoretical and practical knowledge about balanced diet, energy, macro nutrients and micro-nutrients
3. Judiciously adopt healthier methods of cooking based on the available resources
4. Adopt methods of processing food which would help to conserving/ enhancing nutrients while processing food.

SYLLABUS OF DSC-1-FT

THEORY:

UNIT I: Basic Concepts and Introduction to Food and Nutrition (5 Hours)

- *Unit Description:* This unit will introduce the vibrant field of nutrition to the

students. They will be appraised about the relationship of food with health and basics of a balanced diet.

- *Subtopics:*
    - Basic terms in food, nutrition and health
    - Functions of food
    - Foods groups
    - Balanced diet

UNIT II: Energy and Macronutrients (12 Hours)

- *Unit Description:* The students will learn about the concepts of energy in food and its role in maintain good health. They will also learn about the energy giving macronutrients.
- *Subtopics:*
    - Energy: definition and units of measurement, factors affecting energy requirements, energy density of foods, energybalance.
    - Macronutrients: Functions, dietary sources and clinical manifestations of deficiency/ excess of carbohydrates, lipids and proteins.

UNIT III: Micronutrients (16 Hours)

- *Unit Description:* This unit will help students to learn about the role of micronutrients in maintaining good health, effects of deficient and high intake, food sources.
- *Subtopics:*
    - Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients:
    - Fat soluble vitamins-A, D, E and K
    - Water soluble vitamins – thiamine, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C
    - Minerals – calcium, iron, zinc and iodine

Unit IV: Theory of Cooking and Enhancing Nutrients (12 Hours)

- *Unit Description:* The basic principles/methods of cooking food and ways of enhancing, conserving nutrients while cooking or processing food.
- *Subtopics:*
    - Methods of cooking food: dry heat, moist heat and combination
    - Methods of conserving nutrients
    - Methods of enhancing the nutritional quality of foods - supplementation, germination, fermentation, fortification and genetic modification of foods

PRACTICAL:

No. of Students per Practical Class Group: 10-15

1. Prepare educational aid on balanced diet or food groups (2 Hours)
2. Preparing market order, selection of raw material (2 Hours)
3. Weights and measures (2 Hours)
4. Identification of presence/absence of food groups in given samples of food products/dishes/snacks available in college canteen (2 Hours)
5. Estimation of Edible portion size (peas/cauliflower/bottle gourd, potato, green leafy vegetables, one seasonal fruit) (2 Hours)
6. Pre-preparation Methods I: Washing, Peeling, Cutting, Chopping, Grating (2 Hours)
7. Pre-preparation methods II: blanching, kneading, whipping, whisking (2 Hours)
8. Dry-heat methods of cooking like roasting, grilling, frying (2 Hours)
9. Moist-heat methods of cooking like steaming, boiling, pressure cooking (2 Hours)
10. Planning and preparation of energy rich snack/dish. (3 Hours)
11. Planning and preparation of protein rich snack/dish. (3 Hours)
12. Planning and preparation of micronutrient (Vitamin A, Vitamin C) rich snack/dish. (3 Hours)
13. Planning and preparation of micronutrient (Calcium, iron) rich snack/dish (3 Hours)

ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):

1. Suri, S. and Malhotra, A. (2014). *Food Science Nutrition and Safety*. Delhi: Pearson India Ltd. Online Question Bank and student E Resources:https://wps.pearsoned.co.in/suri_fsns_1/Online Instructor Resources: www.pearsoned.co.in/sukhneetsuri
2. Sethi P, Lakra P.(2015). *Aahar Vigyan, poshan evam Suraksha* (Hindi);(2015).First Ed; 2015; Delhi: Elite Publishing House (P)Ltd.
3. Srilakshmi B (2018). Food Science, 7th Edition. Delhi: New Age International Ltd.
4. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T. (2004). *The Art and Science of Cooking: A Practical Manual,* Revised Edition. New Delhi: Elite Publishing House PvtLtd.

SUGGESTED READINGS:

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2016). *Textbook of Human Nutrition*, 4th edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
2. Chadha R and Mathur P (2015). *Nutrition: A Lifecycle Approach*. Hyderabad: Orient BlackSwan.
3. Roday, S (2018). *Food Science and Nutrition.* UK: Oxford UniversityPress.
4. Lanham, SA, Hill, TR, Gallagher, AM, Vorster, HH. (2019). Introduction to Human Nutrition, Third Nutrition, Wiley Blackwell, USA.
5. Whitney, E.N., Rolfes, S.R. (2016). *Understanding Nutrition*. 14th Edition; USA: Elsevier.
6. Pike, R.L. and Brown, M.L. (1984) An Integrated Approach. Nutrition, John Wiley& Sons, Hoboken,197.
7. Swaminathan, M. (2021). Advanced Textbook on Food and Nutrition. Banagalore Press.
8. Desai. (2019). Handbook of Nutrition and Diet. CRC Pres

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-FT: FOOD SCIENCE PART-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Food Science Part-I	4	3	0	1	Class XII Pass	NIL

-

LEARNING OBJECTIVES:

1. To introduce the students to the vibrant field of food science and food technology
2. To impart theoretical and practical knowledge about composition, nutritive value and processing of cereals, pulses, fruits, vegetables and meat.
3. To familiarize students with basics of food adulteration.

LEARNING OUTCOMES:

After completion of the course, the students will be able to:

1. Define food science and describe its association with other related fields; and understand the role of food science in food and health industry.
2. Describe composition, nutritive value and processing of cereals, pulses, fruits, Vegetables, meat, fish and poultry.
3. Justify scientifically the changes occurring in food during processing, handling and Storage. Describe enzymatic and non-enzymatic browning reactions in various foods.
4. Describe harmful effects of adulteration on health and will be able to detect presence of common adulterants in food.

THEORY:

UNIT I: Introduction to Food Science and Technology (15 Hours)

- *Unit Description:* This unit will introduce the students to the field of Food Science and Technology. It will also give information on basics of nutrition and food adulteration.
- *Subtopics:*
  - Definition, scope and current trends in food science and technology.
  - Basic introduction to macro and micronutrients-classification

and functions of various nutrients
  - Definitions- food, safe food, nutrient, nutrition, balanced diet
  - Commonly found food adulterants and their effect on health

UNIT II: Cereals and Pulses (10 Hours)

- *Unit Description:* The unit will focus on various aspects of composition, nutritive value and processing of cereals, millets and pulses.
- *Subtopics:*
  - Composition and nutritive value, types of cereals and millets
  - Gelatinization of starch and the factors affecting it, dextrinization, germination and fermentation
  - Toxic constituents in pulses.

UNIT III: Fruits and Vegetables (12 Hours)

- *Unit Description:* The unit is about composition, nutritive value and processing aspects fruits and vegetables. It also describes about various browning reactions that take place during food processing.
- *Subtopics:*
  - Classification of fruits and vegetables, composition and nutritive value; effect of processing on pigments.
  - Browning Reactions- enzymatic & non-enzymatic, role in food preparation and prevention of undesirable browning.

UNIT IV: Meat, Fish and Poultry (8 Hours)

- *Unit Description:* The unit will focus on composition, nutritive value and processing aspects of meat, fish and poultry.
- *Subtopics:*
  - Composition and nutritive value
  - Types of meat, fish and poultry and their selection/purchasing criteria Rigor mortis, Tenderization and Curing.

PRACTICAL:

No. of Students per Practical Class Group: 10-15

1. Weights and Measures. (2 Hours)
2. Detection of adulterants in food (2 Hours)
3. Gelatinization of starch and the factors affecting it. (2 Hours)
4. Preparation of dish using gelatinization of starch (2 Hours)
5. Dextrinization of starch and its application (2 Hours)
6. Germination of pulses and cereals (2 Hours)
7. Preparation of products using sprouts (2 Hours)
8. Fermentation of cereals and pulses (2 Hours)
9. Preparation of cereal-pulse fermented products (2 Hours)
10. Effect of heat, acid and alkali on water soluble plant pigments. (2 Hours)
11. Effect of heat, acid and alkali on fat soluble plant pigments. (2 Hours)
12. Maillard browning during food preparation. (2 Hours)
13. Enzymatic browning and its prevention. (3 Hours)
14. Caramelization reaction in food. (2 Hours)

ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):

1. Sethi, P. &Lakra, P. (2015). Aahar Vigyan, Poshan Evam Suraksha. Delhi: Elite Publishing House Pvt.Ltd.
2. Srilakshmi, B. (2012). Food Science. Delhi: New Age International Pvt. Ltd.
3. Suri, S. & Malhotra, A. (2014). Food Science Nutrition and Safety. Delhi: Pearson India Ltd.
    i. Online Question Bank and student E Resources: https://wps.pearsoned.co.in/suri_fsns_1/Online Instructor Resources: www.pearsoned.co.in/sukhneetsuri
4. Potter,N., & Hotchkiss,J.H.(2007). FoodScience.5thEdition.Delhi:CBSPublishers.
5. Rekhi,, T. & Yadav, H. (2014). *Fundamentals of Food and Nutrition.* Delhi: Elite Publishing House Pvt. Ltd.

SUGGESTED READINGS:

1. Avantina S (2019). Textbook of Food Science and Technology, 3rd Edition, CBS Publishers and Distributors Pvt Limited

2. McWilliams, M. (2016). Foods: Experimental Perspectives. USA: Pearson.
3. Reddy,S.M. (2015).Basic Food Science and Technology. Delhi: New Age International Publishers.
4. Vaclavik, V.A. & Elizabeth, C. (2014). Essentials of Food Science. 4th Edition. New York: Springer.
5. Roday, S. (2018). *Food Science and Nutrition.* 3rd Edition. Delhi: Oxford University Press.
6. Geoffrey Campbell–Platt. Food Science and Technology. 1st edition (2009). Wiley–Blackwell
7. Sharma A. Textbook of Food Science and Technology 3rd Ed., (2022). CBS Publiher 9789386478009

B.A. (Prog.) with Food Technology (FT) as Non-Major
Category-III

DISCIPLINE SPECIFIC CORE COURSE – DSC-2-FT: FOOD SCIENCE PART-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Food Science Part-I	4	3	0	1	Class XII Pass	NIL

-

LEARNING OBJECTIVES:

1. To introduce the students to the vibrant field of food science and food technology
2. To impart theoretical and practical knowledge about composition, nutritive value and processing of cereals, pulses, fruits, vegetables and meat.
3. To familiarize students with basics of food adulteration.

LEARNING OUTCOMES:

After completion of the course, the students will be able to:

1. Define food science and describe its association with other related fields; and understand the role of food science in food and health industry.
2. Describe composition, nutritive value and processing of cereals, pulses, fruits, Vegetables, meat, fish and poultry.
3. Justify scientifically the changes occurring in food during processing, handling and Storage. Describe enzymatic and non-enzymatic browning reactions in various foods.
4. Describe harmful effects of adulteration on health and will be able to detect presence of common adulterants in food.

THEORY:

UNIT I: Introduction to Food Science and Technology (15 Hours)

- *Unit Description:* This unit will introduce the students to the field of Food Science and Technology. It will also give information on basics of nutrition and food adulteration.

- *Subtopics:*
    - Definition, scope and current trends in food science and technology.
    - Basic introduction to macro and micronutrients-classification and functions of various nutrients
    - Definitions- food, safe food, nutrient, nutrition, balanced diet
    - Commonly found food adulterants and their effect on health

UNIT II: Cereals and Pulses (10 Hours)

- *Unit Description:* The unit will focus on various aspects of composition, nutritive value and processing of cereals, millets and pulses.
- *Subtopics:*
    - Composition and nutritive value, types of cereals and millets
    - Gelatinization of starch and the factors affecting it, dextrinization, germination and fermentation
    - Toxic constituents in pulses.

UNIT III: Fruits and Vegetables (12 Hours)

- *Unit Description:* The unit is about composition, nutritive value and processing aspects fruits and vegetables. It also describes about various browning reactions that take place during food processing.
- *Subtopics:*
    - Classification of fruits and vegetables, composition and nutritive value; effect of processing on pigments.
    - Browning Reactions- enzymatic & non-enzymatic, role in food preparation and prevention of undesirable browning.

UNIT IV: Meat, Fish and Poultry (8 Hours)

- *Unit Description:* The unit will focus on composition, nutritive value and processing aspects of meat, fish and poultry.
- *Subtopics:*
    - Composition and nutritive value
    - Types of meat, fish and poultry and their selection/purchasing criteria Rigor mortis, Tenderization and Curing.

PRACTICAL:

No. of Students per Practical Class Group: 10-15

1. Weights and Measures. (2 Hours)
2. Detection of adulterants in food (2 Hours)
3. Gelatinization of starch and the factors affecting it. (2 Hours)

4. Preparation of dish using gelatinization of starch (2 Hours)
5. Dextrinization of starch and its application (2 Hours)
6. Germination of pulses and cereals (2 Hours)
7. Preparation of products using sprouts (2 Hours)
8. Fermentation of cereals and pulses (2 Hours)
9. Preparation of cereal-pulse fermented products (2 Hours)
10. Effect of heat, acid and alkali on water soluble plant pigments. (2 Hours)
11. Effect of heat, acid and alkali on fat soluble plant pigments. (2 Hours)
12. Maillard browning during food preparation. (2 Hours)
13. Enzymatic browning and its prevention. (3 Hours)
14. Caramelization reaction in food. (2 Hours)

ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):

1. Sethi, P. &Lakra, P. (2015). Aahar Vigyan, Poshan Evam Suraksha. Delhi: Elite Publishing House Pvt.Ltd.
2. Srilakshmi, B. (2012). Food Science. Delhi: New Age International Pvt. Ltd.
3. Suri, S. & Malhotra, A. (2014). Food Science Nutrition and Safety. Delhi: Pearson India Ltd.
   i. Online Question Bank and student E Resources: https://wps.pearsoned.co.in/suri_fsns_1/
   ii. Online Instructor Resources: www.pearsoned.co.in/sukhneetsuri
4. Potter,N., & Hotchkiss,J.H.(2007). FoodScience.5thEdition.Delhi:CBSPublishers.
5. Rekhi,, T. & Yadav, H. (2014). *Fundamentals of Food and Nutrition.* Delhi: Elite Publishing House Pvt. Ltd.

SUGGESTED READINGS:

1. Avantina S (2019). Textbook of Food Science and Technology, 3rd Edition, CBS Publishers and Distributors Pvt Limited
2. McWilliams, M. (2016). Foods: Experimental Perspectives. USA: Pearson.
3. Reddy,S.M. (2015).Basic Food Science and Technology. Delhi: New Age International Publishers.
4. Vaclavik, V.A. & Elizabeth, C. (2014). Essentials of Food Science. 4th Edition. New York: Springer.
5. Roday, S. (2018). *Food Science and Nutrition.* 3rd Edition. Delhi: Oxford University Press.
6. Geoffrey Campbell–Platt. Food Science and Technology. 1st edition (2009). Wiley–Blackwell
7. Sharma A. Textbook of Food Science and Technology 3rd Ed., (2022). CBS Publiher 9789386478009

Common Pool of Generic Elective (GE) Courses
Offered by Department of Home Sciences
Category-IV

GE HS 001
CARE AND WELLBEING ACROSS THE LIFESPAN

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
CARE AND WELLBEING ACROSS THE LIFESPAN	4	3	0	1	12th Pass	NIL

Learning Objectives

1. To understand the concept of care and well-being across the lifespan and talk in context to the current social world.
2. To demonstrate skills to promote well-being of self and others in the society.
3. To gain familiarity of programmes and policy initiatives present on care and wellbeing in India

Course Outcomes:

1. The student will be able to develop an understanding of the concept and dimensions of care and wellbeing of individuals in the contemporary social world.
2. The student will acquire knowledge of the many influences on care and wellbeing across human lifespan.
3. The student will build capacity to promote wellbeing of self and society at large.
4. The student will be familiar with program and policy initiatives present on care and wellbeing in India.

THEORY
(Credits 3; Periods 45)

Unit I: Care and Human Development Unit Description: The unit offers information about the concept of care across lifespan.	**12 Hours**
Subtopics: ● Definition, concepts & relevance of care ● Vulnerable periods in life that require care ● Principles & components of care ● Psychological, social, emotional and spiritual	

Unit II: Well-being and Human Development Unit Description: The unit provides information regarding the concept of wellbeing across lifespan, life crises and factors and experiences that promote wellbeing in human development.	**9 Hours**

Subtopics: ● Concept of well-being: physical, psychological, spiritual ● Life crises and well-being ● Factors & experiences that promote well-being	
Unit III: Care and wellbeing: Birth to adolescent years Unit Description: The unit focuses on the care and wellbeing from the period before birth up to the adolescent years.	**12 Hours**
Subtopics: ● Antenatal care: maternal, fetal and neonatal care ● Care of the young child ● Adolescent reproductive health and wellbeing ● Community and school health programs ● Nutrition and health for all ages	
Unit IV: Care and wellbeing Adulthood and Aging Unit Description: The unit addresses the care and wellbeing issues of the caregiver, role of the family, health, medical and insurance schemes and provisions for the care of the elderly.	**12 Hours**
Subtopics: ● Adulthood and old age: changing and adapting ● Stress, coping strategies and well-being of caregivers ● Counselling, yoga and meditation techniques ● Institutions, schemes and facilities for older adults	

Essential Readings

1. Daaleman, Timothy& Helton, Margaret (2018). Chronic Illness Care: Principles and Practice: Springer. (Chapters 9- 12 & Chapters 21-27) NICHD Early Child Care Research Network. (2005).
2. Child Care and Child Development: Results From the NICHD Study of Early Child Care. New York: Guildford Press. (Chapters 2-6)
3. Berk, L. (2013). Child development. 9th ed. Boston: Pearson.
4. Ronda C. Talley, Rhonda J. V. Montgomery, Caregiving: A Developmental, Life-Long Perspective, Pages 3-10
5. Ronda C. Talley, Lydia LaGue (2013) Caregiving Across the Lifespan: Research . Practice . Policy, Springer.
6. Santrock, J. W. (2011). Life-span development. New York: McGraw-Hill.

7. Singh, A. (Ed.) 2015. Foundations of Human Development. New Delhi: Tata McGraw- Hill.
8. Markin, L. (2013). Health and Well-Being across Life Course. Sage Publication, Inc. Chapter 2-7
9. Asumadu-Sarkodie, Samuel. (2012). Nutritional Problems and Intervention Strategies in India. (All Chapters)
10. Chao, R.C. (2015). Counselling Psychology: An Integrated Positive Psychological Approach. (Chapter 1-4)
11. Institute of Public Health in Ireland and the Centre for Effective Services (2016) Improving Health and Wellbeing Outcomes in the Early Years: Research and Practice Dublin: Institute of Public Health in Ireland and the Centre for Effective Services. (All Chapters).
12. Kamerman,S.B., Pipps, S., Ben-Arieh, A. (2010). From Child Welfare to Child Well-Being. Springer Publication. (Chapter 2, 5, 7, 12, 23)

Suggested Readings

1. Singhi, P. (1999). Child health & well-being: Psychological care within & beyond hospital walls. In T.S. Saraswathi (Ed.). Culture, socialization and human development. New Delhi: Sage.
2. Childhood in south Asia: A critical look at issues, policies and programmes. Conn.USA: Information Age.

PRACTICAL
(Credit 1; Periods 30)

● Use of various tools to understand care needs at different stages- childhood, adolescence, adulthood: Interview, Observation, Movies and Documentaries ● Lectures/ Talks/workshops on- Self-care and well-being, Counselling and Yoga/meditation ● Profile an organization to a senior citizen home/childcare institution to study care and well-being ● Psychometric tests- Well-being scale, Self-concept tests, Subjective well-being scale (WHO), any 2 personality tests	**30 Hours**

GE HS 005 : FUNDAMENTALS OF HUMAN NUTRITION

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/		

				Practice		
FUNDAMENTALS O F HUMAN NUTRITION	**4**	**3**	**0**	**1**	**12th Pass**	**NIL**

Learning Objectives

1. To understand the relationship between food, nutrition and health.
2. To classify foods into various food groups and explain the concept of a balanced diet.
3. To describe the importance of various nutrients as well as list their food sources.
4. To be able to plan and prepare nutritious meals for an adult.

Course Outcomes

1. Relate how food affects health.
2. Classify foods into various food groups and explain the concept of a balanced diet.
3. Understand the importance of various nutrients and how these can be obtained from the diet.
4. Describe the considerations for planning and preparing balanced and nutritious meals for adults.

THEORY
(Credits 3; Periods 45)

Units	**No. of Hours**
Unit I: Basic Concepts in Nutrition Unit Description: Understanding basic terminology used in nutritional sciences and the importance of nutrition	**10 Hours**
Subtopics: ● Basic terms used in nutrition ● Understanding relationship between food, nutrition and health ● Functions of food-Physiological, psychological and social ● Basic food groups and concept of balanced diet	
Unit II: Nutrients Unit Description: Functions, dietary sources, requirements, effects of deficiency and/ or excess consumption of the various nutrients.	**20 Hours**
Subtopics: ● Energy- Concept of energy balance ● Carbohydrates and dietary fibre ● Lipids ● Proteins ● Fat soluble vitamins ● Water soluble vitamins ● Minerals	

Unit III: Healthy Eating Unit Description: Nutritional concerns and dietary guidelines for healthy eating for adults.	**15 Hours**
Subtopics: ● Factors influencing food choices ● Planning balanced meals and diets ● Nutritional concerns for adults ● Dietary guidelines for prevention of diet related lifestyle disorders ● Importance of physical activity and other lifestyle factors	

Essential Readings

1. Chadha R and Mathur P eds. (2015). Nutrition: A Lifecycle Approach. Hyderabad: Orient BlackSwan.
2. Khanna K, Gupta S, Seth R, Passi SJ, Mahna R, Puri S (2013). Textbook of Nutrition and Dietetics. Delhi: Phoenix Publishing House Pvt. Ltd.
3. Longvah T, Ananthan R, Bhaskarachary K and Venkaiah K (2017). Indian Food
4. Composition Tables. National Institute of Nutrition, Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India, Hyderabad.
5. NIN (2011). Dietary Guidelines for Indians- A Manual. Second edition. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.
6. Seth V, Singh K, Mathur P (2018). Diet Planning Through the Lifecycle Part I: Normal Nutrition- A Practical Manual. 6th Edition. Delhi: Elite Publishing House.

Suggested Readings

1. Byrd-Bredbenner C, Moe G, Beshgetoor D, Berning J (2013). Wardlaw‟s Perspectives in Nutrition, International Edition, 9th edition. New York: McGraw- Hill.
2. ICMR (2020). Nutrient Requirements for Indians-Recommended Dietary Allowances and Estimated Average Requirements. Published by National Institute of Nutrition, Hyderabad.
3. Sethi P, Lakra P. Aahar Vigyan, Poshan evam Suraksha (Hindi); First Ed; 2015; Delhi: Elite Publishing House (P) Ltd.
4. Siddhu, A, Bhatia, N, Singh, K, Gupta, S (2017). Compilation of Food Exchange List, Technical Series 6, Lady Irwin College, University of Delhi. Delhi: Global Books Organisation.
5. Suri S and Malhotra A (2014). Food Science, Nutrition and Safety. Dorling Kindersley (India) Pvt. Ltd, India

PRACTICAL

(Credit 1; Periods 30)

Practical	No. of Lectures
1. Making the right food choices **a.** Nutrient rich sources from different food groups **b.** Concept of high fat, salt, sugar (HFSS) foods **c.** Reading food labels	**10**
2. Planning a nutritious meal for adults a. Concept of food exchanges b. Calculating nutritional quality of diets c. Balancing meals according to nutrient requirements d. Healthy snacking options	**20**

GE HS 005 : TRAINING AND CAPACITY BUILDING

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
TRAINING AND CAPACITY BUILDING	**4**	**3**	**0**	**1**	**12th Pass**	**NIL**

Learning Objectives

1. To study the concept and significance of training and capacity building.
2. To understand the training process and the functions of different phases of training.
3. To know how different training approaches can be used to achieve various development goals.
4. To develop skills in designing, implementing and evaluating training programmes.

Course Outcomes

1. The student will be able to know the importance and scope of training for development.
2. The student will be able to learn the functions of different phases of the training process.
3. The student will be able to understand and critically evaluate the different training approaches and methodologies.

4. The student will be able to develop skills in planning, executing and evaluating training programmes for different stakeholders.

THEORY
(Credits 3; Periods 45)

Unit I: Training: Concept and Role in Development Unit Description: This Unit explores the concept, significance and different agencies involved in training for development. The unit focuses on adult learning and various approaches to train them. The Unit discusses the importance of evaluation and follow-up of training programmes. Various NGOs, GOs and Corporate initiatives in community development will also be discussed.	**9 Hours**
Subtopics: ● Nature, scope, advantages and limitations of training ● Goals, approaches and types of training ● Characteristics and principles of adult learning ● Government policies for training and capacity building of different stakeholders ● Agencies involved in training and development - NGOs, GOs and Corporate	
Unit II: **Roles and Responsibilities and Self-development of a Trainer** Unit Description: This Unit elaborates on the roles and responsibilities of a trainer. The various types of skills required of a trainer will be discussed. Concepts of self, self-development and personality development of a trainer will also be covered.	**12 Hours**
Subtopics: ● Roles and responsibilities of a trainer before, during and after a training programme ● Soft skills required by a trainer - communication, group mobilization leadership, team building, decision-making, networking and problem solving ● Technology-based skills - ICTs for facilitating the various aspects of the training process ● Concept of self and self-development of a trainer ● Need for personality development	
Unit III: **Methods and Techniques of Training** Unit Description: This Unit provides an insight into the different types of training methods and techniques which can be used in offline and online training programmes, including training in blended mode.	**12 Hours**

Subtopics: ● Tools and techniques for training (Brainstorming, Buzz Groups, Panel Discussion, Role Play, Focus Group Discussions, Films, Games and Stories) ● New techniques and innovations in training methods especially using technology	
Unit IV: **Designing, Executing and Evaluating Training Modules** Unit Description: This Unit focuses on analyzing training modules developed by different organizations - Government, National and International NGOs. The process of developing, mobilizing resources and implementing training programmes will be discussed. It also focuses on different ways of evaluating training programs for different stakeholders involved in the field of development.	**12 Hours**
Subtopics: ● Analysis of training programmes for different stakeholders ● Tools and techniques for training needs assessment ● Understanding various learning goals and outcomes for specific target groups ● Development of Training modules and materials ● Implementation of training programmes ● Methods of evaluation and follow-up of training	

Essential Readings

1. Agochiya D. (2002). Every Trainer's Handbook. New Delhi, Sage publisher.
2. Dhama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. New Delhi.
3. Gardner, A. & Brindis, C. (2017). Advocacy and Policy Change Evaluation: Theory and Practice. USA: Stanford Business Books. ISBN-13: 978-0804792561.
4. PRIA. (1998). A Manual for Participatory Training Methodology in Development. New Delhi: Society for Participatory Research in Asia.
5. PRIA (2002). Methods of Participatory Training. New Delhi. Participatory Research in Asia.

Suggested Readings

1. Bhatia S.K,2005, Training & Development; Concepts and Principles, Ch-1(3-8), ch-2(9-26), ch-3(28-38).
2. James W. Thacker C, (2004). Effectiveness Training-Systems, Strategies and Practices. Pearson Education.
3. Lyton R and PareekU. (1990). Training for Development. New Delhi, Vistaar Publications.
4. Subedi, N R, (2008). Advocacy Strategies and Approaches: A Training of Trainers Manual. International.

5. UNICEF. (2010). Advocacy toolkit. A guide to influencing decisions that improve children's lives.

PRACTICAL
(Credit 1; Periods 30)

	No. of Hours
● Exercises to understand roles and responsibilities of a trainer ● Undertake activities in building skills of a trainer. ● Undertake analysis of a variety of training modules. ● Development and conduct of training modules for specific client groups. ● Design, production and use of Training methods and materials. ● Evaluation of training programmes ● Visit to organizations involved in training and capacity building	**30**

GE HS 013 : SUSTAINABLE FASHION

Course title & Code	**Credits**	**Credit distribution of the course**			**Eligibility criteria**	**Pre-requisite o f the course**
		Lecture	**Tutorial**	**Practical/ Practice**		
Sustainable Fashion	**4**	**3**	**0**	**1**	**12th Pass**	**NIL**

Learning Objectives

1. Spreading awareness about issues and challenges of sustainable fashion
2. Make students conscious consumers of textiles and apparel
3. Inculcating habits of reducing textile waste generation

Course Outcomes

1. The student will be able to gain knowledge of issues and challenges related to over consumption and non-sustainable fashion.
2. The student will be able to learning to choose garment consciously and become informed consumer
3. The student will be able to using green laundry practices to help environment
4. The student will be able to increasing life cycle of garments for less waste generation

THEORY
(Credits 3; Periods 45)

Unit I: Fashion & Sustainability Learning aspects of sustainability in relation to fashion and textiles.	**9 Hours**
Subtopics: ● Basics of sustainability ● The Fashion Business & sustainability issues ● Ethical & sustainable fashion in the changing global scenario ● Circular fashion ● Start-ups and big brands dealing with sustainability ● Measuring sustainability – How brands do it	
Unit II: Green Consumption Factors that should be kept in mind while selecting and purchasing apparel	**12 Hours**
Subtopics: ● Volumes of textile waste: Over consumption challenges ● Fashion based on values ● Locally made, globally relevant ● Local and connected: Designing with local artisans ● Reducing the speed in fashion consumption: Slow fashion, Durability, Appropriateness, Multifunctional garments, Trans-seasonal garments, emotionally durable design ● Standards, labels and organisations dealing with sustainable textiles and apparel	
Unit III: Ethical care and Maintenance Green practices for laundry and care of apparel.	**12 Hours**
Subtopics: ● Laundering frequency: Reducing consumers' need to clean ● Laundry detergents and softeners: Effectiveness and environmental concerns ● Machine vs line drying: Energy costs vs consumer needs ● Special care laundry: Environmental impacts and changing consumer demands	
● More efficient laundering practices ● Designing sustainable clothing that enables: low-impact care, extended use	
Unit IV: Intelligent Disposal Ways to increase the life of garments to reduce waste generation.	**12 Hours**

Subtopics: ● Slowing the flow of materials ● Take-back schemes ● Waste management strategies: Reuse of goods, repair and reconditioning of goods, recycling of goods, zero waste pattern ● Collaborative consumption: Sharing, pass me down, give away ● Vintage Clothing: The world of second-hand clothing ● Traditional Practices in Indian culture leading to sustainable consumption	

Essential Readings

1. Fletcher, K., & Grose, L. (2012). Fashion & sustainability: Design for change. Hachette UK
2. Fletcher, K. (2013). Sustainable fashion and textiles: design journeys. Routledge.
3. Gwilt, A., & Rissanen, T. (2012). Shaping sustainable fashion: Changing the way we make and use clothes. Routledge.
4. Jacques, P. (2020). Sustainability: the basics. Routledge.
5. Gardetti, M.A., & Torres, A.L. (Eds.). (2013). Sustainability in Fashion and Textiles: Values, Design, Production and Consumption (1st ed.). Routledge.
6. Pratibhan, M. Ed. (2017); Sustainability in Fashion & Apparels (Challenges & Solutions); Woodhead Publishing

Suggested Readings

1. Almeida, L. (2015). Ecolabels and organic certification for textile products. A Roadmap to sustainable textiles and clothing (pp. 175-196). Springer, Singapore.
2. Muthu, S. S. (Ed.). (2014). Roadmap to sustainable textiles and clothing: Eco-friendly raw materials, technologies, and processing methods. Springer.
3. Minney, S. (2011). Naked fashion: The new sustainable fashion revolution. New International
4. Mahapatra N. N. (2015); Textiles & Environment: Woodhead Publishing

PRACTICAL
(Credit 1; Periods 30)

Analysing Market and Consumer Practices: ● Market survey to evaluate presence of Sustainable garments in Indian retail market: Identify any one Multiband apparel outlet and analyse brands selling sustainable clothes, green standards marked on labels and any other information available on labels that talks about sustainability in production of that garment. ● Analysing personal wardrobe to assess individual buying practices ● Analysing personal laundry practices and evaluating its impact on the environment. ● Analysing personal garment disposal practices and finding ways to reduce the waste generation.	**20 Hours**
Case Study: ● Case study of an Indian Apparel Brand that is promoting Sustainable fashion. ● Case study on any one model of Collaborative consumption.	**10 Hours**

Suggested Readings

1. Kaur, J., & Singh, G. (2021). Cool Branding for Indian Sustainable Fashion Brands. Social and Sustainability Marketing: A Casebook for Reaching Your Socially Responsible Consumers through Marketing Science, 115.
2. Gwilt, A. (2020). A practical guide to sustainable fashion. Bloomsbury Publishing.

GE HS 020 :VISUAL MERCHANDISING

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite o f the course
		Lecture	Tutorial	Practical/ Practice		
Visual Merchandising	**4**	**3**	**0**	**1**	**12th Pass**	**NIL**

Learning Objectives

1. To introduce the concept and significance of visual merchandising in store design.
2. To impart knowledge regarding different types of visual displays and ways of achieving them.
3. To develop skill in creating aesthetically pleasing visual displays.

Course Outcomes

1. The student will be able to apprehend the key terms and principles involved in the components of visual merchandising.

2. The student will be able to understand the importance of visual merchandising and attractive visual display in communicating with customers.
3. The student will be able to create aesthetic visual displays on different themes in store design.

THEORY
(Credits 3; Periods 45)

Unit I: Introduction to Visual Merchandising Unit Description: The focus of this unit would be on understanding the concept, significance and key elements of visual merchandising.	**7 Hours**
Subtopics: ● Concept and Significance of Visual Merchandising ● Key elements of Visual Merchandising - Store Exterior, Store Layout, Store Interior, Interior display ● Factors Influencing Visual Merchandising ● Role of Visual Merchandiser	
UNIT II: Store Design Unit Description: This unit attempts to acquaint the students with various store designs, its components and the importance of colour and lighting therein.	**13 Hours**
Subtopics: ● Objectives and Characteristics ● Types of store design ● Interior components ● Exterior components ● Colour ● Lighting design	
Unit III: Design Display Unit Description: This unit will orient the students in understanding the various components of design displays.	**15 Hours**
Subtopics: ● Concept, Purpose, style and importance of displays ● Types of window displays ● Factors in window display ● Signage and Graphics ● Understanding of display fixtures ● Budgeting	

Unit IV: Materials and Technologies Unit Description: This unit will acquaint the students with the materials and technologies used in visual display and the global trends.	**10 Hours**
● Selection of materials ● Use of Latest Technologies: Augmented and Virtual reality tools, Robotics ● Global Trends	

Essential Readings

1. Morgan, T. (2014). Visual Merchandising: Window and in-store displays for retail, Laurence King Publishing, London
2. Bergstrom, B. (2009). Essentials of Visual Communication, Laurence King Publishing, London
3. Poore. J. (1994). Interior Colour by Design, Rockport Publishers.
4. Wiley, J. , (2010), Interior lighting for designers, John Wiley & Sons
5. Williams, R. (2007), Visual Communication: Integrating Media, Art, and Science, Routledge Communication Series

Suggested Readings

1. Khaus, K. (2006). Semantic turn a new foundation for design, CRC press
2. Landa, Robin. (2010), Advertising by design: Generating and Designing Creative Ideas Across Media, Second Edition, James Wiley
3. Linton, H. (1999). Color in Architecture: Design Methods for Buildings, Interiors and Urban Spaces, McGraw-Hill

PRACTICAL
(Credit 1; Periods 30)

Unit I: Design Exploration	**12 Hours**
Activities: ● Preparing a portfolio on elements and principles of visual design ● Creating Theme based mood boards	
● Market survey of materials used in display: accessories, props, signage, backdrop, banners, etc. ● Visit to retail stores for critical assessment of display arrangements.	

Unit II: Store Design and Displays	18 Hours
Activities: ● MKS system and techniques of measurement ● Identification and assessment of different layout plans ● Making a layout plan	
● Prop designing: Identification of types of props, material selection, creating a focal point through prop ● Planning and designing a prop ● Window Display Designing: Identification of types of window displays ● Assessment of selected window display ● Planning and designing a theme based window display ● Costing	

Essential Readings

1. Morgan, T. (2014). Visual Merchandising: Window and in-store displays for retail, Laurence King Publishing, London
2. Bergstrom, B. (2009). Essentials of Visual Communication, Laurence King Publishing, London
3. Poore. J. (1994). Interior Colour by Design, Rockport Publishers.
4. Wiley, J. , (2010), Interior lighting for designers, John Wiley & Sons
5. Williams, R. (2007), Visual Communication: Integrating Media, Art, and Science, Routledge Communication Series

GENERIC ELECTIVE (GE) – FT-01: FOOD PROCESSING AND PRESERVATION

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
FOOD PROCESSING AND PRESERVATION	**4**	**3**	**0**	**1**	**12th Pass**	**NIL**

LEARNING OBJECTIVES:

1. To impart basic concept of Food colloids, Freezing, Dehydration processes and equipment usedduring the processing
2. To understand the Principles of thermal processing, Minimal Processing and hurdle technology
3. To understand the concepts of water disposal and sanitation.

COURSE OUTCOMES:

1. Understand the basic concepts of Food colloids, Freezing, Dehydration processes

andequipment used during the processing

2. Understand the Principles of thermal processing, Minimal Processing and hurdle technology
3. Understand the concepts of water disposal and sanitation.

UNIT I

Food Processing Operations **20 Hours**

Unit Description: Food Processing operations

Subtopics

- Refrigeration and Freezing

Requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing
Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

- Dehydration

Normal drying curve , effect of food properties on dehydration, changein food during drying, drying methods and equipments: air convection dryer, tray dryer, tunnel dryer ,continuous belt dryer , fluidized bed dryer, dryer, drum dryer, vacuum dryer , freeze drying, foam mat drying.

- Thermal Processing of Foods

Classification of thermal processes, Principles of thermal processing, commercial canning operations, Aseptic Processing, UHT Irradiation and microwave heating. Principles, Dosage, Applications of Irradiation, Mechanism of microwave heating and applications.

UNIT II: 10 Hours

Technology of Colloids in Food

Unit Description: **Technology of Colloids in Food**

Subtopics:

Surface chemistry (colloids, emulsions, foam, sols, gels, pectingels

Unit III: **Water Disposal and Sanitation** **10 Hours**

Unit Description: **Water Disposal and Sanitation**

Subtopics:

Waste water , hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, milkplant sanitation, CIP system, sanitizers used in food industry

Unit IV: **Minimal processing and hurdle technology** **05 Hours**

Unit Description: **Minimal processing and hurdle technology**

PRACTICAL **DURATION: 30 HRS (CREDIT 1)**

- Study of canning equipment (Forming, Flanging, Seaming, Exhausting and Retort)
- Canning of foods

- Preservation of food by the process of freezing
- Drying of food using Tray dryer/other dryers
- Study of thawing characteristics of frozen foods
- Preparation of brix solution and checking by hand refractometer
- Analysis of water
- Minimal Processing of food
- Application of colloidal chemistry in food preparation

ESSENTIAL READINGS:

1. Deman, J.M. (2007).Principles of Food Chemistry, 3rd Ed. Springer.
2. Potter, N. and Hotchkiss H. (2007).Food Science. New Delhi: CBS Publication.
3. Ramaswamy, H. and Marcotte, M. (2009).Food Processing Principles and Applications.CRC Press.

SUGGESTED READINGS:

1. Fellows' Food Processing Technology Principles and Practice 5th Edition (2022)Elsevier Publishing

TEACHING LEARNING PROCESS

- Lectured based teaching
- Power point presentations
- Experimental learning through practicals
- Along with pedagogy of flipped classroom students are encouraged to participate actively in theclassroom through regular presentations on curriculum based topics, peer assessment

ASSESSMENT METHODS

- As per University of Delhi norms
- Assessment methods - quiz, identification tests, assignments
- End semester exams for theory and practical
- Feedback given to students for improving
- Continuous evaluation of practicals

KEYWORDS

Food Preservation, Food Processing, Colloidal chemistry, BOD, COD, Sanitation, Effluent system.

REGISTRAR