

UNIVERSITY OF DELHI

CNC-II/093/1(23)/2022-23/

Dated: 13.03.2023

**NOTIFICATION**

Sub: Amendment to Ordinance V

[E.C Resolution No. 38-1/ (38-1-3) dated 08.12.2022]

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-II 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**

**Category-I**

**B.Sc. (H) Botany**

**DISCIPLINE SPECIFIC CORE COURSE – 4: Microbiology and Plant-Microbe Interactions**

**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	Tutorials	Practical/ Practice		
Microbiology and Plant-Microbe Interactions	04	2	0	2	10+2 from any recognized Board with Biology	Nil

**Learning Objectives**

The Learning Objectives of this course are as follows:

To impart basic understanding about microbial world and their interactions with plants.

## Learning outcomes

The Learning Outcomes of this course are as follows:

- Understanding microbes and their roles and applications.
- Understanding about modes of reproduction of Viruses, Archaeobacteria, Eubacteria.
- Understand plant-microbe interaction

## SYLLABUS OF DSC-4

Unit 1: Introduction 02 Hours  
Microbial world, Growth and nutrition of microbes with reference to nutritional media.

Unit 2: Viruses 07 Hours  
Discovery; Physicochemical and biological characteristics; Classification (Baltimore); General structure with special reference to viroids and prions, DNA and RNA viruses; General account and mechanism of replication, lytic and lysogenic cycle; General account of viral diseases of plants (mosaic and vein clearing disease).

Unit 3: Bacteria 09 Hours  
Discovery, General characteristics; Types - Archaeobacteria, Eubacteria, Wall less forms (Mycoplasma, Phytoplasma and Spheroplasts); Cell structure; Nutritional types; Reproduction - vegetative, asexual and recombination (conjugation, transformation and transduction); General account of bacterial diseases of plants (Citrus canker, Angular leaf spots of cotton).

Unit 4: Applied Microbiology 04 Hours  
Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics and agriculture. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit 5: Plant-Microbe interactions 08 Hours  
General account of Plant-microbe interactions; Plant growth promoting rhizobacteria (PGPR); Mechanism of nitrogen fixation by Cyanobacteria and Rhizobia; Types of mycorrhizal association with plants; Ectomycorrhiza and Endomycorrhiza and their effects on plant growth.

### Practicals:

1. Study of Viruses: Electron micrographs / Model - T-Bacteriophage and TMV; specimens/digital resources/ Line drawings of Lytic and Lysogenic Cycle. 08 Hours
2. Study of Bacteria: Electron micrographs of bacteria; Types of Bacteria from temporary/permanent slides. Endospore, Binary fission, Conjugation, Root nodule through specimens/digital resources. 08 Hours
3. Study of Plant Growth Promoting Rhizobacteria (PGPR) through specimens/digital resources (at least three). 04 Hours
4. Gram staining to differentiate between Gram-positive and Gram-negative bacteria. 08 Hours
5. Study of *Rhizobium* from root nodules of a leguminous plant. 08 Hours
6. Isolation of *Anabaena* from *Azolla* leaves. 08 Hours
7. Histochemical staining to observe Arbuscular Mycorrhizal Fungi (AMF) colonization in roots. 08 Hours
8. Study of Bacterial diseases (Citrus canker, Angular leaf spots of cotton) and viral diseases

of plants (mosaic and vein clearing disease) through specimens/digital resources.

08 Hours

Suggested Readings:

1. Pelczar, M.J. (2001) Microbiology, 5<sup>th</sup> edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2016) Microbiology: An Introduction, Indian edition, Pearson India Education Services Pvt. Limited, Noida, India
3. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6<sup>th</sup> edition: McGraw Hill, New Delhi.
4. Gupta, R., Chugh, G. (2022) Plants, Microbes and Diseases 1<sup>st</sup> Edition, I.K. International Pvt. Ltd., Delhi.
5. Subba Rao, N.S. (2000) Soil Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Additional Resources:

1. Talaro, K.P., Talaro, A. (2006). Foundations in Microbiology. Mc-Graw Hill, New Delhi

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

## DISCIPLINE SPECIFIC CORE COURSE – 5: Plant Resources and Economic Botany

### 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 Resources and Economic Botany	<b>04</b>	2	0	2	10+2 from any recognized Board with Biology	<b>Nil</b>

#### Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize students with the economic importance of diverse plant species and train them in identifying plants of economic importance through field visit/s, live plant specimens, herbarium specimens and digital resources.
- To make students understand the importance of various plant parts and derived products used as food, fibers, medicines, oils and other economically important products.
- To acquaint students with the processing of various economically important plant resources and train them to identify and analyses nutrients using simple microchemical tests.

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- This course would provide students with information about the economic importance and products derived from plants and their roles in our daily lives.
- Students will learn to perform micro-chemical tests to study presence of various components.
- Students will explore the regional diversity in food crops and other plants and their ethnobotanical importance.

#### SYLLABUS OF DSC-5

Unit 1: Introduction and Origin of Cultivated Plants

**02 Hours**

Importance of Plant Resources; Vavilov's concept for the Origin of cultivated plants; Centres of Origin (Primary and Secondary); Centres of diversity, Harlan's concept of gene pools. Plant Genetic Resources and their conservation.

Unit 2: Cereals

**04 Hours**

Wheats (Origin, Evolution of Wheats (tetra- & hexaploid), Morphology, Production, and Economic Importance of Hexaploid Wheat); Rice (Origin-Monophyletic and Polyphyletic, Production, Morphology, Comparison between *indica* and *japonica* Rice, Parboiling,

Economic Importance); Other cereals: Maize, Barley, Oats, Millets (jowar, bajra, ragi) and Pseudocereals.

Unit 3: Legumes

**03 Hours**

General account (Nutritive Value of Pulses, Protein Malnutrition, Lathyrism, Favism, Ecological Importance); chick pea and pigeon pea (Production, Morphology and Economic Importance). Other Legumes: Lentil, Cluster Bean, Lathyrus, Beans, Pea, Cowpea, Fodder legumes and Green manure crops.

Unit 4: Sugars and Starches

**03 Hours**

Sugarcane (Morphology, Ratooning, Nobilization, Products and By-products); Potato (Morphology, Tuber Anatomy, Seed Tubers vs True Potato Seeds and Economic uses).

Unit 5: Spices, Condiments & Flavourings

**03 Hours**

General Account (Spices, Condiments, Culinary Herbs and Essences, with examples), Importance of Spices, Clove (Morphology, Anatomy of part used and Economic Importance) and Black Pepper (Morphology, Anatomy of part used and Economic Importance). Other examples: Ginger, Turmeric, Cinnamon, Saffron, Cardamom, Chillies & Pepper, Fennel, Coriander, Cumin, Vanilla, Nutmeg.

Unit 6: Beverages

**02 Hours**

Types of Beverages (Alcoholic and Non-Alcoholic) with examples, Tea and coffee (Morphology, Chemistry, Processing and Economic Importance)

Unit 7: Fibres and Fibre-yielding plants

**03 Hours**

Classification of Fibres based upon their Origin (surface fibres, bast fibres, and leaf fibres, with examples); Jute (morphology, extraction and economic importance), Cotton (*Gossypium* species, morphology, processing and economic importance) Comparison between Jute and Cotton fibers. Other examples: Flax, Hemp and Coconut.

Unit 8: Oil-Yielding Plants

**03 Hours**

Fatty Oils and Essential Oils, Comparison between Fatty Oils and Essential Oils; Fatty Oils (Classification with examples, keeping quality), Groundnut (Morphology and Economic Importance); Essential Oils (General characteristics, Methods of Extraction and Economic Importance, with examples). Other examples: Rapeseed & Mustard (canola), Coconut, Olive, Castor, Cottonseed, Sesame, Soybean, Linseed.

Unit 9: Medicinal and Drug-Yielding Plants

**02 Hours**

Brief Account of Therapeutic Drugs with Examples; Morphology, Chemical Constituents, Economic Importance of *Cinchona*, *Rauwolfia*, *Digitalis*.

Unit 10: Fumigatory & Masticatory

**02 Hours**

Tobacco (Morphology, species - *Nicotiana tabacum* & *N. rustica*), Processing, Products, Economic Importance and Health Hazards), *Cannabis*, *Papaver* (Morphology, Chemical Constituents, Economic Importance)

Unit 11: Rubber

**01 Hour**

Para Rubber - *Hevea brasiliensis* (Morphology, Tapping of latex, Processing, Products and Economic Importance)

**Unit 12: Fruits & Nuts****01 Hour**

Tropical & Temperate; *Citrus*, Mango, Banana, Apple, Pineapple, Papaya; Nuts: Cashew, Walnut, Almond & Pistachio.

**Unit 13: Vegetables****01 Hour**

Common examples of root crops, leafy vegetables (herbage), fruit seed vegetables;

Practicals:

1. **Cereals:** Wheat (Habit Sketch, L.S./T.S. grain, W.M. starch grains, Micro-chemical tests), Rice (Habit Sketch, study of paddy and grain, W.M. starch grains, Micro-chemical tests). Millets - Pearl Millet, Finger Millet and Pseudocereals - Amaranth Grain, Quinoa (specimens/digital resources and grains) **08 Hours**
2. **Legumes:** Chickpea, pigeonpea (Habit, fruit, seed structure, Micro-chemical tests). **04 Hours**
3. **Sugars and Starches:** Sugarcane (Habit Sketch, Products and By-products, Cane Juice-Micro-chemical tests); Potato (Habit Sketch, Tuber morphology, T.S. tuber to show localization of starch grains, W.M. starch grains, Micro-chemical tests). **08 Hours**
4. **Spices:** Clove, Blackpepper (Habit and sections L.S./T.S.), Saffron, fennel (specimen/digital resources) **04 Hours**
5. **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans) **04 Hours**
6. **Fibres:** Jute (specimens/digital resources of *Corchorus capsularis* and *C. olitorius*, T.S. stem, test for cellulose and lignin on section of stem and fibre). Cotton (specimen, W.M. seed to show lint and fuzz; W.M. fibre and test for cellulose) **08 Hours**
7. **Oil-Yielding Plants:** Fatty Oils: Groundnut (Habit-specimen, Fruit, seeds, Microchemical Tests) Coconut-Habit (photograph), Fruit, T.S. nut, Mustard - (Habit-specimen, Fruit, seeds); Essential Oils: Habit Sketch of Rose, Jasmine, Vetiver, Sandalwood and *Eucalyptus* (specimens/photographs) **08 Hours**
8. **Drug-Yielding plants:** Habit - Fever Bark Tree, Poppy, Foxglove and Cannabis (Specimens/ Photographs) **08 Hours**
9. **Tobacco:** *Nicotiana tabacum* and *N. rustica* (specimens/photographs), Tobacco Products
10. **Rubber:** Para Rubber-Habit, Tapping of latex (Specimen/photograph), Rubber Products **04 Hours**
11. **Petro-crops:** *Saccharum officinarum* , *Jatropha* sp. **04 Hours**

Suggested Readings:

1. Kochhar, S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co.
2. Kochhar, S.L. (2016). Economic Botany – A Comprehensive Study, 5<sup>th</sup> Edition. New Delhi, India: Cambridge University Press.
3. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers.
4. Chrispeels, M.J., Sadava, D.E. (1994). Plants. Genes and Agriculture. Jones & Bartlett-Publishers.
5. Berg L, (2008). Introductory Botany: Plants, People, And The Environment, Thomson Brooks/Cole.
6. Cook F.E.M. (1995). Economic Botany: Data Collection Standard Royal Botanic Garden, Kew, Richmond.

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

## DISCIPLINE SPECIFIC CORE COURSE – 6: Plant Systematics

### 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		
<b>Plant Systematics</b>	<b>04</b>	<b>2</b>	<b>0</b>	<b>2</b>	10+2 from any recognized Board with Biology	<b>Nil</b>

### Learning Objectives

The course will help students gain knowledge about:

- The basics of plant systematics and its inter-relationships with allied subject areas

### Learning outcomes

On completion of the course the students will be able to:

- understand technical terminology used in plant taxonomy
- apply the terminologies to describe, identify and classify flowering plants
- search and analyse taxonomic information from internet-based scientific databases and other resources
- interpret and evaluate the concept of species and evolutionary processes in angiosperms
- comprehend and compare various systems of classifications
- recognise diversity in local/regional flora
- appreciate the significance and application of systematics in science and welfare of society

### SYLLABUS OF DSC-6

Unit 1: Introduction

**02 Hours**

Identification, Classification (types) and Nomenclature, Phylogeny; Major contributions - Parasara, Charaka, Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan, Bremer, MW Chase

Unit 2: Resources in Plant Identification

**02 Hours**

Literature (Floras, Manuals, *Icones*, Monographs, Revisions, Journals, e-resources); Herbaria and Botanical gardens (in brief)

Unit 3: Systematics - An Interdisciplinary Science

**04 Hours**

Relevance of palynology, cytology, phytochemistry and molecular data (cite at least (streak, spread & pour), replica plating, serial dilution.

three examples from each with emphasis on application in resolving taxonomic problems - details of techniques to be excluded)

Unit 4: Botanical Nomenclature

**05 Hours**

Principles and rules (ICN); Ranks and names; Principle of priority and its limitations; Concept of 'Type', Author citation, Valid publication, Rejection of names; Nomenclature of hybrids

Unit 5: Systems of Classification

**06 Hours**

Taxonomic hierarchy; Concept of species (morphological, biological and evolutionary); Classifications - Bentham and Hooker's (up to series), Engler and Prantl's (upto sub-class) and Angiosperm Phylogeny Group (APG) classification (major clades).

Unit 6: Approaches in Systematics

**06 Hours**

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly, clades and grades).

**Phenetics** - Principles, Methodology, Characters; Selection of OTUs, Character weighing and Coding; Cluster analysis; Phenogram.

**Cladistics** - Principles, Methodology, Characters; Selection of EUs, Character weighing and Coding; Cluster analysis; Cladogram

Unit 7: Evolution of Angiosperms

**05 Hours**

Concept of a primitive flower (Euanthial theory and Pseudanthial theory); Basal Living Angiosperms; Herbaceous origin; Co-evolution of angiosperms with animals.

**Practicals:**

1. Field trip/ Visit to any herbaria/ Botanical Garden. **04 Hours**
2. To prepare at least five herbarium specimens and identify them using available resources (Literature, herbaria, e-resources, taxonomic keys) and classify up to family level (according to Bentham and Hooker's classification and compare it with APG IV System in the field note book). **08 Hours**
3. Description of taxa using semi-technical terms and identification of the families according to Bentham and Hooker's classification and compare the placement of family with APG IV System (Only placement of family according to APG IV system to be mentioned) **48 Hours**

**Note:** Any **twelve** families from the following list to be studied with **at least two** specimens (**or one** where limitations exist).

**List of Suggested Families (\*mandatory)**

Acanthaceae, Amaranthaceae, \*Apiaceae, Apocynaceae, \*Asteraceae, \*Brassicaceae, \*Euphorbiaceae, \*Fabaceae, \*Lamiaceae, Liliaceae, \*Malvaceae, Moraceae, \*Poaceae, \*Ranunculaceae, \*Solanaceae

**Suggested Readings:**

1. Simpson, M. G. (2019). Plant systematics. 3<sup>rd</sup> Edition, Academic press.
2. Singh, G. (2019). Plant Systematics- An Integrated Approach. 4<sup>th</sup> edition. CRC Press, Taylor and Francis Group.
3. Stuessy, T.F. (2009). Plant Taxonomy: The Systematic Evaluation of Comparative Data, 2<sup>nd</sup> edition, Columbia University Press.
4. Taylor, D.V., Hickey, L.J. (1997) Flowering Plants: Origin, Evolution and Phylogeny.



CBS Publishers & Distributers, New Delhi.

5. Pandey, A. K., Kasana, S. (2021). *Plant Systematics*. 2<sup>nd</sup> Edition. CRC Press Taylor and Francis Group
6. <http://www.mobot.org/MOBOT/research/APweb/>
7. Maheshwari, J. K. (1963). The flora of Delhi. Council of Scientific & Industrial Research.
8. Maheshwari, J. K. (1966). Illustrations to the Flora of Delhi. Council of Scientific & Industrial Research.
9. Harris, J. G., Harris, M. W. (2001). Plant Identification Terminology: An Illustrated Glossary. Spring Lake, Utah: Spring Lake Pub. Spring Lake, Utah.
10. Radford, A. E. (1974). Vascular plant systematics. Harper & Row Publishers, New York, London.
11. Judd, W.S., Campbell, L.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. (2016) Plant Systematics: A Phylogenetic Approach. 4<sup>th</sup> edition. Sunderland, MA: Sinauer Associates

#### **Additional Resources:**

1. The Angiosperm Phylogeny Group, Chase, M. W., Christenhusz, M. J.M., Fay, M. F., Byng, J. W., Judd, W. S., Soltis, D.E. Mabberley, D. J., Sennikov, A. N., Soltis, P. S., Stevens, P. F. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical journal of the Linnean Society 181 (1): 1–20.
2. Soltis, D. E., Bell, C. D., Kim, S., Soltis, P. S. (2008). Origin and early evolution of angiosperms. Annals of the New York Academy of Sciences 1133: 3-25.
3. Scutt, C. P. (2021). The origin of angiosperms. In Evolutionary developmental biology: a reference guide. Cham: Springer International Publishing.
4. <https://www.mobot.org/MOBOT/research/APweb/treeapweb2s.gif>
5. <https://www.digitalatlasofancientlife.org>
6. <http://apps.kew.org/herbcat/navigator.do>
7. <https://efloraofindia.com/>
8. <https://powo.science.kew.org/>
9. Page, R.D.M., Holmes, E.C. (1998). Molecular Evolution: A phylogenetic approach. Blackwell Publishing Ltd.

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

**Category II**  
**B.Sc. Life Science with Botany as one of the Core Discipline**

**DISCIPLINE SPECIFIC CORE COURSE – 2: Genetics and Molecular Biology**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Genetics and Molecular Biology</b>	<b>04</b>	<b>2</b>	<b>0</b>	<b>2</b>	10+2 from any recognized Board with Biology	<b>Nil</b>

**Learning Objective**

To apprise students with the basic principles of Genetics and Molecular Biology and its applications in living systems

**Learning Outcome:**

Students would be able to

- understand the fundamentals of Mendelian inheritance and non-Mendelian inheritance.
- describe the concepts of linkage and crossing over and their usage in constructing genetic maps.
- gain knowledge about chromosomal aberrations and mutations.
- become familiar with structure and function of nucleic acids with reference to replication, transcription and translation.
- understand the mechanisms of gene regulation

**SYLLABUS OF DSC-02**

**Unit 1: Mendelian genetics and extrachromosomal inheritance**

**06 Hours**

Mendel's principles of inheritance; chromosomal theory of inheritance; incomplete dominance and co-dominance; multiple allelism; lethal alleles (dominant and recessive lethals); deviations of Mendelian dihybrid ratio (Epistatic interactions-Dominant, Recessive, Duplicate Dominant, Duplicate Recessive, Duplicate Gene Interaction, Dominant - Recessive); polygenic inheritance; numericals based on above; extrachromosomal inheritance (Chloroplast Inheritance: Variegation in Four O' clock plant; Mitochondrial inheritance: petite mutants in yeast); Maternal effect (shell coiling in snails).

**Unit 2: Structure & Function of the gene**

**02 Hours**

Classical and molecular concept of gene - Benzer's cis-trans complementation analyses & fine map of rII locus in phage. Central Dogma.

**Unit 3: Linkage, crossing over and chromosome mapping**

**03 Hours**

Discovery; linkage and crossing over; recombination frequency: two factor crosses; sex linkage (eye color in *Drosophila*; colour blindness and haemophilia in humans).

**Unit 4: Variation in chromosome number and structure**

**03 Hours**

Haploidy, polyploidy, autopolyploidy (examples: banana, watermelon), allopolyploidy (ancestry of wheat) and aneuploidy (Down's, Turner's and Klinefelter's syndromes); Deletion; Duplication (Bar eye in *Drosophila*); Inversion (paracentric and pericentric); Translocation (*Rhoeo*, *Oenothera*; Robertsonian translocation, Familial Down Syndrome and cancer).

**Unit 5: DNA structure and replication****03 Hours**

Discovery of DNA; Watson and Crick model of DNA structure; semiconservative replication (Meselson & Stahl's experiment); DNA replication mechanism in *E. coli* (semi-discontinuous mode and Y-fork).

**Unit 6: Mutations****03 Hours**

History; mutation types with examples [spontaneous and induced; somatic and germinal; biochemical mutations; point mutations (base substitutions): transition and transversion; deletion and frameshift mutations), missense and nonsense mutations]; Molecular basis of mutation; Mutagens - physical (UV and X-rays), chemical mutagens [Base analogues, deaminating, alkylating and intercalating agents] and Transposons.

**Unit 7: Gene expression****06 Hours**

Genetic code; Structure and types of RNA; Transcription and Translation in Prokaryotes; Transcription, RNA processing and Translation in Eukaryotes.

**Unit 8: Regulation of gene expression: Prokaryotes****04 Hours**

Inducible and repressible systems, negative and positive control of lactose operon and tryptophan operon. **Eukaryotes** - Transcriptional gene silencing - Role of chromatin, DNA methylation, histone modifications; cis-acting elements (promoters & enhancers/silencers), trans-acting factors; Post-transcriptional gene regulation (RNA interference/ PTGS), role of small RNAs, Epigenetics.

**Practicals:**

1. To study mitosis in *Allium cepa* through squash preparation of root tips. **04 Hours**
2. To study meiosis in *Allium cepa* through smear preparation of anthers. **08 Hours**
3. To study incomplete dominance and deviations of Mendelian dihybrid ratio (12:3:1, 9:3:4, 9:7, 15:1, 13:3) through seed samples. **08 Hours**
  - a) Human Genetics b) Study of autosomal & sex-linked dominant & recessive inheritance through pedigree analyses. c) n ABO blood group testing using kits, d) To study the syndromes (Down's, Klinefelter's, and Turner's) through karyotypes **08 Hours**
4. To study chromosomal aberrations: reciprocal translocation through squash preparations of *Rhoeo* anthers. Complex translocation ring, quadrivalents, lagging chromosomes, dicentric/inversion bridge through permanent slides. **08 Hours**
5. To prepare LB medium, inoculate and maintain (spread plate, streak plate, pour plate & serial dilution methods) *E. coli* cultures. **08 Hours**
6. To isolate genomic DNA from cauliflower and *E.coli*. Visualise using agarose gel electrophoresis. **08 Hours**
7. To estimate DNA by diphenylamine method. **04 Hours**

**Suggested Readings:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2020). Introduction to Genetic Analysis, 12<sup>th</sup> edition. New York, NY: W.H. Freeman and Co.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics, 12<sup>th</sup> edition. San Francisco, California: Benjamin Cummings.

**Additional Resources:**

1. Russell, P. J. (2010). Genetics- A Molecular Approach. 3<sup>rd</sup> Edition. Benjamin Cummings
2. Snustad, D.P., Simmons, M.J. (2016). Principles of Genetics, 7<sup>th</sup> Edition. New Delhi, Delhi: John Wiley & sons
3. Pierce, B. A. (2020). Genetics: A Conceptual Approach Seventh Edition, Macmillan

**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 THE  
DEPARTMENT of BOTANY**

**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		
Ethnobotany	04	2	0	2	12 <sup>th</sup> Pass	NIL

**Learning Objectives**

- To have the knowledge of the plants used by the local communities, tribals, ethnic groups, their nutritive and medicinal value.

**Learning outcomes**

After studying this course the student will gain knowledge about:

- Students would have an understanding of the treasure, value and usefulness of the natural products and their efficient use by the local communities as food and medicine and their conservation practices.

**SYLLABUS OF GE-6**

**Unit 1: Introduction to Ethnobotany and Basic Taxonomy**

**06 Hours**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science, databases and knowledge resource (Traditional Knowledge Digital Library), The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles, Plants used by the indigenous societies: a) Food plants b) Medicinal plants c) intoxicants and beverages d) Resins and oils and miscellaneous uses.

**Unit 2: Applied Ethnobotany**

**07 Weeks**

Role of ethnobotany in modern Medicine, Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology): a) *Azadiractha indica*, b) *Ocimum sanctum*, c) *Vitex negundo*, d) *Gloriosa superba*, e) *Tribulus terrestris*, f) *Pongamia pinnata*, g) *Cassia auriculata*, h) *Indigofera tinctoria*.

**Unit 3: The Ecology of Ethnobotany**

**07 Hours**

Ethnobotany—Spirits, Lore, Material Cultures, Folk Magic, Narcotics, Stimulants; Nutritional Ethnobotany – Agriculture, foraging and wild foods; Linguistic

Ethnobotany—Botanical Classification and Ethics; Medicinal Ethnobotany and Ethnopharmacology; Ethnoveterinary knowledge

Unit 4: Research Methods in Ethnobotany

**06 Hours**

Etic and Emic Perspectives: a) Field work; b) Herbarium; c) Ancient Literature and oral traditions; d) Archaeological finding inferences; e) Religious and sacred places.

Unit 5: Protecting Knowledge

**04 Hours**

Ethnobotany and legal aspects, Ethnobotany as a tool to protect interests of ethnic groups, Sharing of wealth concept with few examples from India, Biopiracy, Intellectual Property Rights and Traditional Knowledge; Case studies of traditional medicines leading to development of modern pharmaceutical products (use of *Trichopus zeylanicus* by kanhi tribe and *Artemesia* sp. for malaria cure)

Practicals: **60 Hours**

- Collection, identification and preparation of herbarium of three ethno-botanically important plants with appropriate references
- Preparation of crude extract of ethno-botanically important plants with appropriate references (any method to be used)
- Project work-documentation, literature survey, and collection of information on ethno-botanically useful plants from traditional healers)

**Suggested Readings:**

- Jain, S.K. (2010). Manual of Ethnobotany. Rajasthan: Scientific Publishers.
- Martin, G.J. (1995). Ethnobotany: A Methods Manual. Chapman Hall
- Cunningham, A.B. (2001). Applied Ethnobotany: People, Wild Plant Use and Conservation. Earthscan, London.
- Young, K.J. (2007). Ethnobotany. Infobase Publishing, New York.
- Schmidt, B.M., Cheng, D.M.K. (Eds.) (2017). Ethnobotany: A Phytochemical Perspective. John Wiley & Sons Ltd. Chichester, UK.
- Research papers from various Scientific Journals for case studies.

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

## GENERIC ELECTIVES (GE-7)

### 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		
Viewing and Capturing Diversity in Nature	4	2	0	2	12 <sup>th</sup> Pass	Nil

### Learning Objectives

The Learning Objectives of this course are as follows:

- To provide students a comprehensive introduction to photography, including both aesthetic and technique.
- To get students to rethink the environment in which they live through the medium of pictures.
- To become thoroughly familiar with digital camera and smartphone photography technology.
- To develop a working knowledge of digital image modification,
- To understand the importance and use Nature photography in your business and career prospects.
- To enhance appreciation for the tremendous beauty inherent in plants and gardens.

### Learning outcomes

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

- understand the digital camera or smartphone camera functions.
- use different photographic equipment to enhance their photographic skills.
- know about the photographic variables with weather and season.
- exploit their photographic work in various professions and for entrepreneurship development.

## SYLLABUS OF GE-7

### Unit 1: Basics of Photography and Videography

**10 Hours**

History and development of digital photography, Introduction to lenses and camera, Definitions (Megapixel, Magnification, Resolving Power, Zoom feature, contrast and brightness of image), Types of lenses, analog camera, Digital camera, SLR camera, imaging system in camera. Role of lighting, depth of field, focal length, colour and contrast in photography, types of photography and techniques, working of camera: exposure, shutter speed and aperture.

Understanding Image: Types of shots: distance, angle and movement; digital image basics: image format, resolution, aspect ratio, Pixels, DPI and PPI, composition and aesthetics: rules and guidelines.

## **Unit 2: Diversity of Nature: Colours and Landscape**

**10 Hours**

Importance of plants as natural products, General characteristic features of various plant life forms (Single celled, colonial forms, filamentous forms and multicellular and complex forms). General account of diverse landscaping patterns based on different geographical locations, plant adaptations and ecological interactions, role of plant pigments (diverse forms of alga, leaf coloration, floral pigments) in aesthetic appeal.

## **Unit 3: Diversity around us - A magnified view**

**05 Hours**

Principles of Microscopy: Dissection and compound microscope, scanning electron microscope. importance of sample preparation for microscopy, staining techniques.

## **Unit 4: Photographic visualisation of Nature**

**05 Hours**

Sensitization of Biodiversity conservation; Thematic depiction of nature in Art galleries; Eco-tourism: a general account; role of photography in Eco-tourism and ecological discourse.

## **Practicals: 60 Hours**

1. To study the parts of a digital camera.
2. To study the principle and working of digital camera/ smartphone camera.
3. Working and handling of light microscopes (Dissection and Compound).
4. Study of plant forms through microscopic lens (Single celled, colonial forms, filamentous forms, multicellular and complex forms).
5. To study techniques of capturing shots (using light and lenses effectively, macro and micro photography, wide angle and close-ups).
6. Study of plant adaptations through photographs (Aquatic and desert plants).
7. To capture and understand the Ecological Interactions.
8. Identification of different plant life forms through online available tools/ search engines.
9. Outdoor/ Campus Photography: Plants, Environment, Landscapes and cityscape, Mushrooms.
10. Project Work: To make a portfolio of diverse landscaping patterns/ selected theme through outdoor visits.

## **Suggested Readings:**

1. Ang., T. (2008). Fundamentals of modern Photography. London, Mitchell.
2. Patterson, F. (1999). The Art of Seeing. Key Porter Books.
3. Fitzharris, T. (2011). Landscape Photography. Firefly Books.
4. Kelby, S. (2012). The digital photography book. Peachpit Press.
5. Langford, M., Fox, A., Smith, R.S. (2013). Langford basic photography: the guide for serious photographers. Amsterdam: Focal Press/Elsevier.
6. Peterson, B. (2016). Understanding exposure: how to shoot great photographs with any camera. AmPhoto Books.
7. Karp, G. (2010). Cell Biology, 6<sup>th</sup> edition. New Jersey, U.S.A.: John Wiley & Sons.

## **Additional Resources:**

1. Sharma, P.D. (2010.) Ecology and Environment. Meerut, UP. Rastogi Publications.



2. Wilson, K., Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press

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

## GENERIC ELECTIVES (GE-8)

### 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		
Agricultural Botany and Weed Science	4	2	0	2	12 <sup>th</sup> Pass	Nil

**Objectives:** To gain the knowledge on

- Requirement of the conditions for seed germination
- Growth hormones, plant development and flowering conditions
- Weeds and the methods to control weeds

**Learning Outcomes:**

After completion of this course the students would be able to understand:

- how is the quality of seeds judged and how are the suitable conditions for the seed germination created?
- how are the growth, flowering and fruiting in plants managed through the applications of hormones?
- how are weeds managed in commercial crops?

#### **Unit 1: Seed Physiology**

**04 Hours**

Seed dormancy types, factors, mechanism and methods for breaking dormancy, seed viability, seed vigour and seed germination.

#### **Unit 2: Physiology of Crop Growth and Yield**

**05 Hours**

Growth, methods of growth analysis, factors affecting growth, concept of phytotronics and Fertilizers (Nitrogen, Phosphorus, biofertilizers).

#### **Unit 3: Regulation of Growth and Development**

**04 Hours**

Role of hormones in plant growth and development, growth retardant.

#### **Unit 4: Reproductive Physiology and Senescence**

**06 Hours**

Physiology of flowering, Photoperiodism, vernalization, physiology of fruit ripening, senescence and regulation of senescence.

#### **Unit 5: Biology of Weeds**

**04 Hours**

Ecology of weeds, competition, reproduction of weeds. Allelopathy and Invasive Plants.

#### **Unit 6: Crop Management Practices**

**07 Hours**

Mechanical, Cultural, Biological and Chemical Weed control. Some abnoxious weeds and their management, Integrated pest management (IPM).

**Practicals: (60 hours)**

1. To study the effect of ethylene on shelf life of cut flowers./ To study the effect of cytokinin on leaf senescence.
2. To test the viability of weed seeds.
3. To study the allelopathic effects of weeds on germination of crop seeds.
4. To study the effect of herbicides on seed germination and seedling growth of weeds.
5. Determination of pH and analysis of a soil sample for carbonates, chlorides, sulphates, organic matter and base deficiency by rapid field tests.
6. To perform the qualitative test for Nitrogen ( $\text{NH}_4^+$ ,  $\text{NO}_3^-$ , urea) in a fertilizer and the soil sample.
7. Demonstration / photographs for the mechanisms used in herbicide application.
8. Field trip to a crop land to study weeds.
9. Submission of any two properly dried and mounted weed specimens with the herbarium label.

**Suggested Readings:**

1. Ashton, F. M., Monaco, T. J. (2002). Weed Science: Principles and Practices. New Jersey, U.S.: John Wiley and Sons. Inc.
2. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
3. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development International 6th edition. New York, NY: Oxford University Press, Sinauer Associates.
4. Mandal, R.C. (1990). Weeds, weedicides and weed control: Principle and Practice. New Delhi, Delhi: Agro Botanical Publishers.
5. Rao, V. S. (1999). Principles of Weed Science. Oxford and IBH Publishers, New Delhi.
6. Subramanian, S. (2017). All about weed control. New Delhi, Delhi: Kalayani publishers.

## GENERIC ELECTIVES (GE-9)

### 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		
Intelligent Systems in Plants	04	2	<b>0</b>	2	12 <sup>th</sup> Pass	Nil

### Learning Objectives

- The course aims to lay the foundations on plant intelligence and develops understanding of the intelligent adaptively variable behaviour of plants.

### Learning outcomes

The Learning Outcomes of this course are as follows:

- The students will be learning the concepts of intelligence, distinction between development and intelligent behaviour and morphological /adaptive strategies employed by plants to survive.

### SYLLABUS OF GE-09

#### Unit 1: Introduction

**04 Hours**

An Introduction to Plant Structure (Morphological and Anatomical details), compartmentalization

#### Unit 2: Plants and Intelligence

**03 Hours**

Introduction to Plant Intelligence and Memory - Historical Perspective

#### Unit 3: Sensory Biology

**04 Hours**

Cell to cell communication, Self-recognition, Recognition of Neighbours and Relatives.

#### Unit 4: Learning in Plants

**06 Hours**

Habituation learning, Learning by association (Rhizosphere and Mycorrhizae), Adaptive Intelligence (Hydrophytes, Xerophytes, Parasites, Carnivorous plants, Thermogenic plants), Response to water, heat, salt, cold stress. Mechanical and chemical defence against predators with special reference to secondary metabolites.

#### Unit 5: Intelligent Behaviour of Plants

**13 Hours**

A Guided tour to Plant Movements (Tropic Movements, Movement towards gravity, light, tracking sun movements, prey driven movements, liberation movements), Intelligent response to minerals and light (Seed germination, root cap, response of shoot, leaf morphology and anatomy), Unique pollination and seed dispersal mechanisms, Osmosis, Short and long-distance transport of water and food, Metabolic redundancy, Life Cycle Signaling in response to external stimuli (Reactive Oxygen Species, peptides, receptors, hormones).

**Practicals:(60 hours)**

1. Study the structure of plant cell using temporary mount
2. Study of the cell as an osmotic system (Plasmolysis and Deplasmolysis).
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Extraction and qualitative analysis of alkaloids, flavonoids, tannins and phenols.
5. To study the phenomenon of seed germination (effect of light).
6. To study light sensitivity and etiolation vs. de-etiolation.
7. Morphology and orientation of chloroplasts in leaves growing in light and dark, plasmodesmata connections and plasma membrane receptors. (through photographs or other digital resources)
8. Estimation of total photosynthetic pigments.
9. Study of (a) Root cap (b) Trichomes: non-glandular and glandular (c) Leaf Morphology and Anatomy. (d) pulvinus anatomy in *Mimosa pudica*. (e) Specialised motor tissue at the base of monocot leaves
10. (a) Study of morphological and anatomical adaptations of hydrophytes, xerophytes. (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobancha*) Epiphytes, Predation (Insectivorous plants).
11. Pollination types (selected) and associated seed dispersal mechanisms

**Suggested Readings:**

1. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
2. Evert, R.F., Eichhorn, S.E. (2012). Raven Biology of Plants, 8<sup>th</sup> edition, New York, NY: W.H. Freeman and Company.
3. Koller, D. (2011). The Restless Plant. Edited by Elizabeth Van Volkenburgh, Harvard University Press, Cambridge, Massachusetts, and London, England.
4. Crang, R., Lyons-Sobaski, S., Wise, R. (2018) Plant Anatomy- A Concept based approach to the structure of seed plants, Springer Nature, Switzerland.

**Additional Resources:**

Trewavas A. (2017). The foundations of plant intelligence. Interface Focus 7: 20160098. <http://dx.doi.org/10.1098/rsfs.2016.0098>

**GENERIC ELECTIVES (GE-10)****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		
Informatics and Statistics for Biology and Allied Sciences	4	2	0	2	12 <sup>th</sup> Pass	Nil

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To build an understanding in silico/computational approaches in various aspects of understanding biology and biological research.

- To build analytical skills and integrate the principles of statistical analyses for robust interpretation of biological observations.

### **Learning outcomes**

The student will understand

- the basics of bioinformatics and develop awareness of the interdisciplinary nature of this field.
- learn about biological databases, sequence retrieval, alignment, and phylogenetic analysis using various tools.
- understand the basic concept of sampling methods, data classification, presentation and statistical analysis.

### **SYLLABUS OF GE-10**

#### **Unit 1: Introduction to Bioinformatics**

**03 Hours**

Historical background, Aims and scope, bioinformatics in Genomics, Transcriptomics, Proteomics, Metabolomics, Systems biology and drug discovery, Applications and Limitations in bioinformatics.

#### **Unit 2: Biological databases**

**04 Hours**

Introduction to biological databases - Primary, secondary and composite databases. Study of following databases: NCBI (GenBank, PubChem, PubMed and its tools (BLAST)), introduction to EMBL, DDBJ, UniProt, PDB and KEGG.

#### **Unit 3: Basic concepts of Sequence alignment**

**04 Hours**

Similarity, identity and homology. Concepts of alignment (gaps and penalty); Alignment – pairwise and multiple sequence alignments

#### **Unit 4: Molecular Phylogeny**

**04 Hours**

Introduction to Molecular Phylogeny, methods of construction of phylogenetic trees: maximum parsimony (MP), maximum likelihood (ML) and distance (Neighbor-joining) methods.

#### **Unit 5: Biostatistics**

**02 Hours**

Biostatistics – definition, Basics of descriptive and inferential statistics; Limitations and applications of biostatistics.

#### **Unit 6: Data types and presentation**

**03 Hours**

Primary and secondary data; Sampling methods (in brief); tabulation and presentation of data;

#### **Unit 7: Descriptive Statistics**

**04 Hours**

Measures of central tendency - mean, median, and mode; Measures of dispersion - range, standard deviation, and standard error.

#### **Unit 8: Correlation and Regression**

**03 Hours**

Types and methods of correlation, Introduction to simple regression equation; similarities and dissimilarities between correlation and regression.

#### **Unit 9: Statistical inference**

**03 Hours**

Hypothesis – (simple hypothesis), student's t test, chi-square test.

**(Note: Numerical based questions of unit 7, 8 and 9 should be covered only in practical)**

### **Practicals: 60 Hours**

1. Biological databases (NCBI, EMBL, UniProt, PDB)
2. Literature retrieval from PubMed
3. Sequence retrieval (protein and gene) from NCBI (formats - FASTA, GenBank and GenPept formats)
4. Protein Structure retrieval from PDB (in pdb format) and visualization by viewing tools (Ras Mol/ J mol/Mol\*/Swiss 3D Viewer/Pymol)
5. Multiple sequence alignment (MEGA/Clustal omega)
6. Construction of phylogenetic tree (PHYLIP/ MEGA/ Clustal omega).
7. Making of Bar diagrams, Pie chart, Histogram, Frequency polygon, Cumulative frequency curve (any four) in the given data set using Microsoft Excel
8. Calculation of mean, mode, median, standard deviation and standard error (through manual calculation and using Microsoft Excel) (use only ungrouped data)
9. Calculation of correlation coefficient values by Karl Pearson's /Spearman Rank methods (through manual calculation and using Microsoft Excel)
10. Student's t-test (using Microsoft Excel only), chi square test (Manual and using Microsoft Excel)

### **Suggested readings:**

1. Ghosh, Z., Mallick, B. (2008). *Bioinformatics – Principles and Applications*, 1st edition. New Delhi, Delhi: Oxford University Press.
2. Baxevanis, A.D., Ouellette, B.F., John (2005). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
3. Roy, D. (2009). *Bioinformatics*, 1st edition. New Delhi, Delhi: Narosa Publishing House.
4. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). *Bioinformatics: A practical guide to the analysis of genes and proteins*, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
5. Khan, I.A., Khanum, A. (2004). *Fundamentals of Biostatistics*, 5th edition. Hyderabad: Ukaaz publications.
6. Campbell, R.C. (1998). *Statistics for Biologists*. Cambridge, U.S.A.: Cambridge University Press

### **Additional Resources:**

1. Pevsner, J. (2009). *Bioinformatics and Functional Genomics*, 2<sup>nd</sup> edition. New Jersey, U.S.: Wiley Blackwell.
2. Xiong, J. (2006). *Essential Bioinformatics*, 1<sup>st</sup> edition. Cambridge, U.K.: Cambridge University Press.
3. Mount, D.W. (2004). *Bioinformatics: Sequence and Genome analysis* 2nd edition, Cold Spring Harbor Laboratory Press, USA.
4. Zar, J.H. (2012). *Biostatistical Analysis*, 4<sup>th</sup> edition. London, London: Pearson Publication.
5. Pandey, M. (2015). *Biostatistics Basic and Advanced*. New Delhi, Delhi: M V Learning.

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

## DEPARTMENT OF ZOOLOGY

### Category-I BSc. (H) Zoology

#### DISCIPLINE SPECIFIC CORE COURSE– 4 (DSC-4): Non-Chordata: Coelomates

#### 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		
Non-Chordata: Coelomates	04	02	0	02	Class XII pass with Biology/ Biotechnology	NIL

#### Learning Objectives

The learning objectives of this course are as follows:

- The course aims to impart in-depth knowledge about the diverse life forms from the taxonomic positions of Annelida to Echinodermata.
- It will help the students to identify the body plan types of complex non-chordates and their systematic organization based on evolutionary relationships, structural and functional affinities.
- The course will help the students to understand the characteristic morphological, adaptive and anatomical features of diverse animals
- The course will help students to understand the economic and ecological significance of various animals in human life.
- The course will create interest among them to explore and appreciate the animal diversity in nature.

#### Learning Outcomes

By studying this course, students will be able to

- learn about the importance of systematics, taxonomy, and structural organization of non-chordate coelomates.
- recognize the diversity of non-chordates living in varied ecological habitats.
- critically analyse the organization, complexity and characteristic features of non-chordates.
- comprehend the economic importance of non-chordates, their interaction with the environment and their role in the ecosystem.
- enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.



## **SYLLABUS OF DSC-4**

### **UNIT – I Annelida**

**07 Hours**

General characteristics and classification; Excretion in Annelida; Evolution of coelom and metamerism.

### **UNIT – II Arthropoda and Onychophora**

**12 Hours**

General characteristics and classification (Special reference to Insecta up to orders); Vision and Respiration in Arthropoda; Metamorphosis in insects; Social life of bees and termite, Evolutionary significance of Onychophora.

### **UNIT – III Mollusca**

**06 Hours**

General characteristics and classification; Respiration in Mollusca; Torsion and Detorsion in Gastropoda; Pearl formation in bivalves.

### **UNIT – IV Echinodermata**

**05 Hours**

General characteristics and classification; Water-vascular System in Asteroidea.

**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 -60 Hours**

1. Study of *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*, Trochophore larva.
2. Study of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termite, *Apis*, *Musca*.
4. Study of *Peripatus*.
5. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Patella*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*.
6. Study of *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria*, *Antedon*; Any two larval forms.
7. Study of mouth parts, digestive system and nervous system of *Periplaneta*. \*
8. Study of the digestive system of *Pheretima*. \*
9. Submit a Project Report on the larval forms in different phyla OR field study of the insect diversity.

\*Subject to UGC approval and guidelines

### **Essential/recommended 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

### **Suggestive readings**

1. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
2. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers

## DISCIPLINE SPECIFIC CORE COURSE– 5 (DSC-5): Fundamentals 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		
<b>Fundamentals of Biomolecules</b>	<b>04</b>	<b>02</b>	<b>0</b>	<b>02</b>	<b>Class XII pass with Biology/ Biotechnology</b>	<b>NIL</b>

#### Learning Objectives

The learning objectives of this course are as follows:

- To provide fundamental and precise knowledge of biomolecules that play a crucial role in all processes of life and the development of diseases.
- To make the students understand the fundamental building blocks of living organisms that include carbohydrates, proteins, lipids, nucleic acids
- To apprise the students of the various functions of the molecules like providing structural integrity to the tissue-engineered constructs.
- Through this course, the students would be able to understand the physiological importance of these biomolecules.
- The enzymatic study would enable them to understand the various metabolic pathways and physiological reactions.

#### Learning Outcomes

By studying this course, students will be able to

- Interpret the structure-functional relationships of carbohydrates, proteins, lipids and nucleic acids.
- Understand the qualitative analysis of functional groups
- understand the properties of various biomolecules.
- appreciate the action of the enzyme and the various factors that affect their action detail.

#### SYLLABUS OF DSC-5

##### UNIT – I Carbohydrates

**06 Hours**

Structure and biological importance: with emphasis on aldose, ketose, chiral centre, polarised Light, Fischer nomenclature, Haworth projection formula, mutarotation of glucose, anomers, pyranose, furanose, glycosidic linkage; reducing and non-reducing sugars: monosaccharides, disaccharides, polysaccharides and glycoconjugates.

##### UNIT – II Lipids

**04 Hours**

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, tri-acylglycerols, phospholipids, glycolipids, steroids.

**UNIT – III Proteins****08 Hours**

Amino acids: Structure, classification and general properties of  $\alpha$ -amino acids; physiological importance of essential and non-essential amino acids; proteins: bonds stabilizing protein structure; Levels of organization in protein motifs, folds and domains; Denaturation.

**UNIT – IV Nucleic Acids****04 Hours**

Structure: purines and pyrimidines, nucleosides, nucleotides, nucleic acids; Cot Curves: Base pairing, Denaturation and Renaturation of DNA; Types of DNA and RNA.

**UNIT – V Enzymes****08 Hours**

Nomenclature and classification, cofactors; specificity of enzyme action, Isozymes, Mechanism of enzyme action; Enzyme kinetics; factors affecting rate of enzyme-catalysed reactions; derivation of Michaelis-Menten equation, concept of  $K_m$  and  $V_{max}$ , Lineweaver-Burk plot, multi-substrate reactions, enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme reaction.

**Practical component – 60 Hours**

1. Understanding the structures of biomolecules through ball and stick models.
2. To understand the preparation and roles of two important biological buffer systems: phosphate and bicarbonate; Preparation of buffers and determination of pH.
3. Identification of the functional groups by qualitative tests:
  - a. Carbohydrates
  - b. Lipids
  - c. Proteins
4. Separation of amino acids by paper chromatography.
5. Study the action of salivary amylase under optimum conditions.
6. Study the effect of pH, temperature and inhibitors on the action of salivary amylase.

**Essential/recommended readings**

1. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
2. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry. XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.

**Suggestive readings**

1. Stryer, L., Berg, J., Tymoczko, J., Gatto, G. (2019). Biochemistry (9th ed.). New York, WH: Freeman.
2. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd.

## DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Human Physiology-Control and Coordination Systems

### 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 Physiology- Control and Coordination Systems	04	02	0	02	Class XII pass with Biology/ Biotechnology	NIL

### Learning Objectives

The learning objectives of this course are as follows:

- The course will provide a thorough understanding of the normal body function and helps to determine the cause of disease.
- It will enable the development of new and more effective treatments and guidelines for maintaining good health.
- It will equip the students with an ability to pursue career in medical and healthcare sector, pharmaceuticals and other related areas.
- It will help in understanding how these systems interact among themselves to maintain stability or homeostasis.

### Learning Outcomes

By studying this course, students will be able to:

- appreciate human physiology and have its enhanced knowledge.
- recognize and identify principal tissue structures and functions
- understand the functions of important physiological systems including the nervous system, muscular system, endocrine and reproductive system
- learn an integrative approach to understand how these separate systems interact to yield integrated physiological responses to maintain homeostasis in the body along with feedback mechanisms.
- synthesize ideas to make the connection between knowledge of physiology and real-world situations, including healthy lifestyle decisions and problems faced due to homeostatic imbalances
- perform, analyze and report on experiments and observations in physiology
- know the fundamentals and understand advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue an advanced degree.

### SYLLABUS OF DSC-6

#### UNIT – I Nervous System and Sense Organs

**08 Hours**

Structure of neuron, resting membrane potential, origin and conduction of action potential across

the myelinated and unmyelinated nerve fibers; Types of synapses, synaptic transmission, Neuromuscular junction.

**UNIT – II Muscle Physiology**

**07 Hours**

Mechanism of muscle contraction; Characteristics of muscle twitch; Motor unit, summation, and tetanus.

**UNIT – III Endocrine System**

**08 Hours**

Hormones secreted by the glands, their physiological action and the disorders related to their secretion; Classification of hormones and their regulation; Mode of hormone action- Signal transduction pathways for peptide and steroid hormones.

**UNIT – IV Reproductive System**

**07 Hours**

Physiology of male and female reproduction– spermatogenesis, oogenesis, follicular development, steroidogenesis, implantation, pregnancy, and mammary gland development.

**Practical component – 60 Hours**

1. Classification, structure and functions of tissues: epithelial, connective, muscular and nervous tissue.
2. Structure, histology, types and function of bones and cartilage.
3. Classification and histological structure of muscle; ultrastructure of striated muscle.
4. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres, Nerve cells.
5. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
6. Recording of simple muscle twitch with electrical stimulation (Interpretation/ Virtual).
7. Study of permanent slides of Mammalian Skin, Spinal cord, Hypothalamus, Pineal, Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Testis and Ovary.
8. Permanent slide preparation from various tissues: Tissue fixation, block preparation, tissue sectioning, H&E staining, microscopy (Minimum three tissues; tissue can be procured from the slaughterhouse).

**Essential/recommended readings**

1. Tortora, G.J. and Derrickson, B.H. (2012). Principles of Anatomy and Physiology. XIII Edition, John Wiley and Sons, Inc.
2. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. XIII 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. Eroschenko, Victor P. (2012) Di Fiore's Atlas of Histology with Functional Correlations; 12th edition, CBS Publishers and Distributors Pvt. Ltd.

**Suggestive readings**

1. Chatterjee, C.C. (2021) Human Physiology, 14th Edition, Volume 1 & Volume II, CBS Publishers and Distributors Pvt. Ltd.
2. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.

**Category-II**  
**BSc Life Science with Zoology as one of the Core Disciplines**

**DISCIPLINE SPECIFIC CORE COURSE -6 (Zoo-LS-DSC-06):- Cell and Developmental Biology of Animals**

**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		
Cell and Developmental Biology of Animals Zoo-LS-DSC-06	04	02	0	02	Class XII pass	NIL

**Learning Objectives**

The learning objectives of this course are as follows:

- The course will help the students to learn and develop an understanding of a cell as a basic unit of life.
- The course will enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.
- The course will provide the students a complete comprehension about the essential vertebrate developmental biology
- The course will help the students to understand the conundrum of **the different levels of biological complexity** by tracing them back to events at the level of genes and genomes.

**Learning Outcomes**

By studying this course, students will be able to

- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Know the evolution of different concepts in developmental biology.
- Be able to understand the process of gamete formation from stem cell population to mature ova and sperm. The students will know the differences between Spermatogenesis and Oogenesis.
- Be able to comprehend the sequence of steps leading to the fusion of gametes and learn the contribution of sperm and ova to zygote formation
- Be able to understand how polyspermy is avoided in animal kingdom.
- Learn the mechanisms underpinning cellular diversity and specificity in animals.
- Learn the methods and tools related to developmental biology help to understand different processes of embryogenesis.

## **SYLLABUS OF Zoo-LS-DSC-06**

### **UNIT - I Cell Division and Differentiation**

**06 Hours**

Types of animal cells and tissues, Mitosis, meiosis, Cell cycle regulation, Cell-cell communication, Stem cells, Differential gene expression.

### **UNIT- II: Scope and History of Developmental Biology**

**03 Hours**

Historical perspective including contributions by eminent scientists and landmark experiments in the field of Developmental Biology, Concepts of Epigenesis, Preformation, Von Baer laws.

### **UNIT- III: Early Embryonic Development**

**15 Hours**

Gametogenesis: Spermatogenesis and Oogenesis in mammals; Types of Eggs and Egg membranes Fertilization: External (amphibians) and Internal (mammals), Fast and slow blocks to Polyspermy; Types and Patterns of cleavage; Types of morphogenetic movements; Early development of frog and chick up to gastrulation. Fate maps

### **UNIT- IV: Late Embryonic Development**

**04 Hours**

Fate of Germ Layers; Formation of neural tube, Extra-embryonic membranes in birds

### **UNIT- V: Post Embryonic Development**

**02 Hours**

Metamorphic events and its hormonal regulation in amphibians.

### **Practical Component – 60 Hours**

1. Study of the various stages of meiosis through permanent slides.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides- cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Chick – Study of Whole Mounts of developmental stages of Chick through permanent slides (HH stages)- 13 hrs, 18hrs, 24hrs, 28hrs, 33hrs, 36hrs, 48hrs, 72hrs and 96hrs.
4. Study of the different types of placenta along with its function- through permanent slides / photomicrograph.
5. Study of various developmental stages in the life Cycle of Drosophila using stock culture/ permanent slides/ photomicrograph.
6. Visit to IVF centre/ Poultry Farm.
7. Project report on IVF Centre/ Poultry farm/ Drosophila culture/ Zebra fish culture.

### **Essential/recommended 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. Gilbert, SF (2014) *Developmental Biology* (10th edition). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA. ISBN : 9780878939787
4. Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
5. Freeman and Bracegirdle (1975, 2<sup>nd</sup> Edition) “*An Atlas of Embryology*”, Published by Heinmann.

### **Suggestive readings**

1. De Robertis, E.D.P. and De Robertis, E.M.F. (2009) *The Cell and Molecular Biology*, Lippincott Williams & Wilkins, Philadelphia.
2. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments*, VIII Edition, John Wiley & Sons Inc
3. Kalthoff Klaus (2001) *Analysis of Biological Development*, 2<sup>nd</sup> ed. Boston, MA: Mc Graw-Hill, ISBN : 0071180788
4. Wolpert, L & Tickle, C (2011) *Principles of Developmental Biology* (4th edition). Oxford University Press, ISBN: 9780198792918
5. Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc. ISBN : 9780070634275



### Category-IV

## COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY THE DEPARTMENT OF ZOOLOGY

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

#### GENERIC ELECTIVES (GE-3): Economic Zoology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Economic Zoology	04	02	0	02	Class XII pass	NIL

#### Learning Objectives

The learning objectives of this course are as follows:

- It deals with the application of zoological knowledge for the benefit of mankind by understanding the economy, health and welfare of humans.
- It includes culturing organisms for mass production for human use and to control or eradicate harmful ones.
- It will bring to the fore the multidisciplinary nature of Economic Zoology as it includes sericulture, apiculture, aquaculture, pisciculture and insect pests of agriculture.

#### Learning Outcomes

By studying this course, students will be able to

- develop an understanding of the beneficial higher and lower organisms in terms of economic prospective.
- aquatic organisms and agriculturally important insect pests based on their morphological characteristics/structures.
- develop a critical understanding of the contribution of organisms to the welfare of society.
- examine the diversity of insect pests of different orders in the agro-ecosystem and sustainable pest management strategies.

#### SYLLABUS OF GE-3

##### UNIT – I Aquaculture

**05 Hours**

Definition, scope, and significance of Aquaculture, Prawn culture, Pearl culture, Edible Oyster culture.

##### UNIT – II Pisciculture

**07 Hours**

Basic concept on mono and composite fish culture (Carp culture); Fish diseases caused by *Ichthyophthirius multifiliis*, *Trichodinia* sp. and *Ichthyobodo* sp., symptoms and control; Maintenance of aquarium.

**UNIT – III Sericulture****05 Hours**

Different species and economic importance of silkworm, Mulberry and Non-mulberry Sericulture (Eri, Muga, Tussar), Sericulture techniques.

**UNIT – IV Apiculture****05 Hours**

Different species of Honeybee, types of beehives - Newton and Langstroth, Bee Keeping equipment, Methods of extraction of honey (Indigenous and Modern) and its processing, Products of apiculture industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.) and their uses.

**UNIT – V Agricultural Crop Pest and Management****08 Hours**

Bionomics of crop pests of rice (*Leptocorisa acuta*); sugarcane (*Pyrilla perpusilla*); vegetable (*Raphidopalpa foveicollis*); and stored grain (*Corcyra cephalonica*); Pest Management Strategies (Physical, Chemical & Biological)

**Practical component – 60 Hours**

1. Study of aquatic organisms - prawns, oysters and fishes (*any three*) through museum specimens in the laboratory with details on their classification, distribution and specialized features.
2. Study of different species of aquarium fishes (Goldfish, Guppy, Swordtail fish) and maintenance of aquarium in lab/indoor.
3. Study of major crop pests of rice (*Leptocorisa acuta*), sugarcane (*Pyrilla perpusilla*), vegetable (*Raphidopalpa foveicollis*) and stored grain (*Corcyra cephalonica*) belonging to different orders.
4. Study of *Bombyx mori*, its life cycle and economic importance.
5. Study of the life history of honeybee, *Apis cerana indica* and *Apis mellifera* from specimen/ photographs - egg, larva, pupa, adult (queen, drone, worker)
6. Study of artificial hive (Langstroth/Newton), its various parts and beekeeping equipment.
7. Project report on life cycle of any one crop pest or on a product obtained from apiculture industry.
8. Field study/lab visit to an apiary/honey processing unit/sericulture institute/aquarium shop/fish farm/pisciculture unit.

**Essential/recommended readings**

1. Atwal, A.S. (1993) Agricultural Pests of India and Southeast Asia. Kalyani Publishers, New Delhi.
2. Shukla, G.S. and Upadhyay, V.B.: Economic Zoology, 4e, 2002, Rastogi.
3. D. B. Tembhare. (2017) Modern Entomology. Published by Himalaya Publishing House (ISO 9001: 2008 Certified).
4. Dawes, J. A. (1984) The Freshwater Aquarium, Roberts Royce Ltd. London.

**Suggestive readings**

1. S.S. Khanna and H.R. Singh. A Textbook of Fish Biology & Fisheries Published by Narendra Publishing House. 3<sup>rd</sup> Edition. (ISBN13: 9789384337124)
2. Dokuhon, Z.S. (1998). Illustrated Textbook on Sericulture. Oxford & IBH Publishing Co., Pvt. Ltd. Calcutta.

## GENERIC ELECTIVES (GE-4): Lifestyle Disorders

### 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		
Lifestyle Disorders	04	02	0	02	Class XII pass	NIL

### Learning Objectives

The learning objectives of this course are as follows:

- The course aims to introduce the students to the concept of health, nutrition, and the factors affecting it.
- It will apprise students of the prevalence of emerging health issues affecting the quality of life.
- The course will facilitate the understanding of different physical and psychological associated disorders and their management for a healthy lifestyle.
- It highlights the important lifestyle-related disorders and describes the risks and remedies in relation to adopting a better life.

### Learning Outcomes

By studying this course, students will be able to

- have a better understanding of lifestyle choices and the diseases associated with them.
- have an in-depth understanding of making better lifestyle decisions.
- learn about various techniques for preliminary diagnosis of lifestyle disorders

### SYLLABUS OF GE-4

#### UNIT – I Introduction to Lifestyle

**05 Hours**

Traditional Indian lifestyle vs modern Indian lifestyle, lifestyle diseases – definition, risk factors-erratic sleep patterns, wrong food choices, smoking, alcohol abuse, stress, lack of optimum physical activity, illicit drug use, Obesity, respiratory diseases, diet and exercise.

#### UNIT – II Diabetes and Obesity

**05 Hours**

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes-paediatric and adolescent obesity-weight control and BMI (Body Mass Index), Prediabetes, PCOS/PCOD.

#### UNIT – III Cardiovascular Diseases

**06 Hours**

Coronary atherosclerosis-Coronary artery disease, Causes-Fat and lipid, Alcohol Abuse-Diagnosis, Electrocardiograph, Echocardiograph, Treatment, Exercise and Cardiac rehabilitation.

**UNIT – IV Cancer****05 Hours**

Introduction to Cancer and general diagnostic methods to detect cancer; Lung Cancer, Mouth Cancer: associated lifestyle choices, symptoms and treatment.

**UNIT – V Hypertension****04 Hours**

Risk factors, complications (brain, heart, eye and kidney) and management of hypertension.

**UNIT – VI WHO Global action plan and Monitoring****05 Hours**

WHO Global action plan and Monitoring framework for prevention and control of non-communicable diseases, NPHCE (National Programme for the Health Care of Elderly), Fit India movement (Yoga and meditation).

**Practical component – 60 Hours**

1. Estimation of blood glucose (GOD/POD) by kit.
2. Calculation of BMI, waist to hip ratio, skin fold test.
3. Imaging techniques for cancer diagnosis. CT Scan, MRI, PET-CT scan. Confirmatory Biopsy.
4. Blood pressure measurement using a sphygmomanometer.
5. Study of cardiac rehabilitation- thrombolytic agents and balloon angioplasty.
6. Project Work based on Case studies related to risk factors of any ONE lifestyle disorder studied.

**OR**

7. To write a review of personal experience of using any of the available health or lifestyle-related applications over a period of time with some data to correlate.

**Essential/recommended readings**

1. James M.R, Lifestyle Medicine, 2nd Edition, CRC Press,2013,
2. Tortora, G.J. and Grabowski, S. (2006). Principles of Anatomy & Physiology. XI edition. John Wiley & Sons
3. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates

**Suggestive readings**

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd/W.B. Saunders Company.
2. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. McGraw-Hill Education 13th Edition.

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

**ACBR**

**Category-I**

**BSc. (HONS.) Biomedical Sciences**

**DISCIPLINE SPECIFIC CORE COURSE– 4 (DSC-4): Biochemistry**

**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		
Biochemistry	04	03	0	01	Class pass XII	NIL

**LEARNING OBJECTIVES**

The objective of this course is to effectively incorporate the fundamentals of metabolism through key biochemical pathways and make learners appreciate the requirement for the stringency of their regulation; introduce various biochemical techniques used in the characterization of the proteins and a detailed account on how enzymes function: their kinetics, regulation and inhibition.

**COURSE OUTCOMES**

- Students will gain an understanding of fundamental biochemical principles of metabolism of biomolecules (Carbohydrates, Proteins, Lipids and Nucleic acids) and the associated bio- energetics. They will learn the biochemical reactions in metabolic pathways and understand their interrelations, logics and patterns.
- They will also understand the role of enzymes in the biochemical reactions and the connection between biochemical defects and metabolic disorders. Students would additionally gather a firm understanding and relevance of stringent regulation of metabolic pathways.
- Having understood the structural architecture of proteins in earlier semesters, students shall learn how biological molecules (especially proteins) are characterized through various analytical techniques such as types of column chromatography methods, Polyacrylamide Gel Electrophoresis (PAGE) that are used in contemporary biochemistry research laboratories.
- Students will get a grasp on central concepts underlying enzyme catalysis, kinetics and their mechanism of action. Effects of different kinds of enzyme-inhibitors will also be learned.
- Students would learn how coenzymes assist enzymes in catalyzing biochemical reactions and what is the criterion for their classification.
- Having studied the role of enzymes that regulate metabolic pathways in the third unit, students would learn the general properties of regulatory enzymes, their activity and kinetics.

**COURSE CONTENT:**

<b>Unit I: Metabolic pathways and their allosteric regulation</b>	<b>(22 hrs)</b>
<b>Carbohydrates-</b> Glycolysis, Gluconeogenesis, Tricarboxylic acid cycle and their regulation, Cori cycle, Hexose monophosphate shunt. <b>Lipids-</b> Mobilization of triglycerides, Metabolism of glycerol, Biosynthesis and $\beta$ -oxidation of saturated fatty acids (palmitic acid) and their regulation. Significance of ketone bodies. <b>Proteins-</b> General over view, Transamination, Deamination, Glucose-Alanine cycle, Urea cycle and its regulation. <b>Nucleic acid-</b> General overview, an outline of purine and pyrimidine metabolism. Electron transport chain, Oxidative phosphorylation and Substrate-level phosphorylation.	
<b>Unit II: Analytical methods in protein characterization</b>	<b>(08 Hours)</b>
Introduction to spectrophotometry & Lambert-Beer's law, Column chromatography: Ion exchange chromatography, Gel filtration and Affinity chromatography, SDS-PAGE	
<b>Unit III: Enzymes</b>	<b>(07 Hours)</b>
Introduction to enzymes, Concept of Lock & key and 'Induced fit theory, Concept of activation energy and binding energy. Enzyme kinetics: Michaelis-Menten equation and its physiological significance. Concept of enzyme inhibition: types of inhibitors (competitive & non-competitive) and their examples.	
<b>Unit IV: Coenzymes</b>	<b>(04 Hours)</b>
Classification: various types and their function.	
<b>Unit V: Regulatory Enzymes</b>	<b>(04 Hours)</b>
General properties of allosteric enzymes. Enzyme regulation by covalent modification. Zymogens.	

**PRACTICAL – 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. Measurement of absorbance & %transmittance of a solution using spectrophotometer/colorimeter.

2. Preparation of standard plot and estimation of protein concentration by any one method: Biuret/Lowry/Bradford.
3. Estimation of glucose concentration by an enzymatic/non-enzymatic method.
4. Separation of biomolecules (sugar/amino acids) by thin-layer chromatography (TLC).
5. Separation of biomolecules by gel filtration/Calculation of void volume of Sephadex G-25 column, using Blue Dextran.
6. Analysis of SDS-PAGE as a separation technique (gel analysis).
7. To perform an assay of an enzyme under optimal conditions.
8. Determination of  $K_m$ ,  $V_{max}$  and  $K_{cat}$  value of a given enzyme from the provided experimental data.

#### **SUGGESTED READINGS:**

- Nelson, D. L., & Cox, M. M. (2021). *Lehninger: Principles of Biochemistry* (8<sup>th</sup> ed.). Macmillan. ISBN:9781319322328
- Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8<sup>th</sup> ed. Hofmann A. and Clokie S.(Eds.) Cambridge University Press, Cambridge, U.K.
- Plummer, D.T. (2012). *An Introduction to Practical Biochemistry*. New Delhi, India: McGraw-Hill College.
- S. K. Sawhney / Randhir Singh. (2009): *Introductory Practical Biochemistry*, Narosa Publishers, ISBN-13 : 978-8173193026
- Donald Voet, Judith G. Voet (2021) *Voet's Biochemistry*, Adapted ed 2021, ISBN: 9789354243820.

#### **BOOK FOR BASIC CONCEPTUAL READING**

- Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). *Biochemistry*. New York, USA: W. H. Freeman and Company.
- Devlin, (2011). *Textbook of biochemistry with clinical correlations*. UK: Wiley T & Sons.

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

## DISCIPLINE SPECIFIC CORE COURSE– 5 (DSC-5): PRINCIPLES OF GENETICS

### 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		
<b>Principles of Genetics</b>	<b>04</b>	<b>03</b>	<b>0</b>	<b>01</b>	<b>Class XII pass</b>	<b>NIL</b>

#### **LEARNING OBJECTIVES:**

The course intends to introduce students to Mendelian principles of inheritance, deviations from Mendelian inheritance and extra-nuclear inheritance, Introduction to pedigree analysis for autosomal and X-linked traits, Understanding of differences between prokaryotic and eukaryotic genome organization, transposons, and basic cytogenetics and Understanding of mechanisms of sex determination.

#### **COURSE OUTCOMES:**

- The flavour of genomics as a progression from Mendelian genetics will be introduced to the students. They will learn about classical experiments that led to discovery of the genetic material. They will also learn the structure of DNA.
- Students will be able to explain Mendelian laws of inheritance, deviations from monohybrid ratio (incomplete dominance, codominance, multiple alleles and lethal genes) and deviations from dihybrid ratio (gene-gene interactions, linkage). They must be able to distinguish sex-linked, sex-limited and sex-influenced traits. Students must also be able to interpret patterns of inheritance for autosomal and X-linked traits from pedigrees.
- Students would learn the concept of extra-nuclear inheritance.
- Students would learn the differences in genomes of prokaryotes and eukaryotes. They would also learn about transposable genetic elements with examples from prokaryotes and eukaryotes.
- The lectures will cover details of the structure of the chromosomes, the abnormalities that commonly occur at chromosomal level. Discussion of various types of mutations at the DNA level (deletion, addition, substitution), their consequence on gene structure/product and the diseases associated with these abnormalities.
- Students would gain insights into genetic and environmental sex determination mechanisms.

#### **COURSE CONTENT:**



<b>Unit I: Overview of Changing Paradigms in Genetics</b>	<b>05 Hours</b>
A brief overview of how genetic principles took shape, leading to the concept of a blueprint of life within the cell to the physical entity of DNA. Basic structure of DNA, salient features of the double helix, semi-conservative replication– Meselson and Stahl experiment. Also mention the surprises we have from genomics such as genetic variation between individuals. There are popular videos/presentations that can be used. The purpose is to ignite the curiosity of the students.	
<b>Unit II: Concept of Genetic Inheritance</b>	<b>15 Hours</b>
Concept of alleles, haploid and diploid status, phenotype and genotype, Mendel’s laws of inheritance, dominant and recessive inheritance, test, back and reciprocal crosses with two examples each. Chromosomal theory of inheritance. Concept of linkage and crossing over, cytological proof of crossing over, genetic mapping: two and three-point cross over. Distinguishing recombination and complementation. Allelic interactions- dominance relationships- complete, incomplete and co-dominance, gene-gene interactions. Sex linked, sex-limited and sex-influenced traits. Gathering family history, pedigree symbols and construction of pedigrees for autosomal and sex linked traits (dominant and recessive).	
<b>Unit III: Extra Nuclear Inheritance</b>	<b>05 Hours</b>
Criteria for extra nuclear inheritance, plastid inheritance in <i>Mirabilis jalapa</i> , kappa particles in <i>Paramecium</i> , maternal effect- snail shell coiling, cytoplasmic inheritance (mitochondria and chloroplast).	
<b>Unit IV: Genome Organization</b>	<b>07 Hours</b>
Organization of Genomes in prokaryotes and eukaryotes. Establishing the Central Dogma. Nucleosomes organization and assembly. Euchromatin, heterochromatin- constitutive and facultative heterochromatin. Structure and significance of polytene and lampbrush chromosomes. Transposable genetic elements: Prokaryotic transposable elements- IS elements, Composite transposons; Eukaryotic transposable elements- Ac-Ds system in maize; Uses of transposons.	
<b>Unit V: Cytogenetics and Mutations</b>	<b>08 Hours</b>

Chromosome: Structure- centromere and telomere, types of chromosomes based on centromere. Karyotyping- banding pattern and nomenclature (G and Q banding). Structural abnormalities (Duplication, Insertion, Deletion, Translocation-Reciprocal and Non-Reciprocal) and associated syndromes. Numerical abnormalities (Aneuploidy and Euploidy) and associated syndromes. Spontaneous and induced mutations. Types of mutations: Point (Non-sense, miss-sense, silent, frameshift, insertion, deletion). Effects on the Gene products- loss of function and gain of function.	
<b>Unit VI: Introduction to Mechanisms of Sex Determination</b>	<b>05 Hours</b>
Chromosomal theory of sex determination, mechanisms of sex determination, environmental factors and sex determination in human and <i>Drosophila</i> . Barr bodies and dosage compensation.	

### **PRACTICAL – 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. Observation of wild type and mutant phenotypes in *Drosophila*.
2. Preparation of culture media for *Drosophila* and study different stages of the life cycle of *Drosophila*.
3. Verification of Mendelian laws through *Drosophila* seeds – dominant, recessive and sex-linked
4. Study of Barr bodies.
5. Karyotyping with the help of photographs (normal and abnormal karyotypes).
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of diploidy in onion root tip.
8. Study of polyploidy in onion root tip by colchicine treatment.
9. Study of polytene chromosomes.

### **SUGGESTED READINGS:**

- Klug, W. S., Cummings, M., Spencer, C. A., Palladino, M. A., Darrell K. (2019). 12<sup>th</sup> Edition. *Concepts of genetics*. San Francisco, NY:Pearson ISBN-13: 9780134604718.
- Snustad, D.P. and Simmons, M.J. (2019). 7<sup>th</sup> Asia Edition. *Principles of genetics*. New York, USA: John Wiley and Sons. ISBN-13: 9781119657552.
- Gardner E. J., Simmons M. J. and Snustad D. P. (2006). 8th edition *Principles of genetics*. USA. Wiley. ISBN-13: 978-8126510436.

### **BOOK FOR BASIC CONCEPTUAL READING**

- Cooper, G. M. and Hausman, R. E. (2019). 8<sup>th</sup> Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13: 978-1605358635.
- Hardin, J., Bertoni, G. P., Becker, W.M. (2017). 9<sup>th</sup> Edition. *Becker's world of the cell*. NY:Pearso. ISBN-13: 978-0805393934.
- Karp, G., Iwasa, J., Marshall W. (2018). 8<sup>th</sup> Edition. *Karp's Cell Biology*. New Jersey, USA: Wiley. ISBN-13: 978-1119456292.
- Kornberg, A. (2005). 2<sup>nd</sup> Edition. *DNA replication*. California, USA: University Science Books. ISBN-13: 978-1891389443.
- Griffith A. J. F., Wessler S. R., Carroll S. B. and Doebley J. (2011). 9th edition. *Introduction to Genetic Analysis*. W H Freeman & Co. ISBN-13 : 978-0716768876.
- Elrod, S and Stansfield, W. (2010). 5th edition. *Schaum's Outline of Genetics*. McGraw Hill. ISBN-13: 978-0071625036

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

## DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Human Physiology and Anatomy II

### 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		
<b>Human Physiology and Anatomy II</b>	<b>04</b>	<b>03</b>	<b>0</b>	<b>01</b>	<b>Class XII pass</b>	<b>NIL</b>

#### LEARNING OBJECTIVES:

- 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.

#### COURSE OUTCOMES:

Having successfully completed this course, students shall be able to learn and appreciate:

- The students will learn appreciate the structure and functioning of heart, pattern and significance of blood flow in the blood vessels, heart sounds, ECG and purpose of lymph and lymphatic circulation.
- The students would correlate how structure and function of lungs are so intricately designed and how they function with its blood flow and help giving vital oxygen to body. They would develop understanding for neural control and other regulators of respiration and understand daily phenomenon like coughing, sneezing, yawning etc.
- Kidneys are vital organs and students would learn the functional anatomy of a nephron and how it contributes in removing the toxic waste from our body in form of urine. The curriculum would outline the process of micturition and abnormalities associated with it. It would also highlight the role of kidney in controlling pH of the body and preventing acidosis/alkalosis
- The students would have insight into the anatomy of the female and male reproductive systems, including their accessory structures. The student would understand the role of hypothalamic and pituitary hormones in reproductive system. Trace the route of a sperm mother cell from its production till it can fertilize an oocyte. Explain the events in the ovary prior to ovulation, development and maturation of the sex organs and the emergence of

secondary sex characteristics during puberty.

- The students would be able to integrate the role of the endocrine system to maintain homeostasis in human body. Understand the chemical composition mechanisms of hormone action, their site of production, regulation, and effects of hormones of the pituitary, thyroid, parathyroid and adrenal, glands. Hormonal regulation of the reproductive system. The role of the pancreatic endocrine cells in the regulation of blood glucose In addition the contributions of hormones released by the heart, kidneys, and other organs with secondary endocrine functions. The student would be aware of several common diseases associated with endocrine system dysfunction.
- Students would be able to understand the organs of the alimentary canal from proximal to distal, and understand their function. Identify the accessory digestive organs and their functions. Describe the histology that is four fundamental tissue layers of the digestive tract. Contrast the contributions of the enteric and autonomic nervous systems to alimentary tract functioning. Gain awareness about common dysfunctions of digestive system like constipation, gastritis, ulcers, diarrhea etc.

#### **COURSE CONTENT:**

<b>Unit-I: Cardiovascular System</b>	<b>09 Hours</b>
Functional Anatomy of heart, The Cardiac Cycle, Electrocardiogram. Circulatory system: Bloodvessels, hemodynamics and regulatory mechanisms, Lymphatic circulation - hemodynamics and regulation, micro-circulation	
<b>Unit-II: Respiratory system</b>	<b>09 Hours</b>
Functional Anatomy of the respiratory system. Mechanisms of pulmonary ventilation, alveolarventilation, gaseous exchange, transport of gases, respiratory and nervous control and regulation of respiration	
<b>Unit-III: Renal Physiology</b>	<b>06 Hours</b>
Body fluid and electrolytes: their balances and imbalances. Functional Anatomy of kidney,Histology of nephron and its physiology, Urine formation, renal regulation of urine volume and osmolarity, acid-base balance. Urinary bladder: structure, micturition and its regulation	
<b>Unit-IV: Reproductive System</b>	<b>06 Hours</b>
Structure and function of male and female reproductive organ. Function and regulation of testicularand ovarian hormones. Gametogenesis (oogenesis and spermatogenesis), fertilization, implantation, parturition and lactation, menopause and basic concepts of infertility.	
<b>Unit-V: Endocrine System</b>	<b>09 Hours</b>

General mechanism of hormone action, Structure, function and regulation of the following glands and their secretions: Pituitary, Hypothalamus, Thyroid, Parathyroid, Adrenal, and Pancreas. Basic concepts about hypo and hyper secretion of hormones.	
<b>Unit-VI: Gastrointestinal system</b>	<b>06 Hours</b>
Anatomy and histology of digestive tract, gastrointestinal physiology: General principles of gut motility secretion, digestion, absorption and assimilation. Gastrointestinal hormones: their formation and action. Physiological anatomy and functions of liver and pancreas.	

**PRACTICAL – 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. Physiological data acquisition based experiments (ECG).
2. Physiological data acquisition-based experiments (EMG).
3. Physiological data acquisition-based experiments (PFT).
4. Blood Pressure recordings in humans.
5. Determination of specific gravity of blood.
6. Determination of osmotic fragility of RBC.
7. To study various types of contraceptives (condoms, IUD's, oral and injectable contraceptives)
8. To study different human organs and their sections through permanent slides. T. S. of thyroid, liver, thymus, spleen, ovary, artery, vein, capillaries, testis, pancreas, esophagus, adrenal, kidney (cortex and medulla), urinary bladder, urethra, fallopian tubes, epididymis, prostate glands, lungs, trachea, bronchioles, pituitary, heart. (Minimum 8 slides covering the systems mentioned in theory.)

**SUGGESTED READINGS:**

- Guyton and Hall Textbook of Medical Physiology, 14th edition (2020), J. E. Hall; W B Saunders and Company, ebook ISBN: 978-0-3236-4003-9; Hardcover ISBN: 978-0-3235-9712-8
- Human Physiology, 16th edition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN10: 1260720462; ISBN13: 978-1-26-072046-4.
- 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).

- Textbook of Practical Physiology, 9th edition (2019), CL Ghai; Jaypee Publication, ISBN-9789352705320.

**BOOK FOR BASIC CONCEPTUAL READING**

- Ganong's Review of Medical physiology, 26th edition (2019), K. E. Barrett, S. M. Barman, S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-26-012240-4 (for ebook)  
ISBN:978-1-26-012241-1 (for print Book)

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

**Category-IV**  
**Common Pool of Generic Electives offered by Department of**  
**Biomedical Sciences**

**Generic Elective -2 (GE-2): Landmark Discoveries in 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		
Landmark Discoveries in Science	04	03	0	01	Class XII pass	NIL

**LEARNING OBJECTIVES:**

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.

**COURSE OUTCOMES**

- 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 DNA 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.

**COURSE CONTENT:**

<b>Unit I: View of the invisible Biology</b>	<b>04 Hours</b>
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	
<b>Unit-II: Origin of Life – A question</b>	<b>03 Hours</b>
Spontaneous generation versus biogenesis; Problem of spores; Microbiology and Medicine - Germ theory of Disease; Recognition of agents of infection – Koch’s Postulates.	
<b>Unit-III: Understanding Biology by observations</b>	<b>04 Hours</b>

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 JohannMendel, his work on pea plants, theory of Mendelian inheritance (C) Study of compositionof 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 tetranucleotidehypothesis.	
<b>Unit-IV: DNA as the hereditary material – An experimental view</b>	<b>06 Hours</b>
Transformation: Classic work of Frederick Griffith; DNA as the Pneumococcal Transforming Factor; <i>In vitro</i> Transformation system; Announcement that the transformingPrinciple 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	
<b>Unit-V: Solving the puzzle of DNA structure</b>	<b>07 Hours</b>
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.	
<b>Unit-VI: Technical advancements in biology</b>	<b>07 Hours</b>
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	
<b>Unit-VII: Research as a backbone of modern medicine</b>	<b>07 Hours</b>

(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.	
<b>Unit VIII: Project Work [On any one topic]</b>	<b>07 Hours</b>
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 – 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.

### **SUGGESTED 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). 6<sup>th</sup> Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Karp, G. (2013). 7<sup>th</sup> 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). 1<sup>st</sup> 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). 7<sup>th</sup> Edition. *Molecular Biology of the Gene*. New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

### **BOOK FOR BASIC CONCEPTUAL READING**

- 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). 4<sup>th</sup> Edition. *Molecular Cloning: A Laboratory Manual*, New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13:978-1936113422.
- Kornberg, A. (2005). 2<sup>nd</sup> Edition. *DNA Replication*. California, United States: University ScienceBooks, ISBN-13: 978-1891389443.

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

**Note: *The Generic Electives courses offered in Semester-I are also open for Semester-II***

# DEPARTMENT OF GEOLOGY

## Category-I BSc (Hons.) Geology

### DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4) – : Structural Geology

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		
Structural Geology (DSC-4)	4	3	0	1	12 <sup>th</sup> Pass	---

#### Learning Objectives

Structural geology essentially deals with the geometry, kinematics and dynamics of deformation of rocks. In response to the instability of the lithosphere produced by complex plate tectonic movements, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales and at different depths, which manifests in a variety of complex structures in these rocks.

#### Learning outcomes

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

- Identify the different geometric features of deformation, different types of deformation-induced structures,
- Understand basic techniques of measurement of different parameters in deformed rocks, and
- Understand a glimpse of the underlying deformation processes and mechanisms.

#### SYLLABUS OF DSC-4

##### UNIT – I (09 Hours)

Introduction to Structure and Topography: Understanding a topographic map; Effects of topography on structural features: Rule of V; Planar and linear structures; Concept of dip and strike, trend and plunge.

##### UNIT – II (09 Hours)

Stress and strain in rocks: Concept of rock deformation: Definition of Stress and Strain, Strain ellipses of different types and their geological significance. Mohr circle for stress and its application.

##### UNIT – III (08 Hours)

Folds: Fold morphology; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding.

##### UNIT – IV (08 Hours)

Foliation and lineation: Description and origin of foliations: axial plane cleavage and its tectonic significance; different types of foliations: crenulation cleavage, disjunctive cleavage,

salty cleavage, schistosity, gneissosity etc. Description and origin of lineation and relationship with major structures; stretching lineation and its relationship with strain.

**UNIT – V (08 Hours)**

Fractures and faults: Geometric and genetic classification of fractures and faults; Effects of faulting on the outcrops; Geologic/geomorphic criteria for recognition of faults and Mechanism of faulting: Anderson theory of faulting. Joints – different types of joints and their geological significance – columnar joint, pinnate joint, plumose structure.

**UNIT – VI (03 Hours)**

Shear Zones: Introduction, Geometry, strain profile, shear zones rocks and shear sense indicators.

**Practical component - 30 Hours**

Basic idea of topographic contours, Topographic sheets of various scales.

Structural contouring and 3-point problems of dip and strike

Introduction to Geological maps: Drawing profile sections and interpretation of geological maps of different complexities.

Exercises of stereographic projections

**Essential/recommended readings**

Fossen, H. (2010) Structural Geology. Cambridge University Press

Park, R. G. (2004) Foundations of Structural Geology. Chapman & Hall.

**Suggestive readings**

Fossen, H. (2010) Structural Geology. Cambridge University Press.

Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley

Billings, M. P. (1987). Structural Geology, 4th edition, Prentice-Hall.

Park, R. G. (2004) Foundations of Structural Geology. Chapman & Hall.

Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press.

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

## DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): Igneous Petrology

### 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		
Igneous Petrology (DSC-5)	4	3	0	1	12 <sup>th</sup> Pass	----

#### Learning Objectives

To develop an understanding of the types of magma as well as types of igneous rocks. Magma generation in relation to different geodynamic settings and its relation with the petrological and geochemical features of the igneous rocks.

#### Learning outcomes

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

- a) Identify the igneous rocks using petrographical, mineralogical and geochemical indices
- b) Determine the evolution of igneous rocks in relation to different geodynamic settings

### SYLLABUS OF DSC- 5

#### UNIT – I (09 Hours)

Introduction to Igneous Petrology: Scope of Igneous petrology, classification of Igneous rocks, igneous textures, igneous structures.

#### UNIT – II (09 Hours)

Introduction to silicate melts and magmas: Physical properties of magma, the ascent of magmas, magmatic differentiation.

#### UNIT – III (09 Hours)

Introduction to Igneous Phase diagrams. The phase rule, the lever rule, Two Component systems involving melt: Binary system with a Eutectic, Binary system with a peritectic, Binary system thermal barrier, Binary system with solid solution.

#### UNIT – IV (09 Hours)

The chemistry of igneous rocks. Modal mineralogy, normative mineralogy, variation diagrams based on major elements, trace elements and their significance, application of radioactive isotopes in igneous petrology.

#### UNIT – V (09 Hours)

Introduction to igneous environments: Basalts and mantle structure, Magma generation and igneous rocks associated with various plate tectonic settings.

**Practical component : 30 Hours**

Study of important igneous rocks in hand specimens and thin sections- granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite.

Classification of Igneous Rocks.

Plotting and interpretation of variation diagrams.

Igneous rock occurrences in Indian context.

**Essential/recommended readings**

Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.

Wilson, M. (1989) Igneous Petrogenesis, Springer-Verlag Berlin Heidelberg.

Frost, B. R. and Frost, C. D., (2013) Essentials of Igneous and Metamorphic Petrology Cambridge University Press.

**Suggestive readings (if any)**

Frost, B. R. and Frost, C. D., (2013) Essentials of Igneous and Metamorphic Petrology Cambridge University Press.

Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.

Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.

Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation. Routledge.

Sen, G. (2014) Petrology Principles and Practice, Springer-Verlag Berlin Heidelberg

Bose M.K. (1997). Igneous Petrology.

Wilson, M. (1989) Igneous Petrogenesis, Springer-Verlag Berlin Heidelberg.

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



## DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Elements of Geochemistry

### 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		
Elements of Geochemistry DSC-6	4	3	0	1	12 <sup>th</sup> Pass	---

#### Learning Objectives

The Learning Objectives of this course are as follows:

- To develop an understanding of the chemical nature of the earth and other planetary material and relate mineralogy, geochemistry and bulk chemistry.

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will be able to appreciate the field of geochemistry and understand the properties of the elements - Nucleosynthesis; Cosmochemistry; Principles of isotope geochemistry; Solid earth geochemistry: Core, Mantle, Crust. Near-surface geochemical environment, Chemical weathering of minerals and rocks. Examples of instrumentation, data collection and analyses

### SYLLABUS OF DSC-6

#### UNIT – I (09 Hours)

The abundance of elements in the cosmos, solar system and earth. Meteorites, distribution of elements in core, mantle, crust.

#### UNIT – II (12 Hours)

Introduction to properties of elements: periodic table, chemical bonding, states of matter and atomic environment of elements, geochemical classification of elements, the concept of elemental fractionation.

#### UNIT – III (12 Hours)

Geochemistry of igneous rocks: geochemical variability of magma and its products. Near-surface geochemical environment: Chemical weathering of minerals and rocks.

#### UNIT – IV (12 Hours)

Introduction to isotope geology: use of stable and radiogenic isotopes in earth science.

**Practical component: - 30 Hours**

- Geochemical analysis of geological materials (analytical methods, concept of normalization)
- Geochemical variation diagrams, common geochemical plots, and their interpretations.
- Basic idea about handling and interpretation of isotope data.

**Essential/recommended readings**

Mason, B (1986). Principles of Geochemistry. 3<sup>rd</sup> Edition, Wiley New York.

Faure, G., 1986. Principle of Isotope Geology, J. Wiley & Sons.

**Suggestive readings**

Mason, B (1986). Principles of Geochemistry. 3<sup>rd</sup> Edition, Wiley New York.

Rollinson H. (2007). Using geochemical data evaluation. Presentation and interpretation. 2<sup>nd</sup> Edition. Publisher Longman Scientific & Technical.

Walther John, V., 2009 Essentials of geochemistry, student edition. Jones and Bartlett Publishers

Albarede, F, 2003. An introduction to geochemistry. Cambridge University Press.

Faure, G., 1986. Principle of Isotope Geology, J. Wiley & Sons.

Geochemistry by William M White, Wiley-Blackwell (2013).

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

## CATEGORY-IV

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY DEPARTMENT OF GEOLOGY

#### GENERIC ELECTIVES (GE-2): Physics & Chemistry of Earth

#### 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		
Physics & Chemistry of Earth (GE-2)	4	3	1	0	Class-XII	---

#### Learning Objectives

To develop an understanding of the surface and internal structure of the Earth and its mineralogy and chemistry; To equip the students about the present and past processes operative in shaping the physical and chemical make-up of the planet Earth

#### Learning outcomes

After completion of this course students will learn about:

- Physical, mineralogical and chemical structure of the earth
- Major surface features and their evolution through time
- Concept of geological time and its determination
- Earth's magnetic field, its short term and long term variation and its application
- Physical and chemical evolution of earth through time

#### SYLLABUS OF GE-2 – (Lecture- 45 Hours )

##### UNIT – I

Earth: surface features: Continents, continental margins, oceans

Earth's materials: Rocks and Minerals

##### UNIT – II

Earth's interior - variation of physical parameters and seismic wave velocity inside the earth, major sub divisions and discontinuities. Depth-wise mineralogical variation in the Earth. Concepts of Isostasy; Airy and Pratt Model. Core and Mantle: Seismological and other geophysical constraints. The geodynamo - Convection in the mantle. Plate Tectonics. Types of plate margins and their Dynamics.

##### UNIT – III

Elements of Earth's magnetism: Secular variation and westward drift. Solar activity and magnetic disturbance. Paleomagnetism

#### **UNIT – IV**

Elements: Origin of elements/nucleosynthesis. Abundance of the elements in the solar system/planet Earth. Geochemical classification of elements. Earth accretion and early differentiation. Isotopes and their applications in understanding Earth processes.

#### **UNIT – V**

Isotopes: Radiogenic and Stable. Radiogenic isotopes and their applications  
Stable isotope fractionation. Oxygen isotopes. Sublithospheric Mantle (Mineralogy/phase transitions) Concept of mantle heterogeneity

#### **UNIT – VI**

Low-temperature geochemistry; surface and near-surface processes

#### **Essential/recommended readings**

- Holmes, A. (1992). Principles of Physical Geology, 1992, Chapman and Hall.
- Anderson, G. M. (1996). Thermodynamics of natural systems. John Wiley & Sons Inc.
- Condie, K.C. (2016) Earth as an evolving planetary system (3rd Edn.) Elsevier

#### **Suggestive readings**

- Holmes, A., Principles of Physical Geology, 1992, Chapman and Hall
- Condie, K.C. Plate Tectonics and Crustal Evolution, Pargamon Press, 1989.
- Krauskopf, K. B., & Dennis, K. Bird, 1995, Introduction to Geochemistry. McGraw-Hill
- Faure, G. Principles and Applications of Geochemistry, 2/e (1998), Prentice Hall, 600 pp.
- Anderson, G. M. (1996). Thermodynamics of natural systems. John Wiley & Sons Inc.
- Steiner, E. (2008). The chemistry maths book. Oxford University Press.
- Yates, P. (2007) Chemical calculations. 2nd Ed. CRC Press.
- Condie, K.C. (2016) Earth as an evolving planetary system (3rd Edn.) Elsevier

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

**DEPARTMENT OF PHYSICS & ASTROPHYSICS**

**Category-I  
BSc. (H) Physics**

**DISCIPLINE SPECIFIC CORE COURSE – 4:  
MATHEMATICAL PHYSICS II**

Course title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Mathematical Physics II  DSC – 4	4	2	0	2	Class XII Pass	-----

**LEARNING OBJECTIVES**

The emphasis of course is on applications in solving problems of interest to physicists. The course will also expose 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,

- Use curvilinear coordinates to solve problems with spherical and cylindrical symmetries
- Represent a periodic function by a sum of harmonics using Fourier series
- Obtain power series solution of differential equation of second order with variable coefficient using Frobenius method
- Understand the properties and applications of Legendre polynomials
- Learn about gamma and beta functions and their applications
- In the laboratory course, the students will learn to
  - Apply appropriate numerical method to solve selected physics problems both using user defined and in-built functions from Scilab/ Python
  - Solve non-linear equations
  - Perform least square fitting of the data taken in physics lab by user defined functions.
  - Interpolate a data by polynomial approximations
  - Generate and plot a function by its series representation
  - Generate and plot Legendre polynomials and verify their properties.
  - Numerically integrate a function and solve first order initial value problems numerically.

## **SYLLABUS OF DSC – 4**

### **UNIT – I**

**(13 Hours)**

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Scale factors, element of area and volume in spherical and cylindrical coordinate Systems. Derivation of Gradient, Divergence, Curl and Laplacian in Spherical and Cylindrical Coordinate Systems  
Fourier Series: 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), Parseval's Identity.

### **UNIT – II**

**(17 Hours)**

Frobenius Method and series solution of Differential Equations: Singular Points of Second Order Linear Differential Equations and their importance, Frobenius method for finding series solution and its applications, Legendre Differential Equations and its solution. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality of Legendre Polynomials, Simple recurrence relations, Expansion of function in a series of Legendre Polynomials.

Some Special Integrals: Beta and Gamma Functions and relation between them, Expression of Integrals in terms of Gamma and Beta Functions.

### **References:**

#### **Essential Readings:**

- 1) Mathematical Methods for Scientists and Engineers, D. A. McQuarrie, 2003, Viva Book.
- 2) Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- 3) Essential Mathematical Methods, K. F. Riley and M. P. Hobson, 2011, Cambridge Univ. Press.
- 4) Vector Analysis and Cartesian Tensors, D. E. Bourne and P. C. Kendall, 3 Ed., 2017, CRC Press.
- 5) Vector Analysis, Murray Spiegel, 2nd Ed., 2017, Schaum's Outlines Series.
- 6) Fourier analysis: With Applications to Boundary Value Problems, Murray Spiegel, 2017, McGraw Hill Education.
- 7) Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- 8) Mathematical Methods for Physicists, G. B. Arfken, H. J. Weber, F. E. Harris, 7 Ed., 2013, Elsevier.

#### **Additional Readings:**

- 1) Introduction to Electrodynamics, Chapter 1, David J. Griffiths, 4 Ed., 2017, Cambridge University Press.
- 2) The Feynman Lectures on Physics, Volume II, Feynman, Leighton and Sands, 2008, Narosa Publishing House.
- 3) Advanced Engineering Mathematics, D. G. Zill and W. S. Wright, 5 Ed., 2012, Jones and

Bartlett Learning.

- 4) Introduction to Vector Analysis, Davis and Snider, 6 Ed., 1990, McGraw Hill.
- 5) Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- 6) Mathematical Physics, A. K. Ghatak, I. C. Goyal and S. J. Chua, 2017, Laxmi Publications Private Limited.

## **PRACTICAL COMPONENT –**

**60 Hours**

The aim of this laboratory 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 12 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 formulate a physics problem as mathematical one and solve by computational methods.
- The implementation can be either in Python/ C++/ Scilab.

**Unit 1: Root Finding:** Bisection, Newton Raphson and secant methods for solving roots of equations, Convergence analysis.

Recommended List of Programs (At least two):

- (a) Determine the depth up to which a spherical homogeneous object of given radius and density will sink into a fluid of given density.
- (b) Solve transcendental equations like  $\alpha = \tan(\alpha)$ .
- (c) To approximate nth root of a number up to a given number of significant digits.

**Unit 2: Least Square fitting (At least one):** Algorithm for least square fitting and its relation to maximum likelihood for normally distributed data.

- a) Make a function for least square fitting, use it for fitting given data  $(x, y)$  and estimate the parameters  $a, b$  as well as uncertainties in the parameters for the following cases.
  - i. Linear ( $y = ax + b$ )
  - ii. Power law ( $y = ax^b$ )
  - iii. Exponential ( $y = ae^{bx}$ )
- b) Weighted least square fitting of given data  $(x, y)$  with known error/uncertainty-values using user defined function.

**Unit 3: Generating and plotting of a function using series representation (At least one):**

- a) To approximate the elementary functions (e.g.  $\exp(x)$ ,  $\sin(x)$ ,  $\cos(x)$ ,  $\ln(1+x)$ , etc.) by a finite number of terms of Taylor's series and discuss the truncation error. To plot the function as well the nth partial sum of its series for various values of  $n$  on the same graph and visualise the convergence of series.
- b) Generating and plotting Legendre Polynomials using series expansion and verifying recurrence relation

**Unit 4: Interpolation:** Concept of Interpolation, Lagrange form of interpolating polynomial,

Error estimation, optimal points for interpolation.

Recommended List of Programs (At least one)

- (a) Write program to determine the unique polynomial of a degree  $n$  that agrees with a given set of  $(n+1)$  data points  $(x_i, y_i)$  and use this polynomial to find the value of  $y$  at a value of  $x$  not included in the data.
- (b) Generate a tabulated data containing a given number of values  $(x_i, f(x_i))$  of a function  $f(x)$  and use it to interpolate at a value of  $x$  not used in table.

**Unit 5: Numerical Integration:** Newton Cotes Integration methods (Trapezoidal and Simpson rules) for definite integrals, derivation of composite formulae for these methods and discussion of error estimation.

Recommended List of Programs (At least three)

- (a) Given acceleration at equidistant time values, calculate position and velocity and plot them.
- (b) Use integral definition of  $\ln(x)$  to compute and plot  $\ln(x)$  in a given range. Use trapezoidal, Simpson and Gauss quadrature methods and compare the results.
- (c) Verify the rate of convergence of the composite Trapezoidal and Simpson methods by approximating the value of a given definite integral.
- (d) Verify the Orthogonality of Legendre Polynomials.
- (e) To evaluate the Fourier coefficients of a given periodic function (e.g. square wave, triangle wave, half wave and full wave rectifier etc.). To plot the function as well the  $n$ th partial sum of its series for various values of  $n$  on the same graph and visualise the convergence of series. Study of Gibbs phenomenon.
- (f) Verify the properties of Dirac Delta function using its representation as a sequence of functions.

**Unit 6: Numerical Solutions of Ordinary Differential Equations:** Euler, modified Euler, and Runge-Kutta (RK) second and fourth order methods for solving first order initial value problems (IVP) and system of first order differential equations,

Recommended List of Programs (At least two)

- (a) Solve given first order differential equation (Initial value problems) numerically using Euler RK2 and RK4 methods and apply to the following physics problems:
  - i. Radioactive decay
  - ii. Current in RC and LR circuits with DC source
  - iii. Newton's law of cooling
- (b) Write a code to compare the errors in various numerical methods learnt by solving a first order IVP with known solution.
- (c) Solve a system of first order IVP numerically using Euler and Runge-Kutta methods. Application to physical problems.



**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) Computational Physics, Darren Walker, 1st Edn., Scientific International Pvt. Ltd (2015).
- 4) Elementary Numerical Analysis, K. E. Atkinson, 3rd Edn., 2007, Wiley India Edition.
- 5) An Introduction to Computational Physics, T. Pang, Cambridge University Press (2010).
- 6) Introduction to Numerical Analysis, S. S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- 7) Applied numerical analysis, Cutis F. Gerald and P. O. Wheatley, Pearson Education, India (2007).
- 8) Numerical Recipes: The art of scientific computing, William H. Press, Saul A. Teukolsky and William Vetterling, Cambridge University Press; 3rd edition (2007)
- 9) Computational Problems for Physics, R. H. Landau and M. J. Páez, 2018, CRC Press.

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

## DISCIPLINE SPECIFIC CORE COURSE – 5: ELECTRICITY AND MAGNETISM

Course title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electricity and Magnetism  DSC – 5	4	3	0	1	Class XII Pass	----

### LEARNING OBJECTIVES

This course reviews the concepts of electromagnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields due to continuous charge and current distributions respectively.

### LEARNING OUTCOMES

After completing this course, student will be able to,

- Apply Coulomb's law to line, surface, and volume distribution of charges.
- Apply Gauss's law of electrostatics to distribution of charges
- Solve boundary value problems using method of images
- Understand the concept of electric polarization and bound charges in dielectric materials
- Understand and calculate the vector potential and magnetic field of arbitrary current distribution
- Understand the concept of bound currents and magnetic susceptibility in magnetic materials
- Understand the impact of time-varying magnetic and electric fields in order to comprehend the formulation of Maxwell's equations.

### SYLLABUS OF DSC – 5

#### UNIT – I

**(15 Hours)**

Electric Field and Electric Potential for continuous charge distributions: Electric field due to a line charge, surface charge and volume charge, Divergence of electric field using the Dirac Delta function, Curl of electric field, Electric field vector as negative gradient of scalar potential, Ambiguities of electric potential, Differential and integral forms of Gauss's Law, Application of Gauss's law to various charge distributions having spherical, cylindrical and planar symmetries.

Boundary Value Problems in Electrostatics: Formulation of Laplace's and Poisson equations, First and second uniqueness theorems, Solutions of Laplace and Poisson equations in one

dimension using spherical and cylindrical coordinate systems and solutions in three-dimensional using Cartesian coordinates applying separable variable technique, Electrostatic boundary conditions for conductors and capacitors.

## **UNIT – II**

**(11 Hours)**

Special techniques for the calculation of Potential and Field: The Method of Images is applied to a system of a point charge and finite continuous charge distribution (line charge and surface charge) in the presence of (i) a plane infinite sheet maintained at constant potential, and (ii) a sphere maintained at constant potential.

Electric Field in Matter: Polarization in matter, Bound charges and their physical interpretation, Field inside a dielectric, Displacement vector  $\mathbf{D}$ , Gauss' law in the presence of dielectrics, Boundary conditions for  $\mathbf{D}$ , Linear dielectrics, electric susceptibility and dielectric constant, Idea of complex dielectric constant due to varying electric field, Boundary value problems with linear dielectrics

## **UNIT – III**

**(19 Hours)**

Magnetic Field: Divergence and curl of magnetic field  $\mathbf{B}$ , Magnetic field due to arbitrary current distribution using Biot-Savart law, Integral and differential forms of Ampere's law, Vector potential and its ambiguities, Coulomb gauge and possibility of making vector potential divergence less, Vector potential due to line, surface and volume currents using Poisson equations for components of vector potential.

Magnetic Properties of Matter: Magnetization vector, Bound currents, Magnetic intensity, Differential and integral form of Ampere's Law in the presence of magnetised materials, Magnetic susceptibility and permeability of diamagnetic, paramagnetic and ferromagnetic materials.

Electrodynamics: Faraday's law, Lenz's law, Inductance and electromotive force, Ohm's law ( $\vec{J} = \sigma \vec{E}$ ), Energy stored in a magnetic field, Continuity equation, Displacement current and displacement current density, Basic introduction to Maxwell's equations in electromagnetism.

### **References:**

#### **Essential Readings:**

- 1) Introduction to Electrodynamics, D. J. Griffiths, 3<sup>rd</sup> Edn., 1998, Benjamin Cummings
- 2) Schaum's Outlines of Electromagnetics by J. A. Edminister and M. Nahvi
- 3) Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2<sup>nd</sup> Edn. 1981, McGraw-Hill.
- 4) Electromagnetic Fields and Waves, Paul Lorrain and Dale Corson, 1991, W. H. Freeman.
- 5) Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- 6) Electricity and Magnetism, Tom Weideman, University of California Davis. [url: [https://zhu.physics.ucdavis.edu/Physics9C-C\\_2021/Physics%209C\\_EM%20by%20Tom%20Weideman.pdf](https://zhu.physics.ucdavis.edu/Physics9C-C_2021/Physics%209C_EM%20by%20Tom%20Weideman.pdf)]

#### **Additional Readings:**

- 1) Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

- 2) Electricity, Magnetism and Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- 3) Electricity and Magnetism, J. H. Fewkes and J. Yarwood, Vol. I, 1991, Oxford Univ. Press.
- 4) Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan and Ravi Varshney.

## **PRACTICAL**

**– 30 Hours**

Every student must perform at least five experiments.

- 1) Magnetic field variation along the axis of a circular coil and in a Helmholtz coil (( $r > a$ ,  $r = a$  and  $r < a$ ). Here, 'a' is radius of coil and 'r' is distance between the coils).
- 2) **B-H** curves for soft and hard ferromagnetic materials and comparison of their coercivity, retentivity and saturation magnetization for same applied magnetic field.
- 3) Measurement of field strength **B** and its variation in a solenoid (determine  $d\mathbf{B}/dx$ )
- 4) Measurement of current and charge sensitivity of ballistic galvanometer
- 5) Measurement of critical damping resistance of ballistic galvanometer
- 6) Determination of a high resistance by leakage method using ballistic galvanometer
- 7) Measurement of self-inductance of a coil by Anderson's Bridge
- 8) Measurement of self-inductance of a coil by Owen's Bridge
- 9) To determine the mutual inductance of two coils by the Absolute method

### **References (for Laboratory Work):**

- 1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House
- 2) A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
- 3) Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
- 4) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning
- 5) Practical Physics, G. L. Squires, 2015, 4<sup>th</sup> Edition, Cambridge University Press

## DISCIPLINE SPECIFIC CORE COURSE – 6: ELECTRICAL CIRCUIT ANALYSIS

Course title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electrical Circuit Analysis DSC – 6	4	2	0	2	Class XII pass	----

### LEARNING OBJECTIVES

This course covers the basic circuit concepts in a systematic manner which is suitable for analysis and design. It aims at study and analysis of electric circuits using network theorems and two-port parameters.

### LEARNING OUTCOMES

At the end of the course the student will be able to,

- Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and their difference
- Solve complex electric circuits using network theorems.
- Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
- Evaluate the performance of two port networks.

### SYLLABUS OF DSC – 6

#### THEORY COMPONENT

##### **Unit 1: (8 Hours)**

Circuit Analysis: Ideal voltage source, real voltage source, current source, Kirchhoff's current law, Kirchhoff's voltage law, node analysis, mesh analysis, Star and Delta conversion  
DC Transient Analysis: Charging and discharging with initial charge in RC circuit, RL circuit with initial current, time constant, RL and RC Circuits with source

##### **Unit 2: (12 Hours)**

AC Circuit Analysis: Sinusoidal voltage and current, Definitions of instantaneous, peak to peak, root mean square and average values, form factor and peak factor (for half-rectified and full-rectified sinusoidal wave, rectangular wave and triangular wave), voltage-current relationship in resistor, inductor and capacitor, phasor, complex impedance, power in AC circuits, sinusoidal circuit analysis for RL, RC and RLC Circuits, resonance in series and

parallel RLC Circuits (Frequency Response, Bandwidth, Quality Factor), selectivity, application of resonant circuits

**Unit 3: (10 Hours)**

Network Theorems: Principal of duality, Superposition theorem, Thevenin theorem, Norton theorem, Their applications in DC and AC circuits with more than one source, Maximum Power Transfer theorem for AC circuits, Reciprocity Theorem, Millman's Theorem, Tellegen's theorem

Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission Parameters, Impedance matching

**References:**

**Essential Readings:**

- 1) Electric Circuits, S. A. Nasar, Schaum's Outline Series, Tata McGraw Hill (2004)
- 2) Essentials of Circuit Analysis, Robert L. Boylestad, Pearson Education (2004)
- 3) Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)
- 4) Fundamentals of Electric Circuits, C. Alexander and M. Sadiku, McGraw Hill (2008)
- 5) Principles of Electric Circuits, Thomas L. Floyd, 9/e (2016)

**Additional Readings:**

- 1) Network analysis, M. E. Van Valkenburg, Third edition, Prentice Hall
- 2) Network, Lines and Fields, John D. Ryder, Pearson Ed. II, 2015.
- 3) Electrical Circuits, K. A. Smith and R. E. Alley, 2014, Cambridge University Press

**PRACTICAL COMPONENT – 60 Hours**

Every student must perform at least seven experiments from the following list of experiments

- 1) Verification of Kirchoff's Law.
- 2) Verification of Superposition Theorem by using d.c. and a.c. voltage source
- 3) Verification of Norton's theorem.
- 4) Verification of Thevenin's Theorem and Maximum Power Transfer Theorem by using d.c. and a.c. voltage source
- 5) Determination of unknown capacitance using de Sauty's Bridge
- 6) Determination of time constant of RC and RL circuit
- 7) Study of frequency response of RC circuit
- 8) Study of frequency response of a parallel LCR Circuit and determination of its resonant frequency, impedance at resonance, quality factor and bandwidth.
- 9) Explore electrical properties of matter using Arduino:
  - a. To study the characteristics of a series RC Circuit.
  - b. To study the response curve of a series LCR circuit and determine its resonant frequency, impedance at resonance, quality factor and bandwidth

**References (for Laboratory Work):**

- 1) A Textbook of Electrical Technology, B. L. Thareja, A. K. Thareja, Volume II, S. Chand
- 2) Fundamentals of Electric Circuits, C. Alexander and M. Sadiku, McGraw Hill (2008)
- 3) Electric Circuits, S. A. Nasar, Schaum's Outline series, Tata McGraw Hill (2004)
- 4) Electrical Circuits, K. A. Smith and R.E. Alley, 2014, Cambridge University Press
- 5) Electrical Circuit Analysis, K. Mahadevan and C. Chitran, 2<sup>nd</sup> Edition, 2018, PHI Learning Pvt. Ltd.

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

## Category II

### B. Sc. Physical Science with Physics as one of the Core Discipline

#### DISCIPLINE SPECIFIC CORE COURSE (PHYSICS DSC - 2): ELECTRICITY AND MAGNETISM

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electricity and Magnetism Physics DSC 2	4	2	0	2	Class XII pass	----

#### LEARNING OBJECTIVES

This course reviews the concepts of electricity and magnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real world problems.

#### LEARNING OUTCOMES

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

- Understand Gauss' law, Coulomb's law for the electric field, and apply them to systems of point charges as well as line, surface, and volume distributions of charges. Also to use the knowledge to solve some simple problems
- Express electric current and capacitance in terms of electric field and electric potential.
- Calculate the force experienced by a moving charge in a magnetic field
- Determine the magnetic force generated by a current carrying conductor
- Have brief idea of magnetic materials, understand the concept of electromagnetic induction, solve problems using Faraday's and Lenz's laws

In the laboratory course, students will be able to measure resistance (high and low), voltage, current, self and mutual inductance, capacitor, strength of magnetic field and its variation, study different electric circuits.



## SYLLABUS OF PHYSICS DSC – 2

### THEORY COMPONENT

#### **Unit 1: (10 Hours)**

Electrostatics: Electric field, electric flux, Gauss' theorem in electrostatics, applications of Gauss' theorem (linear, plane and spherical charge distribution), line integral of electric field, electric potential due to a point charge, electric potential and electric field of a dipole and charged disc, capacitance due to parallel plates and spherical condenser. Electrostatic energy of system of charge (charged sphere), dielectric medium, dielectric polarization, displacement vector, Gauss' theorem in dielectrics, parallel plate capacitor filled with dielectric.

#### **Unit 2: (8 Hours)**

Magnetostatics: Magnetic force between current elements and definition of magnetic field  $\mathbf{B}$ , Biot-Savart's law and its applications (current carrying straight conductor, current carrying circular coil, current carrying solenoid), divergence and curl of magnetic field, Ampere's circuital law, magnetic properties of materials (magnetic intensity, magnetic induction, permeability, magnetic susceptibility), brief introduction of dia-, para- and ferro magnetic materials

#### **Unit 3: (7 Hours)**

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self-inductance of single coil, mutual inductance of two coils, energy stored in magnetic field. Maxwell's equations and equation of continuity of current, displacement current

#### **Unit 4: (5 Hours)**

DC Circuits: Review of Kirchhoff's Voltage and Current Laws, Thevenin theorem, Norton theorem, Superposition theorem, Maximum Power Transfer theorem.

#### **References:**

##### **Essential Readings:**

- 1) Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn. 1981, McGraw-Hill.
- 2) Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I, 1991, Oxford Univ. Press
- 3) Electricity and Magnetism, D. C. Tayal, 1988, Himalaya Publishing House.
- 4) Fundamentals of Electromagnetics, M. A. W. Miah, 1982, Tata McGraw Hill
- 5) Introduction to Electrodynamics, D. J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

##### **Additional Readings:**

- 1) Electricity and Magnetism, Berkeley Physics Course, Edward M. Purcell, 1986, McGraw-Hill Education.
- 2) Problems and Solutions in Electromagnetics, Ajoy Ghatak, K Thyagarajan and Ravi Varshney.
- 3) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

- 4) Schaum's Outline of Electric Circuits, J. Edminister and M. Nahvi, 3rd Edn., 1995, McGraw Hill.

### **PRACTICAL COMPONENT – 60 Hours**

The teacher is expected to give basic idea and working of various instruments and circuits 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 of experiments.

- 1) To use a multimeter for measuring resistances, a.c and d.c voltages, d.c. current, capacitance and for checking electrical fuses.
- 2) Ballistic Galvanometer:
  - a) Measurement of charge and current sensitivity
  - b) Measurement of critical damping resistance
  - c) Determine a high resistance by leakage method
  - d) Determine self-inductance of a coil by Rayleigh's Method.
- 3) To compare capacitances using de Sauty's bridge.
- 4) Measurement of field strength B and its variation in a Solenoid
- 5) To study the Characteristics of a Series RC Circuit.
- 6) To study a series LCR circuit and determine its resonant frequency and quality factor.
- 7) To study a parallel LCR circuit and determine its anti-resonant frequency and quality factor
- 8) To determine a low resistance by Carey Foster bridge.
- 9) To verify the Thevenin, superposition and maximum power transfer theorems
- 10) To verify Norton theorem

### **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) A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- 4) Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press
- 5) Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

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

## Category II

(Physical Science Courses (with Electronics) for Undergraduate Programme of study with Physics and Electronics discipline as Core Disciplines)

### DISCIPLINE SPECIFIC CORE COURSE (PHYSICS DSC - 3): ELECTRICITY AND MAGNETISM

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electricity and Magnetism Physics DSC 3	4	2	0	2	Class XII pass	----

#### LEARNING OBJECTIVES

This course reviews the concepts of electricity and magnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real world problems.

#### LEARNING OUTCOMES

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

- Understand Gauss' law, Coulomb's law for the electric field, and apply them to systems of point charges as well as line, surface, and volume distributions of charges. Also to use the knowledge to solve some simple problems
- Express electric current and capacitance in terms of electric field and electric potential.
- Calculate the force experienced by a moving charge in a magnetic field
- Determine the magnetic force generated by a current carrying conductor
- Have brief idea of magnetic materials, understand the concept of electromagnetic induction, solve problems using Faraday's and Lenz's laws

In the laboratory course, students will be able to measure resistance (high and low), voltage, current, self and mutual inductance, capacitor, strength of magnetic field and its variation, study different electric circuits.

## SYLLABUS OF PHYSICS DSC – 3

### THEORY COMPONENT

#### **Unit 1: (10 Hours)**

Electrostatics: Electric field, electric flux, Gauss' theorem in electrostatics, applications of Gauss' theorem (linear, plane and spherical charge distribution), line integral of electric field, electric potential due to a point charge, electric potential and electric field of a dipole and charged disc, capacitance due to parallel plates and spherical condenser. Electrostatic energy of system of charge (charged sphere), dielectric medium, dielectric polarization, displacement vector, Gauss' theorem in dielectrics, parallel plate capacitor filled with dielectric.

#### **Unit 2: (8 Hours)**

Magnetostatics: Magnetic force between current elements and definition of magnetic field  $\mathbf{B}$ , Biot-Savart's law and its applications (current carrying straight conductor, current carrying circular coil, current carrying solenoid), divergence and curl of magnetic field, Ampere's circuital law, magnetic properties of materials (magnetic intensity, magnetic induction, permeability, magnetic susceptibility), brief introduction of dia-, para- and ferro magnetic materials

#### **Unit 3: (7 Hours)**

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self-inductance of single coil, mutual inductance of two coils, energy stored in magnetic field. Maxwell's equations and equation of continuity of current, displacement current

#### **Unit 4: (5 Hours)**

DC Circuits: Review of Kirchhoff's Voltage and Current Laws, Thevenin theorem, Norton theorem, Superposition theorem, Maximum Power Transfer theorem.

#### **References:**

##### **Essential Readings:**

- 1) Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn. 1981, McGraw-Hill.
- 2) Electricity and Magnetism, J. H. Fewkes and J. Yarwood, Vol. I, 1991, Oxford Univ. Press
- 3) Electricity and Magnetism, D. C. Tayal, 1988, Himalaya Publishing House.
- 4) Fundamentals of Electromagnetics, M. A. W. Miah, 1982, Tata McGraw Hill
- 5) Introduction to Electrodynamics, D. J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

##### **Additional Readings:**

- 1) Electricity and Magnetism, Berkeley Physics Course, Edward M. Purcell, 1986, McGraw-Hill Education.
- 2) Problems and Solutions in Electromagnetics, Ajoy Ghatak, K Thyagarajan and Ravi Varshney

- 3) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- 4) Schaum's Outline of Electric Circuits, J. Edminister and M. Nahvi, 3rd Edn., 1995, McGraw Hill.

### **PRACTICAL COMPONENT – 60 Hours**

The teacher is expected to give basic idea and working of various instruments and circuits 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 of experiments.

- 1) To use a multimeter for measuring resistances, a.c and d.c voltages, d.c. current, capacitance and for checking electrical fuses.
- 2) Ballistic Galvanometer:
  - e) Measurement of charge and current sensitivity
  - f) Measurement of critical damping resistance
  - g) Determine a high resistance by leakage method
  - h) Determine self-inductance of a coil by Rayleigh's Method.
- 3) To compare capacitances using de Sauty's bridge.
- 4) Measurement of field strength B and its variation in a Solenoid
- 5) To study the Characteristics of a Series RC Circuit.
- 6) To study a series LCR circuit and determine its resonant frequency and quality factor.
- 7) To study a parallel LCR circuit and determine its anti-resonant frequency and quality factor
- 8) To determine a low resistance by Carey Foster bridge.
- 9) To verify the Thevenin, superposition and maximum power transfer theorems
- 10) To verify Norton theorem

### **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) A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- 4) Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press
- 5) Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

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

## DISCIPLINE SPECIFIC CORE COURSE (PHYSICS DSC - 4): LINEAR AND DIGITAL INTEGRATED CIRCUITS

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Linear and Digital Integrated Circuits Physics DSC 4	4	2	0	2	Class XII pass	----

### LEARNING OBJECTIVES

This paper aims to provide the basic knowledge of linear and digital electronics. It discusses about the operational amplifier and its applications. Boolean algebra and combinational logic circuits are also discussed.

### LEARNING OUTCOMES

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

- To understand Op-Amp basics and its various applications.
- To become familiar with logic gates and boolean algebra theorems.
- To understand the minimization techniques for designing a simplified logic circuit.
- To design a half adder, full adder, half-subtractor, and full-subtractor.
- To understand the working of data processing circuits, multiplexers, de-multiplexers, decoders and encoders.
- To become familiar with the working of flip-flop circuits, its working and applications.

### SYLLABUS OF PHYSICS DSC – 4

#### THEORY COMPONENT

##### **Unit 1: (8 Hours)**

Operational Amplifiers (Black box approach): Characteristics of an ideal and practical Operational Amplifier (IC 741), Open and closed loop configuration, CMRR, Slew Rate and the concept of Virtual Ground.

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Summing and Difference Amplifier, (3) Differentiator, (4) Integrator, (5) Wein bridge oscillator, (6) Comparator, and (7) Active low pass and high pass Butter worth filter (1st order only).

**Unit 2: (6 Hours)**

Logic Gates and Boolean algebra: Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Basic postulates and fundamental theorems of Boolean algebra.

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP).

**Unit 3: (6 Hours)**

Arithmetic Circuits: Half and Full Adder, Half and Full Subtractor, 4-bit binary Adder/Subtractor

Data processing circuits: Multiplexers, De-multiplexers, Decoders, Encoders

**Unit 4: (5 Hours)**

Sequential Circuits: SR, D, and JK Flip-Flops. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop.

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel in-Parallel-out Shift Registers (only up to 4 bits). Ring Counter.

**Unit 5: (5 Hours)**

Counters (4 bits): Asynchronous counter, Synchronous Counter.

D-A and A-D Conversion: 4 bit binary weighted and R-2R D-A converters, A-D conversion characteristics, successive approximation ADC.

**References:****Essential Readings:**

- 1) Op-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- 2) Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
- 3) Digital Principles and Applications, A. P. Malvino, D. P. Leach and Saha, 8th Ed., 2018, Tata McGraw
- 4) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill
- 5) Digital Fundamentals, Thomas L. Floyd, Pearson Education Asia (1994).
- 6) Digital Principles, R. L. Tokheim, Schaum's outline series, Tata McGraw- Hill (1994).

**PRACTICAL COMPONENT – 60 Hours**

Every student should perform at least 04 experiments each from section A, B and C

**Section A: Op-Amp. Circuits (Hardware design)**

- 1) To design an inverting and non-inverting amplifier using Op-amp (741,351) for dc voltage of given gain.
- 2) To design inverting and non-inverting amplifier using Op-amp (741,351) and study their frequency responses
- 3) To add two dc voltages using Op-Amp in inverting and non-inverting mode.
- 4) To design a precision Differential amplifier of given I/O specification using Op-amplifier.

- 5) To investigate the use of an op-amp as an Integrator.
- 6) To investigate the use of an op-amp as a Differentiator.
- 7) To design a Wien bridge oscillator for given frequency using an Op-Amplifier.
- 8) Design a Butter-worth Low Pass active Filter (1st order) and study frequency response.
- 9) Design a Butter-worth High Pass active Filter (1st order) and study frequency response.
- 10) Design a digital to analog converter (DAC) of given specifications.

### **Section B: Digital circuits (Hardware design)**

- 1) (a) To design a combinational logic system for a specified Truth Table.  
 (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.  
 (c) To minimize a given logic circuit.
- 2) Half Adder and Full Adder.
- 3) Half Subtractor and Full Subtractor.
- 4) 4 bit binary adder and adder-subtractor using Full adder IC.
- 5) To design a seven segment decoder.
- 6) To build Flip-Flop (RS, D-type and JK) circuits using NAND gates.
- 7) To build JK Master-slave flip-flop using Flip-Flop ICs.
- 8) To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
- 9) To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

### **Section C: SPICE/MULTISIM simulations for electronic circuits and devices**

- 1) To verify the Thevenin and Norton Theorems.
- 2) Design and analyze the series and parallel LCR circuits.
- 3) Design the inverting and non-inverting amplifier using an Op-Amp of given gain.
- 4) Design and Verification of op-amp as integrator and differentiator.
- 5) Design the 1st order active low pass and high pass filters of given cutoff frequency.
- 6) Design a Wein's Bridge oscillator of given frequency.
- 7) Design clocked SR and JK Flip-Flop's using NAND Gates.
- 8) Design 4-bit asynchronous counter using Flip-Flop ICs.

### **References (For Laboratory Work):**

- 1) Fundamentals of Digital Circuits, Anand Kumar, 4th Edn, 2018, PHI Learning.
- 2) Digital Computer Electronics, A. P. Malvino, J.A. Brown, 3rd Edition, 2018, Tata McGraw Hill Education.
- 3) Digital Electronics, S. K. Mandal, 2010, 1st edition, Tata McGraw Hill.

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



## Category-IV

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY THE DEPARTMENTS

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electricity and Magnetism GE – 11	4	3	0	1	Class XII pass	NIL

### LEARNING OBJECTIVES

This course begins with theorems of network analysis which are required to perform the associated experiments in the laboratory. Then course delves into the elementary vector analysis, an essential mathematical tool for understanding static electric field and magnetic field. By the end of the course, the student should appreciate Maxwell's equations.

### LEARNING OUTCOMES

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

- Apply Coulomb's law to line, surface, and volume distributions of charges.
- Apply Gauss's law of electrostatics to distribution of charges
- Understand the effects of electric polarization and concepts of bound charges in dielectric materials
- Understand and calculate the vector potential and magnetic field of arbitrary current distribution
- Understand the concept of bound currents and ferromagnetism in magnetic materials

### SYLLABUS OF GE – 11

#### THEORY COMPONENT

#### **Unit 1: (15 Hours)**

Network Analysis: Superposition, Thevenin, Norton theorems and their applications in DC and AC circuits with more than one source, Maximum Power Transfer theorem for AC circuits  
Mathematical Preliminaries: Concept of scalar and vector fields, Gradient of a scalar field, Divergence and curl of vector fields and their physical interpretation, Conservative forces and Laplace and Poisson equations.

Concept of a line integral of a scalar and vector field, surface integral of vector fields and volume integral, Gauss's theorem, Stoke's theorem.

**Unit 2: (15 Hours)**

Electric Field and Electric Potential for continuous charge distributions: Electric field due to a line charge, surface charge and volume charge distributions, Electric field vector as negative gradient of scalar potential, Ambiguities of Electric potential, Differential and integral forms of Gauss's Law, Applications of Gauss's Law to various charge distributions with spherical, cylindrical and planar symmetries, Uniqueness theorem

Electric Field in Matter: Bound charges due to polarization and their physical interpretation. Average electric field inside a dielectric, Electric Field in spherical and cylindrical cavities of a dielectric, Displacement vector and its boundary conditions, Gauss' Law in the presence of dielectrics, Linear dielectrics: electric susceptibility and dielectric constant, Boundary value problems with linear dielectrics.

**Unit 3: (15 Hours)**

Magnetic Field: Divergence and curl of magnetic field B, Magnetic field due to arbitrary current distribution using Biot-Savart law, Ampere's law, integral and differential forms of Ampere's Law, Vector potential and its ambiguities.

Magnetic Properties of Matter: Magnetization vector, Bound Currents, Magnetic Intensity, Differential and integral form of Ampere's Law in the presence of magnetised materials, Magnetic susceptibility and permeability, Ferromagnetism (Hund's rule)

Electrodynamics: Faraday's Law, Lenz's Law, inductance, Electromotive force, Ohm's Law ( $\vec{J} = \sigma \vec{E}$ ), Energy stored in a Magnetic Field. Charge Conservation, Continuity equation, Differential and integral forms of Maxwell's equations in matter.

**References:****Essential Readings:**

- 1) Introduction to Electrodynamics, D. J. Griffiths, 4th Edn., 2015, Pearson Education India Learning Private Limited.
- 2) Schaum's Outlines of Electromagnetics, M. Nahvi and J. A. Edminister, 2019, McGraw-Hill Education.
- 3) Electromagnetic Fields and Waves, Paul Lorrain and Dale Corson, 1991, W. H. Freeman.
- 4) Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
- 5) Network, Lines and Fields, John D. Ryder, 2nd Edn., 2015, Pearson.
- 6) Introductory Circuit Analysis, R. Boylestead, 2016, Pearson.
- 7) Electricity and Magnetism, Tom Weideman, University of California Davis.  
[url: [https://zhu.physics.ucdavis.edu/Physics9C-C\\_2021/Physics%209C\\_EM%20by%20Tom%20Weideman.pdf](https://zhu.physics.ucdavis.edu/Physics9C-C_2021/Physics%209C_EM%20by%20Tom%20Weideman.pdf)]

**Additional Readings:**

- 1) Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
- 2) Electricity, Magnetism and Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- 3) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley

**PRACTICAL COMPONENT- 30 Hours**

Learning Outcome:

- To understand working of Arduino Microcontroller System
- To use Arduino to measure time, count events and time between events
- To use Arduino to measure voltage/current/resistance
- To use Arduino to measure various physical parameters like magnetic field

### **Unit I (Mandatory): Arduino Programming**

Introduction to Arduino Microcontroller platform. Getting acquainted with the Arduino IDE and Basic Sketch structure. Digital Input and output. Measuring time and events. Measuring analog voltage. Generating analog voltage using Pulse Width Modulation. Serial communication and serial monitor. Programming using Interrupts.

### **Unit II: Exploring electrical properties of matter using Arduino** (at least one experiment)

- To study the characteristics of a series RC Circuit.
- To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, Impedance at resonance, (c) Quality factor Q, and (d) Band width.
- Diode Characteristics:
  - To study characteristics of diode and estimate Boltzman constant.
  - To study characteristics of LED and estimate Planck's constant

### **Unit III: Exploring magnetic properties of matter using Arduino**

- To verify Faraday's law and Lenz's law by measuring induced voltage across a coil subjected to varying magnetic field. Also, estimate dipole moment of the magnet.

### **Unit IV: DC and AC Bridges** (at least one experiment)

- To compare capacitances using de Sauty Bridge
- To determine a Low Resistance by Carey - Foster Bridge

### **Unit V: Network Theorems**

(at least one experiment)

- To verify the Thevenin and Norton theorems
- To verify the Superposition, and Maximum Power Transfer Theorems

### **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) A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11th Ed.2011, Kitab Mahal
- 4) Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press

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

**GENERIC ELECTIVE (GE - 12): THERMAL PHYSICS**

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical			
Thermal Physics GE – 12	4	3	0	1	Class XII pass	NIL	Physics and Astrophysics

**LEARNING OBJECTIVES**

This course will review the basic concepts of thermodynamics, kinetic theory of gases with a brief introduction to statistical mechanics. The primary goal is to understand the applications of fundamental laws of thermodynamics to various systems and processes. This coursework will also enable the students to understand the connection between the macroscopic observations of physical systems and microscopic behaviour of atoms and molecule through statistical mechanics.

**LEARNING OUTCOMES**

At the end of this course, students will,

- Get an essence of the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations.
- Know the fundamentals of the kinetic theory of gases, Maxwell-Boltzman distribution law, mean free path of molecular collisions, viscosity, thermal conductivity and diffusion.
- Learn about the black body radiations, Stefan- Boltzmann's law, Rayleigh-Jean's law and Planck's law and their significances.
- Learn the basics of quantum statistical distributions, viz., the Bose-Einstein statistics and the Fermi-Dirac statistics.

In the laboratory course, the students are expected to measure of Planck's constant using black body radiation, determine Stefan's constant, coefficient of thermal conductivity of a bad conductor and a good conductor, determine the temperature coefficient of resistance, study variation of thermo-emf across two junctions of a thermocouple with temperature etc.

## SYLLABUS OF GE – 12

### THEORY COMPONENT

#### **Unit 1: (12 Hours)**

Laws of Thermodynamics: Fundamental basics of Thermodynamic system and variables, Zeroth Law of Thermodynamics and temperature, First law and internal energy, various thermodynamical processes, Applications of First Law: general relation between  $C_P$  and  $C_V$ , work done during various processes, Compressibility and Expansion Coefficient, reversible and irreversible processes, Second law: Kelvin-Planck and Clausius statements, Carnot engine, Carnot cycle and theorem, basic concept of Entropy, Entropy changes in reversible and irreversible processes, Clausius inequality, Entropy-temperature diagrams.

#### **Unit 2: (08 Hours)**

Thermodynamical Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Clausius Clapeyron Equation, Expression for  $(C_P - C_V)$ ,  $C_P/C_V$ , TdS equations, energy equations for ideal gases.

#### **Unit 3: (8 Hours)**

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (zeroth order only), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case).

#### **Unit 4: (7 Hours)**

Theory of Radiation: Blackbody radiation, Spectral distribution, Derivation of Planck's law, Deduction of Wien's law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

#### **Unit 5: (10 Hours)**

Statistical Mechanics: Macrostate and Microstate, phase space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann law, Fermi-Dirac distribution law - Bose-Einstein distribution law - comparison of three statistics.

#### **References:**

##### **Essential Readings:**

- 1) A Treatise on Heat, Meghnad Saha, and B. N. Srivastava, 1969, Indian Press.
- 2) Heat and Thermodynamics, M. W. Zemasky and R. Dittman, 1981, McGraw Hill.
- 3) Thermodynamics, Kinetic theory and statistical thermodynamics, F. W. Sears and G. L. Salinger. 1988, Narosa.
- 4) Thermal Physics, A. Kumar and S. P. Taneja, 2014, R. Chand Publications.
- 5) Thermal Physics: S. C. Garg, R. M. Bansal and C.K. Ghosh, 2nd Ed. Tata McGraw-Hill.

##### **Additional Readings:**

- 1) Concepts in Thermal Physics: Blundell and Blundell, 2nd Ed. 2009, Oxford Univ. Press.

- 2) An Introduction to Thermal Physics: D. Schroeder 2021, Oxford Univ. Press (earlier published by Pearsons).
- 3) Heat, Thermodynamics and Statistical Physics, Brij Lal, N. Subrahmanyam and P. S. Hemne, S. Chand and Company.

### **PRACTICAL COMPONENT- 30 Hours**

- Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the thermal physics lab, including necessary precautions.
- Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
- Application to the specific experiments done in the lab.

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

- 1) To determine Mechanical Equivalent of Heat,  $J$ , by Callender and Barne's constant flow method.
- 2) Measurement of Planck's constant using black body radiation.
- 3) To determine Stefan's Constant.
- 4) To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
- 5) To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method by steam or electrical heating.
- 6) To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
- 7) To study the variation of thermos-emf across two junctions of a thermocouple with temperature.

### **References (For Laboratory Work):**

- 1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
- 2) A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal.
- 3) A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication.
- 4) Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press.
- 5) An Advanced Course in Practical Physics: D. Chattopadhyay and P. C. Rakshit, New Central Book Agency

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

**GENERIC ELECTIVE (GE - 13): MODERN PHYSICS**

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Modern Physics GE – 13	4	3	0	1	Class XII pass	NIL

### LEARNING OBJECTIVES

The objective of this course is to teach the physics foundation necessary for learning various topics in modern physics which are crucial for understanding atoms, molecules, photons, nuclei and elementary particles. These concepts are also important to understand phenomena in Laser physics, condensed matter physics and astrophysics.

### LEARNING OUTCOMES

After getting exposure to this course, the following topics would have learnt,

- Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics, laying the foundation of modern physics.
- Formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions.
- The spontaneous and stimulated emission of radiation, optical pumping and population inversion, Basic lasing action.
- The properties of nuclei like density, size, binding energy, nuclear force and structure of atomic nucleus, liquid drop model and mass formula.
- Radioactive decays like alpha, beta, gamma decay. Neutrino, its properties and its role in theory of beta decay.
- Fission and fusion: Nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.

In the laboratory course, the students will get opportunity to measure Planck's constant, verify photoelectric effect, and determine  $e/m$  of electron and work function of a metal. They will also find wavelength of Laser sources by single and double slit experiment, wavelength and angular spread of He-Ne Laser using plane diffraction grating.

## SYLLABUS OF GE – 13

### THEORY COMPONENT

#### **Unit 1: (10 Hours)**

Origin of Modern Physics: Blackbody Radiation: Failure of explanation from classical theory; Planck's idea of a quantum; Quantum theory of Light: Photo-electric effect and Compton scattering, de Broglie wavelength and matter waves; Davisson-Germer experiment; Wave description of particles by wave packets, Group and Phase velocities and relation between them.

#### **Unit 2: (10 Hours)**

Problems with Rutherford model: Instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen-like atoms and their spectra.

Uncertainty principle: Gamma ray microscope thought experiment; Wave-particle duality leading to Heisenberg uncertainty principle; Impossibility of an electron being in the nucleus, Energy-time uncertainty principle; origin of natural width of emission lines

#### **Unit 3: (10 Hours)**

Basics of quantum Mechanics: Two-slit interference experiment with photons and electrons; Concept of wave functions, linearity and superposition, Time independent Schrodinger wave equation for non-relativistic particles; Momentum and Energy operators; physical interpretation of a wave function, probabilities, normalization and probability current densities in one dimension. Problem: One dimensional infinitely rigid box. An application: Quantum dot.

#### **Unit 4: (05 Hours)**

X-rays: Ionizing Power, X-ray Diffraction, Bragg's Law. Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley's Law.

LASERS: Properties and applications of Lasers. Emission (spontaneous and stimulated emissions) and absorption processes, Metastable states, components of a laser and lasing action.

#### **Unit 5: (10 Hours)**

Nuclear Physics: Size and structure of atomic nucleus and its relation with atomic weight; Nature of nuclear force, Stability of the nucleus; N-Z graph, Drip line nuclei, Binding Energy, Liquid Drop model: semi-empirical mass formula.

Radioactivity: Different equilibrium, Alpha decay; Beta decay: energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation:

Fission and fusion: Mass deficit and generation of energy; Fission: nature of fragments and emission of neutrons. Fusion and thermonuclear reactions driving stellar evolution (brief qualitative discussions only).



## References:

### Essential Readings:

- 1) Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- 2) Modern Physics by R. A. Serway, C. J. Moses and C. A. Moyer, 3<sup>rd</sup> edition, Thomson Brooks Cole, 2012.
- 3) Modern Physics for Scientists and Engineers by S. T. Thornton and A Rex, 4<sup>th</sup> edition, Cengage Learning, 2013.
- 4) Concepts of Nuclear Physics by B. L. Cohen, Tata McGraw Hill Publication, 1974.
- 5) Quantum Mechanics: Theory and Applications, Ajoy Ghatak and S. Lokanathan, Laxmi Publications, 2019

### Additional Readings:

- 1) Six Ideas that Shaped Physics: Particle Behave like Waves, T.A. Moore, 2003, McGraw Hill.
- 2) Thirty years that shook physics: the story of quantum theory, George Gamow, Garden City, NY: Doubleday, 1966.
- 3) New Physics, ed. Paul Davies, Cambridge University Press (1989).
- 4) Quantum Theory, David Bohm, Dover Publications, 1979.
- 5) Lectures on Quantum Mechanics: Fundamentals and Applications, eds. A. Pathak and Ajoy Ghatak, Viva Books Pvt. Ltd., 2019
- 6) Quantum Mechanics, Robert Eisberg and Robert Resnick, 2<sup>nd</sup> Edn., 2002, Wiley.
- 7) Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.

## **PRACTICAL COMPONENT – 30 Hours**

- Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the modern physics lab, including necessary precautions.
- Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
- Application to the specific experiments done in the lab.

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

- 1) Measurement of Planck's constant using black body radiation and photo-detector.
- 2) Photo-electric effect: estimate Planck's constant using graph of maximum energy of photo-electrons versus frequency of light.
- 3) To determine work function of material of filament of directly heated vacuum diode.
- 4) To determine the Planck's constant using LEDs, using at least 4 LEDs.
- 5) To determine the wavelength of H-alpha emission line of Hydrogen atom.
- 6) To determine the value of  $e/m$  by (a) Magnetic focusing or (b) Bar magnet.
- 7) To setup the Millikan oil drop apparatus and determine the charge of an electron.
- 8) To show the tunneling effect in tunnel diode using I-V characteristics.
- 9) To determine the wavelength of laser source using diffraction of single slit.

- 10) To determine wavelength and angular spread of He-Ne laser using plane diffraction grating.
- 11) To determine the wavelength of laser source using diffraction of double slits.

**References (for Laboratory Work):**

- 1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
- 2) Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
- 3) A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11<sup>th</sup> Edition, 2011, Kitab Mahal, New Delhi.
- 4) Practical Physics, G. L. Squires, 2015, 4<sup>th</sup> Edition, Cambridge University Press.
- 5) B. Sc. Practical Physics, Geeta Sanon, R. Chand, 2016.

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

**GENERIC ELECTIVE (GE - 14): INTRODUCTORY ASTRONOMY**

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Introductory Astronomy GE – 14	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 – 14 (Lecture-45 hours)**

### **THEORY COMPONENT**

#### **Unit 1:**

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:**

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:**

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:**

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

#### **Unit 5:**

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 Type Ia), 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:**



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)

### **References:**

#### **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/>

#### **Additional 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

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

**DEPARTMENT OF CHEMISTRY**  
**Category-I**

**B.Sc. (H) Chemistry**

**DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4): CHEMISTRY OF S- AND P-BLOCK ELEMENTS**

**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		
Chemistry of s- and p-Block Elements (DSC-4: Inorganic Chemistry -II)	04	03	0	01	Class 12 <sup>th</sup> Pass	----

**Learning objectives**

The objectives of this course are as follows:

- To develop the general principles of metallurgy and s-, p-block elements.
- To introduce the terms minerals, ores, concentration, benefaction, calcination, roasting, refining, etc. and explain the principles of oxidation and reduction as applied to the extraction procedures.
- To make students ware of different methods of purification of metals, such as electrolytic, oxidative refining, VanArkel-De Boer process and Mond's process are discussed and applications of thermodynamic concepts like that of Gibbs energy and entropy to the extraction of metals.
- To familiarize students with the patterns and trends exhibited by s- and p-block elements and their compounds with emphasis on synthesis, structure, bonding and uses.
- To impart information about the fundamentals of internal and external redox indicators, and iodometric/iodimetric titrations.

**Learning outcomes**

**By studying this course, students will be able to:**

- Learn the fundamental principles of metallurgy and understand the importance of recovery of by-products during extraction.
- Applications of thermodynamic concepts like that of Gibbs energy and



entropy to the principles of extraction of metals.

- Learn about the characteristics of s- and p- block elements as well as the synthesis, structure, bonding and uses of their compounds
- Understand the concept and use of internal and external redox indicators
- Comprehend the theory and application of iodometric and iodimetric titrimetric analysis

## **SYLLABUS OF DSC-4**

### **UNIT – I: General Principles of Metallurgy**

**(6 Hours)**

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, Van Arkel-De Boer process, Zone refining. Brief discussion of metals and alloys used in ancient and medieval India.

### **UNIT – II: Chemistry of s- Block Elements**

**(15 Hours)**

General characteristics: melting point, flame colouration, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.

Common features such as ease of formation, thermal stability, energetics of dissolution, and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.

Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium.

Solutions of alkali metals in liquid ammonia and their properties

### **UNIT – III: Chemistry of p-Block Elements**

**(9 Hours)**

Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Catenation, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.

### **UNIT – IV: Compounds of p-Block Elements**

**(15 Hours)**

Acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat on the following:

- Hydrides of Group 13 (only diborane), Group 14, Group 15 (EH<sub>3</sub> where E = N, P, As, Sb, Bi), Group 16 and Group 17.
- Oxoacids of phosphorus, sulphur and chlorine
- Interhalogen and pseudohalogen compound
- Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF<sub>2</sub>).

## Practical component – 30 Hours

### 1. Redox Titrations

- (i) Estimation of Fe(II) with  $K_2Cr_2O_7$  using diphenylamine as internal indicator.
- (ii) Estimation of Fe(II) with  $K_2Cr_2O_7$  using N-phenyl anthranilic acid as internal indicator.
- (iii) Estimation of Fe(II) with  $K_2Cr_2O_7$  using external indicator.

### 2. Iodo/Iodimetric Titrations

- (i) Estimation of Cu(II) using sodium thiosulphate solution (Iodometrically).
- (ii) Estimation of  $K_2Cr_2O_7$  using sodium thiosulphate solution (Iodometrically).
- (iii) Estimation of antimony in tartaremetic iodimetrically.
- (iv) Estimation of Iodine content in iodized salt.

## Essential/recommended readings

### 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. Atkins, P. W.; Overton, T. L.; Rourke, J. P.; Weller, M. T.; Armstrong, F. A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5<sup>th</sup> Edition, Oxford University Press.
4. Miessler, G. L.; Fischer P. J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5<sup>th</sup> Edition, Pearson.
5. Housecraft, C. E.; Sharpe, A. G., (2018), **Inorganic Chemistry**, 5<sup>th</sup> Edition, Pearson.
6. Canham, G. R., Overton, T. (2014), **Descriptive Inorganic Chemistry**, 6<sup>th</sup> Edition, Freeman and Company.
7. Greenwood, N. N.; Earnshaw, A., (1997), **Chemistry of Elements**, 2<sup>nd</sup> Edition, Elsevier.

### Practicals:

1. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denney, R. C. (1989), Vogel's Text book of **Quantitative Chemical Analysis**, John Wiley and Sons.
2. Harris, D. C.; Lucy, C. A. (2016), **Quantitative Chemical Analysis**, 9<sup>th</sup> Edition, Freeman and Company.
3. Day, R. A.; Underwood, A. L. (2012), **Quantitative Analysis**, 6<sup>th</sup> Edition, PHI Learning Private Limited.

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

**DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): HALOALKANES, ARENES,  
HALOARENES, ALCOHOLS, PHENOLS, ETHERS AND EPOXIDES**

**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		
Haloalkanes, Arenes, Haloarenes, Alcohols, Phenols, Ethers and Epoxides (DSC-5: Organic Chemistry-II)	04	02	0	02	Class Pass 12 <sup>th</sup>	---

### Learning Objectives

The Learning Objectives of this course are as follows:

- To impart understanding of the chemistry of organic functional groups, which include haloalkanes, aromatic hydrocarbons, haloarenes and some oxygen containing functional groups, along with their reactivity patterns.
- To develop understanding of detailed reactions and mechanistic pathways for each functional group to unravel the spectrum of organic chemistry and the extent of organic transformations.
- To aid in the paramount learning of the concepts and their applications.

### Learning outcomes

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

- Understand reactions of arenes, haloarenes and some oxygen containing functional groups.
- Understand the concept of protection and deprotection
- Use the synthetic chemistry learnt in this course to do functional group transformations.
- Propose plausible mechanisms for the reactions under study.

## SYLLABUS OF DSC-5

### Unit - 1: Haloalkanes

( 10 Hours)

Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions –  $S_N1$ ,  $S_N2$  and  $S_Ni$  mechanisms with stereochemical aspects and effect of solvent; nucleophilic substitution v/s elimination.

Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

### Unit - II: Aromatic Hydrocarbons

(06 Hours)

Concept of Aromaticity and anti-aromaticity; Electrophilic aromatic substitution: halogenation, nitration, sulphonation, Friedel Crafts alkylation/acylation with their mechanism. Directing effects of groups in electrophilic substitution.

### Unit - III: Aryl halides

(04 Hours)

Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution;  $S_NAr$ , Benzyne mechanism. Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

### Unit - IV: Alcohols, Phenols, Ethers & Epoxides

(10 Hours)

*Alcohols*: Relative reactivity of  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  alcohols, reactions of alcohols with sodium, HX (Lucas test), esterification, oxidation (with PCC, alkaline  $KMnO_4$ , acidic dichromate, conc.  $HNO_3$ ). Oppenauer oxidation; Diols: oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

*Phenols*: Preparation using Cumene hydroperoxide, Acidity and factors affecting it, Kolbe's–Schmidt reactions, Riemer-Tiemann reaction, Houben–Hoesch condensation, Schotten–Baumann reaction, Fries and Claisen rearrangements and their mechanism.

Ethers and Epoxides: Acid and Base catalyzed cleavage reactions.

### Practical

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60 Hours

1. Acetylation of any one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols ( $\beta$ -naphthol, salicylic acid) by any one method:
  - i. Using conventional method
  - ii. Using green approach
2. Benzoylation of one of the following amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) or one of the following phenols ( $\beta$ -naphthol, resorcinol, *p*-cresol) by Schotten-Baumann reaction.
3. Bromination of acetanilide/aniline/phenol by anyone of the following:
  - (a) Green method
  - (b) Conventional method
4. Nitration of nitrobenzene/chlorobenzene.
5. Haloform reaction of ethanol.
6. Oxidation of benzyl alcohol to benzoic acid
7. Estimation of the given sample of phenol/amine by:

- a) Acetylation                      b) Bromate-Bromide method
8. Functional group tests for alcohols, phenols, carboxylic acids, phenols, carbonyl compounds, esters.

### Essential/recommended readings

#### Theory:

1. Morrison, R. N., Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7<sup>th</sup> Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
2. Finar, I.L. (2002), **Organic Chemistry**, Volume 1, 6<sup>th</sup> Edition, Dorling Kindersley (India) Pvt. Ltd., Pearson Education.
3. Ahluwalia, V.K.; Bhagat, P.; Aggarwal, R.; Chandra, R. (2005), **Intermediate for Organic Synthesis**, I.K. International.
4. Solomons, T.W.G., Fryhle, C.B., Snyder, S.A. (2017), **Organic Chemistry**, 12<sup>th</sup> Edition, Wiley.

#### Practical:

1. Mann, F.G., Saunders, B.C. (2009), **Practical Organic Chemistry**, 4<sup>th</sup> Edition, Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. (2005), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
3. Ahluwalia, V.K., Aggarwal, R. (2004), **Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis**, University Press.
4. Ahluwalia, V.K., Dhingra, S. (2004), **Comprehensive Practical Organic Chemistry: Qualitative Analysis**, University Press.
5. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume–I**, I K International Publishing house Pvt. Ltd, New Delhi
6. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume–II**, I K International Publishing house Pvt. Ltd, New Delhi

#### Suggestive readings

1. Carey, F.A., Sundberg, R. J. (2008), **Advanced Organic Chemistry: Part B: Reaction and Synthesis**, Springer.
2. Bruice, P.Y. (2020), **Organic Chemistry**, 3<sup>rd</sup> Edition, Pearson.
3. Patrick, G. (2012), **BIOS Instant Notes in Organic Chemistry**, Viva Books.
4. Parashar, R.K., Ahluwalia, V.K. (2018), **Organic Reaction Mechanism**, 4<sup>th</sup> Edition, Narosa Publishing House.

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

**DISCIPLINE SPECIFIC CORE COURSE – 6 (DSC-6): Thermodynamics and its Applications**

**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		
Chemical Thermodynamics and its Applications (DSC – 6: Physical Chemistry – II)	04	03	-	01	Class Pass XII	----

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To make students understand thermodynamic concepts, terminology, properties of thermodynamic systems, laws of thermodynamics and their correlation with other branches of physical chemistry and make them able to apply thermodynamic concepts to the system of variable compositions, equilibrium and colligative properties.

**Learning outcomes**

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

- Understand the three laws of thermodynamics, concept of State and Path functions, extensive and intensive properties.
- Derive the expressions of  $\Delta U$ ,  $\Delta H$ ,  $\Delta S$ ,  $\Delta G$ ,  $\Delta A$  for an ideal gas under different conditions.
- Explain the concept of partial molar properties.

**SYLLABUS OF DSC-6**

**UNIT – I: Basic Concepts of Chemical Thermodynamics (06 Hours)**

Intensive and extensive variables; state and path functions; isolated, closed and open systems.

Mathematical treatment - Exact and inexact differential, Partial derivatives, Euler's reciprocity rule, cyclic rule.

**UNIT – II: First law and Thermochemistry (15 Hours)**

Concept of heat,  $Q$ , work,  $W$ , internal energy,  $U$ , and statement of first law; enthalpy,  $H$ , relation between heat capacities, Joule Thompson Porous Plug experiment, Nature of Joule Thompson coefficient, calculations of  $Q$ ,  $W$ ,  $\Delta U$  and  $\Delta H$  for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Enthalpy of reactions: standard states; enthalpy of neutralization, enthalpy of hydration, enthalpy of formation and enthalpy of combustion and its applications, bond dissociation energy and bond enthalpy; effect of temperature (Kirchhoff's equations) on enthalpy of reactions.

**UNIT – III: Second Law (15 Hours)**

Concept of entropy; statement of the second law of thermodynamics, Carnot cycle. Calculation of entropy change for reversible and irreversible processes (for ideal gases). Free Energy Functions: Gibbs and Helmholtz energy; variation of  $S$ ,  $G$ ,  $A$  with  $T$ ,  $V$ ,  $P$ ; Free energy change and spontaneity (for ideal gases). Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

**UNIT – IV Third Law (03 Hours)**

Statement of third law, unattainability of absolute zero, calculation of absolute entropy of molecules, concept of residual entropy, calculation of absolute entropy of solid, liquid and gases.

**UNIT – V Systems of Variable Composition (06 Hours)**

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, Change in thermodynamic functions on mixing of ideal gases.

**Practical – 30 Hours  
Thermochemistry:**

- (a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulphuric acid or enthalpy of neutralization).
- (b) Determination of heat capacity of a calorimeter for different volumes using heat gained equal to heat lost by cold water and hot water.
- (c) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

- (d) Determination of the enthalpy of ionization of ethanoic acid.
  - (e) Determination of integral enthalpy solution of endothermic salts.
  - (f) Determination of integral enthalpy solution of exothermic salts.
  - (g) Determination of basicity of a diprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
  - (h) Determination of enthalpy of hydration of salt.
  - (i) Study of the solubility of benzoic acid in water and determination of  $\Delta H$ .
- Any other experiment carried out in the class.

### **Essential/recommended readings**

#### **Theory**

1. Peter, A.; Paula, J. de. (2011), **Physical Chemistry**, 9<sup>th</sup> Edition, Oxford University Press.
2. Castellan, G. W. (2004), **Physical Chemistry**, 4<sup>th</sup> Edition, Narosa.
3. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 2, 6<sup>th</sup> Edition, McGraw Hill Education.
4. Kapoor, K.L., **A Textbook of Physical Chemistry**, Vol 3, 5<sup>th</sup> Edition, McGraw Hill Education.
5. McQuarrie, D. A.; Simon, J. D. (2004), **Molecular Thermodynamics**, Viva Books Pvt. Ltd.

#### **Practical:**

1. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand & Co, New Delhi.
2. Kapoor, K.L. (2019), **A Textbook of Physical Chemistry**, Vol.7, 1<sup>st</sup> Edition, McGraw Hill Education.
3. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments in Physical Chemistry**, 8<sup>th</sup> Edition, McGraw-Hill, New York.

#### **Suggestive readings**

1. Levine, I.N. (2010), **Physical Chemistry**, Tata Mc Graw Hill.
2. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A.; Will, S. (2011), **Commonly asked Questions in Thermodynamics**. CRC Press.

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



## Category II

### BSc. Life Science with Chemistry as one of the Core Discipline

#### DISCIPLINE SPECIFIC CORE COURSE – 4:

#### 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		
Chemical Bonding and Elements in Biological System CHEM-DSC-02	4	2	0	2	Class XII Pass	----

#### Learning Objectives

The Learning Objectives of this course are as follows:

- Students gain basic knowledge of chemical bonding in compounds which is a necessary pre-requisite in understanding the general properties of the compound.
- Unit 2 reviews the importance of inorganic chemical species, especially metals in biological systems, their classification and detailed discussion of toxic metals.
- The discussions also provide them the details of sodium-potassium pump, role of some metal ions such as calcium, magnesium and the role of iron in transport and storage system

#### Learning outcomes

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

- Understand the concept of lattice energy using Born-Landé and Born Haber Cycle and their applications
- Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.
- Understand the importance and application of chemical bonds, inter-molecular and intramolecular weak chemical forces and their effect on melting points, boiling points, solubility and energetics of dissolution.
- Know about the essential, non-essential, trace and toxic metal ions and their role in biological system and effects of their deficiency. They will also learn their dose response relationship curves.
- Understand active and Passive transport and diagrammatically explain the working of

the sodium-potassium pump in organisms and the factors affecting it

- Explain the sources and consequences of excess and deficiency of trace metals and learn about the toxicity of certain metal ions, the reasons for toxicity
- Storage and transport of iron in bio-systems

## **SYLLABUS OF DSC-4**

### **Unit I: Chemical Bonding**

**(18 Hours)**

**Ionic Bonding:** General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Landé equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**Covalent Bonding:** Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1<sup>st</sup> and 2<sup>nd</sup> periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.

Brief introduction to Metallic Bonding, Hydrogen Bonding, van der Waals forces

### **Unit II: Elements in Biological System**

**(12 Hours)**

Classification of elements in biological system, Geochemical effect on the distribution of metals, Metal ions present in biological systems with special reference to Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Fe<sup>2+</sup>, Cu<sup>2+</sup> and Zn<sup>2+</sup>, Sodium / K-pump, Role of Ca<sup>2+</sup> (blood clotting and structural), Role of Mg<sup>2+</sup> in chlorophyll and energy production, Excess and deficiency of some trace metals, Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Dose response relationship curves of metal ions, Iron and its application in bio-systems, Storage and transport of iron.

### **PRACTICALS:**

**60 Hours**

1. Preparation of standard solutions.
2. Estimation of Sodium carbonate using HCl by acid base titration.
3. Estimation of carbonate and hydroxide present together in a mixture.
4. Estimation of carbonate and bicarbonate present together in a mixture.
5. Estimation of free alkali present in different soaps/detergents
6. Estimation of oxalic acid using KMnO<sub>4</sub> by redox titration.
7. Estimation of Mohr's salt using KMnO<sub>4</sub> by redox titration.
8. Determination of dissolved oxygen in water.
9. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using internal and external indicators.
10. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>
11. Paper Chromatographic separation of mixture of metal ions

- a.  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$
- b.  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ .

12. Any suitable experiment (other than the listed ones) based upon neutralisation/redox reactions.

**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. Crichton, R.; (2019), **Biological inorganic chemistry: a new introduction to molecular structure and function**, third edition, Elsevier, Academic Press.
6. Kaim, W; Schwederski, B.; Klein, A. (2013), **Bioinorganic Chemistry - Inorganic Elements in the Chemistry of Life: An Introduction and Guide**, 2<sup>nd</sup> 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.

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

## Category II

### BSc. Physical Science with Chemistry as one of the Core Disciplines

#### DISCIPLINE SPECIFIC CORE COURSE – 4:

#### 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		
Periodic Properties and Chemical Bonding DSC-4 Chemistry-II	4	2	0	2	Class Pass 12 <sup>th</sup>	----

#### Learning Objectives

The Learning Objectives of this course are as follows:

- The course discusses the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry.
- It provides basic knowledge about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases.
- It provides an overview of hydrogen bonding and van der Waal's forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds

#### Learning outcomes

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

- Understand periodicity in ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
- Understand variability in oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes
- Understand the concept of lattice energy using Born-Landé expression.
- Draw Born Haber Cycle and analyse reaction energies.
- Draw the plausible structures and geometries of molecules using VSEPR theory.
- Understand and draw MO diagrams (homo- & hetero-nuclear diatomic molecules).  
Understand the importance and applications of hydrogen and van der Wall bonding

## SYLLABUS OF DSC-4

### Unit I: Periodic Properties

(12 Hours)

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect.

General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Enthalpy of Atomization, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes

### UNIT II: Chemical Bonding

(18 Hours)

**Ionic Bonding:** General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Landé equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**Covalent Bonding:** Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1<sup>st</sup> and 2<sup>nd</sup> periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.

Brief introduction to Metallic Bonding, Hydrogen Bonding, van der Waal's Forces

### PRACTICALS:

60 Hours

1. Preparation of standard solutions.
2. Estimation of Sodium carbonate with HCl
3. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.
4. Estimation of Mohr's salt by titrating it with KMnO<sub>4</sub>.
5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO<sub>4</sub>.
6. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using internal and external indicators.
7. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.
8. Chromatographic separation of mixture of metal ions Cu<sup>2+</sup>, Cd<sup>2+</sup> or Ni<sup>2+</sup>, Co<sup>2+</sup>.
9. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using
  - a). internal indicator
  - b). external indicator
10. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.
11. Paper Chromatographic separation of mixture of metal ions
  - a). Cu<sup>2+</sup>, Cd<sup>2+</sup>
  - b). Ni<sup>2+</sup>, Co<sup>2+</sup>
12. Any suitable experiment (other than the listed ones) based upon neutralisation/redox reactions.

### 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. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Inorganic Chemistry**, 5th Edition, W. H. Freeman and Company.
4. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India
5. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
6. Wulfsberg, G (2002), **Inorganic Chemistry**, Viva Books Private Limited.
7. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

**Practical:**

- 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 mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

**Category-I**  
**B.Sc. (H) Analytical Chemistry**

**DISCIPLINE SPECIFIC CORE COURSE – 4: DSC-4:AC-2**

**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		
<b>Course Title:</b> SEPARATION METHODS-I  <b>Course Code:</b> Analytical Chemistry-2 (DSC4:AC-2)	<b>04</b>	<b>02</b>	<b>00</b>	<b>02</b>	<b>Class XII Pass</b>	---

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To acquire basic knowledge of the analytical chemistry of important techniques that will provide the basis for their industrial production methods.
- To provide an adequate mastery of analytical methods used for the determination of commercial/domestic raw materials and finished product quality.

**Learning outcomes**

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

- Become familiar with fundamental concepts of partition coefficients and their role in achieving separations across different types of chromatography.
- Develop the core skills to parse existing chromatographic protocols and identify the key factors influencing a chromatography experiment.
- Understand the underlying assumptions of the most common chromatographic separation techniques and approaches to method validation.
- Understand the concept of solubility and their application in separation using distribution law.

## SYLLABUS OF Analytical Chemistry-2 (DSC-4: AC-2)

### Theory Component

#### UNIT – I: Chromatography (08 Hours)

Classification of chromatographic methods: Principles of differential migration, description of chromatographic process, distribution coefficients, modes of chromatography. the chromatography (elution time and volume) capacity factor, column efficiency and resolution, sample preparation.

#### UNIT – II: Techniques of paper chromatography (06 Hours)

Experimental modifications, various modes of developments, nature of paper, detections of spots, retardation factors, factors that affect reproducibility of  $R_f$  values (due to paper, solvent system, sample, development procedures), selection of solvent, quantitative analysis, applications.

#### UNIT – III: Thin Layer Chromatography (06 Hours)

Stationary phase, adsorbents, liquid phase support, plate preparation, mobile phase, sample application, development, saturation of chamber, detection of spot,  $R_f$  values (effect of adsorbent, solvent, solute, development process), quantitative analysis, applications.

#### UNIT – IV: Solvent Extraction (04 Hours)

Distribution law, determination of distribution ratio, batch extraction, continuous extraction, discontinuous extraction, counter-current extraction.

#### UNIT –V: Dialysis and membrane filtration (06 Hours)

General laboratory methods, filters-nitrocellulose, fiberglass and polycarbonates.

### Practical component – 60 Hours

1. Separation and identification of amino acids present in the given mixture by **radial** and **ascending** paper Chromatography (*Perform both*).
2. Separation of ortho-nitrophenol & para-nitrophenol and *o*- and *p*-amino phenol by thin layer chromatography (TLC) and calculation of their  $R_f$  values.
3. Separation of constituents of leaf pigments by thin layer chromatography and paper chromatography (*radial & ascending both*).
4. Separation of a mixture of compounds by solvent extraction.
5. Separation of a mixture of naphthalene, benzoic acid and 2-naphthol.
6. Separation of a mixture of 1,4-dimethoxybenzene, 2-chloro benzoic acid and *p*-cresol.
7. Analysis of soil samples (at least three soil samples to be collected for analysis) collected from college nursery, sports ground Delhi villages/ Yamuna River bank.
  - (a) Determination of pH of soil samples.
  - (b) Determination of total soluble salts.
  - (c) Determination of carbonate and bicarbonate.
  - (d) Determination of calcium, magnesium and iron.



- (e) Determination of conductance of the soil samples.
8. Industrial visit to STP plant.

**Essential/recommended readings**

- Fifeild, F.W.; Kealey, D. (2000), Principles and Practice of Analytical Chemistry, Wiley.
- Harris, D. C. (2007), Exploring Chemical Analysis, W.H. Freeman and Co.
- Harris, D. C. (2007), Quantitative Chemical Analysis, 6th Edition, Freeman
- Mikes, O. (2000), Laboratory Handbook of Chromatographic methods, D. Van Nostrand Company Inc.

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

**DISCIPLINE SPECIFIC CORE COURSE – 5: DSC5:C2**

**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		
PERIODIC PROPERTIES AND CHEMICAL BONDING  CHEMISTRY-2 (DSC5-C2)	04	02	0	02	Class XII Pass	----

**Learning Objectives**

The Learning Objectives of this course are as follows:

- The course discusses the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry.
- It provides basic knowledge about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases.
- It provides an overview of hydrogen bonding and van der Waal forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds.

**Learning outcomes**

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

- Understand periodicity in ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
- Understand variability in oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes
- Understand the concept of lattice energy using Born-Landé expression.
- Draw Born Haber Cycle and analyse reaction energies.
- Draw the plausible structures and geometries of molecules using VSEPR theory.
- Understand and draw MO diagrams (homo- & hetero-nuclear diatomic molecules).
- Understand the importance and applications of hydrogen and van der Wall bonding.

## SYLLABUS OF Chemistry-2 (DSC-5:C2)

### UNIT – I: Periodic Properties

(12 Hours)

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect.

General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Enthalpy of Atomization, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes.

### UNIT – II: Bonding in Coordination Compounds

(18 Hours)

**Ionic Bonding:** General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Landé equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**Covalent Bonding:** Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1<sup>st</sup> and 2<sup>nd</sup> periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.  
Metallic Bonding, Hydrogen Bonding, van der Waals Forces.

### Practical –

60 Hours

1. Preparation of standard solutions of different normality and molarity of Mohr's salt and oxalic acid.
2. Estimation of free alkali present in different soaps and detergents (*At least two samples to be taken*).
3. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub> (*Provide at least two unknown solutions*).
4. Estimation of Mohr's salt by titrating it with KMnO<sub>4</sub> (*Provide a least two unknown solutions*).
5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO<sub>4</sub>.
6. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using internal and external indicators.
7. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.
8. Chromatographic separation of mixture of metal ions Cu<sup>2+</sup>, Cd<sup>2+</sup> and Ni<sup>2+</sup>, Co<sup>2+</sup>.

### Essential/recommended readings

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. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company.

4. Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India
5. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
6. Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited.
7. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.
8. 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 mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

**DISCIPLINE SPECIFIC CORE COURSE – 6: Mathematics-1:DSC6**

**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		
Topics in Calculus  Mathematics-1 (DSC6)	04	03	01	0	Class 12 <sup>th</sup> Pass	----

**Course Objectives**

The Learning Objectives of this course are as follows:

- 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.

**Course Learning Outcomes:** This course will enable the students to:

- Understand continuity and differentiability in terms of limits and graphs of certain functions.
- Describe asymptotic behaviour in terms of limits involving infinity.
- Use of derivatives to explore the behaviour of a given function locating and classify its extrema and graphing the function.
- Apply the concepts of asymptotes, and inflexion points in tracing of Cartesian curves.
- Compute the reduction formulae of standard transcendental functions with applications.

**Syllabus: Theory Component**

**Unit 1: Limits, Continuity and Differentiability – 20 Hours**

Limit of a function,  $\varepsilon-\delta$  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 2: Mean Value Theorems and its Applications – 20 Hours**

Rolle's theorem, Mean value theorems and applications to monotonic functions and inequalities; Taylor's theorem, Taylor's series, Maclaurin's series expansions of  $e^x$ ,  $\sin x$ ,  $\cos x$ ,  $\log(1+x)$  and  $(1+x)^m$ ; Indeterminate forms.

**Unit 3: Tracing of Curves and Reduction Formulae – 20 Hours**

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  $\int \sin^n x dx$ ,  $\int \cos^n x dx$ , and  $\int \sin^m x \cos^n x dx$  and their applications.

**Practical Component (if any): NIL**

**Essential/recommended readings**

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

**Additional Readings:**

- Apostol, T. M. (2007). *Calculus: One-Variable Calculus with An Introduction to Linear Algebra* (2nd ed.). Vol. 1. Wiley India Pvt. Ltd.
- Ross, Kenneth. A. (2013). *Elementary Analysis: The Theory of Calculus* (2<sup>nd</sup> 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.**

## Category I

### BSc. (Hons.) Industrial Chemistry

#### DISCIPLINE SPECIFIC CORE COURSE – 4: (DSC-4) Fossil Fuels and Cleansing Agents

#### 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		
Fossil Fuels and Cleansing Agents (DSC-4: Industrial Chemistry -II)	04	02	0	02	Class 12 <sup>th</sup> Pass	----

#### Learning Objectives

- After studying this course, student shall be able to understand the different aspects of industrial processes of fossil fuels in detail.
- Optimised use of limited resources of non-renewable energy and technology investment in improving the production of renewable cleaner energy sources and biofuels.
- The analytical approach of this course is to enhance the reasoning and to understand the mechanical part of the industry.

#### Learning outcomes

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

- Know about fuels, composition, carbonization of coal, liquefaction, and coal tar based chemicals and layout for key processes in oil refining.
- Understand the role of petroleum and petrochemical industry, composition, applications, process-cracking. Increasing demand for non-petroleum fuels, synthetic fuels.
- Understand different fossil fuel products and processes
- Know types of oils, familiarized with rancidity, saponification value, iodine number, Superiority of synthetic detergents, gain knowledge about surfactants.

#### SYLLABUS OF DSC-4

##### UNIT – I: Fuel Chemistry and Introduction to Coal

(10 Hours)

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Introduction of coal, uses of coal (fuel and non-fuel) in various industries (at least three examples), its types and composition, carbonization of coal. Coal gas, producer gas

and water gas—composition and their uses, uses of coal-tar based chemicals, Requisites of a good metallurgical coke, Coal liquefaction and Solvent refining.

#### **UNIT – II: Petroleum and Petrochemical Industry (12 Hours)**

Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional distillation (principle and process), Cracking (thermal and catalytic cracking), Reforming petroleum and non-petroleum fuels (LPG,CNG,LNG, bio-gas, biofuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels

#### **UNIT – III: Oils and Fats (8 Hours)**

Classification of oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, soap and synthetic detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS).

#### **Practical component- 60 Hours**

##### **Industrial Chemistry-II**

1. Determination of alkali in water samples and soaps.
2. Determination of iodine value of the oils/ fats.
3. Determination of saponification value of the oils/ fats.
4. Determination of acid value of the oils/ fats.
5. To determine the moisture content of different fuels.
6. Estimation of hardness of water by titration with soap solution.
7. Preparation of soap.
8. Preparation of biodiesel from waste cooking oil and its characterization.
9. To compare the viscosity of biodiesel and vegetable oil.
10. To determine the density of the given fuel sample.
11. Characterization of different petroleum products using UV and IR.

##### **Essential/recommended readings**

###### **Theory:**

1. Vermani, O. P.; Narula, A. K. (2004), **Industrial Chemistry**,Galgotia Publications Pvt. Ltd., New Delhi.
2. Bhatia, S. C. (2004), **Chemical Process Industries**, Vol. I & II, CBS Publishers, New Delhi.
3. Jain, P. C.; Jain, M. (2013), **Engineering Chemistry**, DhanpatRai& Sons, Delhi.
4. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), **Engineering Chemistry**, Vikas Publications.
5. Sharma, B. K. (1997), **Engineering Chemistry**, Goel Publishing House, Meerut.

###### **Practical:**

1. Verma, S. and Goyal, R. K. (2021) **Fuel Chemistry Theory and Practical**,1<sup>st</sup> Edition Aaryush Publications, Muzaffarnagar (U.P.)
2. Ahluwalia, V. K. and Aggarwal, R. **Comprehensive Practical Organic Chemistry, Preparation and Quantitative Analysis** ,University Press, New Delhi.



3. Sharma, R.K., Sidhwani, I.T., Chaudhari, M.K. (2013), **Green Chemistry Experiments: A monograph**, I.K. International Publishing House Pvt Ltd. New Delhi.

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

## DISCIPLINE SPECIFIC CORE COURSE –DSC 5: Periodic Properties and Chemical bonding

### 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		
<b>Periodic Properties and Chemical bonding (DSC-5: Chemistry -II)</b>	<b>04</b>	<b>02</b>	<b>0</b>	<b>02</b>	<b>Class XII Pass</b>	---

#### Learning Objectives

- The course discusses the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry.
- It provides basic knowledge about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases.
- It provides an overview of hydrogen bonding and van der Waal's forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds

#### Learning outcomes

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

- Understand periodicity in ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
- Understand variability in oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes
- Understand the concept of lattice energy using Born-Landé expression.
- Draw Born Haber Cycle and analyse reaction energies.
- Draw the plausible structures and geometries of molecules using VSEPR theory.
- Understand and draw MO diagrams (homo- & hetero-nuclear diatomic molecules).
- Understand the importance and applications of hydrogen and van der Wall bonding.

#### SYLLABUS OF DSC- 5

##### UNIT – I: Periodic Properties

**(12 Hours)**

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect.

General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Enthalpy of Atomization, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes

### UNIT – II: Chemical bonding

(18 Hours)

**Ionic Bonding:** General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Landé equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**Covalent Bonding:** Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1<sup>st</sup> and 2<sup>nd</sup> periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.

Brief introduction to Metallic Bonding, Hydrogen Bonding, van der Waal's Forces

### Practical component – 60 Hours

#### Chemistry-II,

1. Preparation of standard solutions.
2. Estimation of Sodium carbonate with HCl.
3. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.
4. Estimation of Mohr's salt by titrating it with KMnO<sub>4</sub>.
5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO<sub>4</sub>.
6. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using internal and external indicators.
7. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.
8. Chromatographic separation of mixture of metal ions Cu<sup>2+</sup>, Cd<sup>2+</sup> or Ni<sup>2+</sup>, Co<sup>2+</sup>.
9. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using
  - a. internal indicator
  - b. external indicator
10. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.
11. Paper Chromatographic separation of mixture of metal ions
  - a. Cu<sup>2+</sup>, Cd<sup>2+</sup>
  - b. Ni<sup>2+</sup>, Co<sup>2+</sup>
12. Any suitable experiment (other than the listed ones) based upon neutralisation/redox reactions.

### Essential/recommended readings

#### Theory:

9. Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry- Principles of Structure and Reactivity**, Pearson Education
10. Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), **Inorganic Chemistry** 2nd Ed., Oxford University Press.

11. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Inorganic Chemistry**, 5th Edition, W. H. Freeman and Company.
12. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India
13. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
14. Wulfsberg, G (2002), **Inorganic Chemistry**, Viva Books Private Limited.
15. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

**Practical:**

1. 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 mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

## DISCIPLINE SPECIFIC CORE COURSE – DSC 6: 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 (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Mechanics</b>  DSC - 6	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass with Physics and Mathematics as main subjects</b>	<b>Physics and Mathematics syllabus of class XII</b>

#### 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 a wire, 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 travelling microscope.
- 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 due to 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, Asia Publishing 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, McGraw Hill 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  
OFFERED BY DEPARTMENT OF CHEMISTRY**

**GENERIC ELECTIVES -12: Coordination and Organometallic Compounds**

**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		
Coordination and Organometallic Compounds (GE-2)	4	2	0	2	Class XII Pass	---

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To introduce students to some important d-block metals and their compounds which they are likely to come across.
- To make students learn about organometallic compounds, a frontier area of chemistry providing an interface between organic and inorganic chemistry.
- To familiarize students with coordination compounds which find manifold applications in diverse fields.

**Learning outcomes**

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

- Familiarize with different types of organometallic compounds, their structures and bonding involved.
- Understand the nature of Zeise's salt and compare its synergic effect with that of carbonyls.
- Identify important structural features of tetrameric methyl lithium and understand the concept of multicenter bonding in these compounds
- Apply 18-electron rule to rationalize the stability of metal carbonyls and related species
- Use IR data to explain the extent of back bonding in carbonyl complexes
- Understand the terms, ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds
- Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes
- Understand the properties of coordination compounds and VBT and CFT for bonding in coordination compounds



- Explain the meaning of the terms  $\Delta_o$ ,  $\Delta_t$ , pairing energy, CFSE, high spin and low spin and how
- CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy

**Theory:**

**Unit 1: Coordination Chemistry**

**4 Hours**

Brief discussion with examples of types of ligands, denticity and concept of chelate. IUPAC system of nomenclature of coordination compounds (mononuclear and binuclear) involving simple monodentate and bidentate ligands.

**Unit 2: Bonding in coordination compounds**

**14 Hours**

Valence Bond Theory (VBT): Salient features of theory, concept of inner and outer orbital complexes of Cr, Fe, Co and Ni. Drawbacks of VBT.

**Crystal Field Theory:** Splitting of d orbitals in octahedral symmetry. Crystal field effects for weak and strong fields. Crystal field stabilization energy (CFSE), concept of pairing energy. Factors affecting the magnitude of  $\Delta_o$ .

Spectrochemical series. Splitting of d orbitals in tetrahedral symmetry. Comparison of CFSE for octahedral and tetrahedral fields, tetragonal distortion of octahedral geometry. Jahn-Teller distortion, square planar coordination.

**Unit 3: Organometallic Compounds**

**12 Hours**

Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structure and bonding of methyl lithium and Zeise's salt. Structure and physical properties of ferrocene. 18-electron rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals.  $\pi$ -acceptor behaviour of carbon monoxide (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

**Practicals:**

**60 Hours**

**1. Gravimetry**

**Discuss basic principles of gravimetry (precipitation, co-precipitation and post precipitation, digestion, washing etc)**

- Estimation of Ni(II) using dimethylglyoxime (DMG).
- Estimation of copper as CuSCN.
- Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)<sub>3</sub> (aluminium oxinate).

**2. Inorganic Preparations**

- (i) Schiff's base involving ethylenediamine and salicylaldehyde (or any other amine and aldehyde/ketone) and to check its purity using TLC.
- (ii) Nickel/ Copper complex of the above prepared Schiff's base and its characterisation using UV/Vis spectrophotometer. The IR spectra also to be interpreted
- (iii) tetraamminecopper (II) sulphate
- (iv) potassium trioxalatoferrate (III) trihydrate.
- (v) tetraamminecarbonatocobalt(III) nitrate

### References:

### Theory:

1. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, W. H. Freeman and Company.
2. Miessler, G. L.; Fischer P.J.; Tarr, D.A. (2014), **Inorganic Chemistry**, Pearson.
3. Huheey, J.E.; Keiter, E.A., Keiter; R.L., Medhi, O.K. (2009), **Inorganic Chemistry- Principles of Structure and Reactivity**, Pearson Education.
4. Pfennig, B. W. (2015), **Principles of Inorganic Chemistry**. John Wiley & Sons.
5. Cotton, F.A.; Wilkinson, G. (1999), **Advanced Inorganic Chemistry** Wiley-VCH.

### 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. Schiff Base Complex of Cu (II) with Antibacterial and Electrochemical Study, Arjun C. Bhowmick, Majharul I. Moim, Miththira Balasingam , **American Journal of Chemistry** 2020, 10(2): 33-37, DOI: 10.5923/j.chemistry.20201002.03

**Keywords:** Organometallic compounds, metal carbonyls, synergistic effect, Coordination compounds, VBT, Crystal field theory, Splitting of d levels, Dq

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

**GENERIC ELECTIVES -13: – CHEMISTRY OF OXYGEN CONTAINING  
FUNCTIONAL GROUPS AND THEIR APPLICATIONS TO BIOLOGY**

**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 Oxygen containing Functional Groups and their Applications to Biology (GE-5)	4	2	0	2	Class XII Pass	----

**Learning Objectives**

- To teach the fundamental chemistry of oxygen containing functional groups.
- To establish these concepts typical reactions of alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives.
- To make students understand the relevance of oxygen containing functional groups to biology and the importance of these compounds in real world.

**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 reaction chemistry.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Understand the applications of functional group chemistry to biology.

**Syllabus - Theory:**

**Unit 1: Alcohols (upto 5 Carbon)**

**5 Hours**

Structure and classification of alcohols as 1<sup>o</sup>, 2<sup>o</sup> & 3<sup>o</sup>, Reactions: Acidic character of alcohols and reaction with sodium, with HX (Lucas Test), esterification, oxidation (with PCC, alkaline KMnO<sub>4</sub>, acidic K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and conc. HNO<sub>3</sub>), Oppeneauer Oxidation, Biological oxidation Reactions

**Unit 2: Phenols****4 Hours**

Acidity of phenols and factors affecting their acidity, Reactions: Electrophilic substitution reactions, viz. nitration, halogenation, sulphonation, Reimer-Tiemann reaction, Gattermann-Koch reaction, Houben-Hoesch condensation; Reaction due to OH group: Schotten-Baumann reaction

**Unit 3: Aldehydes and Ketones (Aliphatic and Aromatic)****12 Hours**

Reactions: Nucleophilic addition, nucleophilic addition-elimination reaction including reaction with HCN, ROH, NaHSO<sub>3</sub>, NH<sub>2</sub>-G derivatives. Iodoform test, Aldol condensation and its biological application, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemmensen reduction, Wolff Kishner reduction, Meerwein-Ponndorf Verley reduction, enzyme-catalyzed additions to  $\alpha,\beta$ -unsaturated carbonyl compounds.

**Unit 4: Carboxylic acids and their derivatives (Aliphatic and Aromatic)****9 Hours**

Reactions: Hell-Volhard Zelinsky reaction, acidity of carboxylic acids, effect of substitution on acid strength, Claisen condensation and its biological applications, decarboxylation in biological systems, relative reactivities of acid derivatives towards nucleophiles, activation of carboxylate ions for nucleophilic acyl substitution reactions in biological systems, Reformatsky reaction, Perkin condensation.

**Practicals: :****60 Hours**

Preparations: (Mechanism of various reactions involved to be discussed) (Recrystallization, determination of melting point and calculation of quantitative yields to be done in all cases)

1. Oxime of aldehydes and ketones
2. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
3. Aldol condensation using green method.
4. Benzoin condensation using Thiamine Hydrochloride as a catalyst.
5. Alkaline hydrolysis of amide/ester.
6. Benzoylation of one of the following amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) or one of the following phenols ( $\beta$ -naphthol, resorcinol, *p*-cresol) by Schotten-Baumann reaction.
7. Identification of functional group for monofunctional organic compounds (Alcohols, phenols, aldehydes, ketones, carboxylic acids).

**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**, 7<sup>th</sup> Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Mehta B.; Mehta M. (2015), **Organic Chemistry**, PHI Learning Private Limited Bahl,
5. Bahl, A., Bahl, B. S. (2012), **Advanced Organic Chemistry**, S. Chand.
6. Bruice, Paula Y. (2020), **Organic Chemistry**, 8<sup>th</sup> Edition, Pearson.

**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.

**Keywords:** Alcohols, Lucas Test, Phenol, Aldehydes, Ketones, Nucleophilic addition, nucleophilic addition – elimination, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Enzyme-catalysed reaction, Carboxylic acid, Claisen condensation

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

## GENERIC ELECTIVES-14: MOLECULES OF 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		
Molecules of Life (GE-6)	4	2	0	2	Class XII Pass	----

#### Learning Objectives

- To deliver information about the chemistry of carbohydrates, proteins & enzymes and its relevance in the biological system using suitable examples.
- To place key emphasis on understanding the structural principles that govern reactivity/physical /biological properties of biomolecules as opposed to learning structural details.

#### Learning outcomes

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

- Learn and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses.
- Gain an insight into the mechanism of enzyme action and inhibition.
- Understand the basic principles of drug-receptor interaction and SAR.

#### Syllabus - Theory:

##### Unit 1: Carbohydrates

**12 Hours**

Classification of carbohydrates, reducing and non-reducing sugars, biological functions, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, determination of configuration of glucose (Fischer proof), cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharides: structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

##### Unit 2: Amino Acids, Peptides and Proteins

**10 Hours**

Classification of amino acids and biological uses of amino Acids, peptides and proteins. Zwitterion structure, isoelectric point and correlation to acidity and basicity of amino acids. Determination of primary structure of peptides, determination of N-terminal amino acid (by

Edman method) and C-terminal amino acid (with carboxypeptidase enzyme). Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl) & C-activating groups (only DCC) and Merrifield solid phase synthesis, Overview of primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins.

### Unit 3: Enzymes and correlation with drug action

08 Hours

Classification of enzymes and their uses (mention Ribozymes). Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and non-competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group, –NH<sub>2</sub> group, double bond and aromatic ring.

### Practicals:

(60 Hours)

1. Estimation of glucose by Fehling's solution.
2. Determination of total sugar content by ferricyanide method (volumetric/colorimetric method).
3. Study of the titration curve of glycine.
4. Estimation of proteins by Lowry's method.
5. Study of the action of salivary amylase on starch under optimum conditions.
6. Qualitative tests for amino acids, proteins and carbohydrates.
7. Separation and identification of mixture of sugars by paper chromatography.

### References:

#### Theory:

1. Finar, I. L. **Organic Chemistry** (Volume 1 & 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7<sup>th</sup> Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Berg, J. M.; Tymoczko, J. L.; Stryer, L. (2019), **Biochemistry**, 9<sup>th</sup> Ed., W. H. Freeman Co Ltd.

#### 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. **Manual of Biochemistry Workshop**, 2012, Department of Chemistry, University of Delhi.

#### Teaching Learning Process:

- Chalk and black board method. Along with pedagogy of flipped classroom

- Certain topics like mechanism of enzyme action and enzyme inhibition can be taught through audio-visual aids.
- Students should be encouraged to participate actively in the classroom through regular presentations on curriculum-based topics, peer assessment, designing games based on specific topics etc.
- As the best way to learn something is to do it yourself, practicals are planned in such a way so as to reinforce the topics covered in theory.

**Assessment Methods:**

- Graded assignments
- Class tests and Quizzes
- Class seminars by students on course topics with a view to strengthening the content through width and depth
- Continuous evaluation for the practicals
- End semester university theory and practical examination.

**Keywords:** Carbohydrates, point, Amino acids, Enzymes, SAR, Drug Receptor Theory

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



## GENERIC ELECTIVES -15 : CHEMICAL KINETICS AND PHOTOCHEMISTRY

### 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		
Chemical Kinetics and Photochemistry <b>(GE-8)</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII Pass</b>	-----

#### Learning Objectives

- To make students learn about the fundamentals of chemical kinetics, rates of chemical reactions, complex reactions, theories of reaction rate and the laws of photochemistry aimed at understanding electronic transitions upon irradiation of electromagnetic radiation in UV-Vis region.

#### Learning outcomes

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

- Understand the concept of rate of a reaction, order and molecularity of a reaction, various factors affecting the rate and theories of reaction rates.
- Students will be able to apply the learnt concepts in studying the reaction kinetics of various reactions.
- Understand the basic concepts of photochemistry, photochemical and photosensitized reactions and their role in biochemical systems.

#### Syllabus - Theory:

##### Unit 1: Chemical Kinetics

**20 Hours**

The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants), half-life of a reaction, general methods for determination of order of a reaction. kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate

equations (steady-state approximation in reaction mechanisms). Concept of activation energy and its calculation from Arrhenius equation. Theories of reaction rates: Collision theory and activated complex theory of bi-molecular reactions. Comparison of the two theories (qualitative treatment only)

## **Unit 2: Photochemistry**

**10 Hours**

Characteristics of electromagnetic radiation, Jablonski Diagram. Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes.

### **Practicals:**

**(60 Hours)**

#### **Chemical Kinetics**

Study the kinetics of the following reactions by integrated rate method:

- a) Acid hydrolysis of methyl acetate with hydrochloric acid.
- b) Compare the strength of HCl and H<sub>2</sub>SO<sub>4</sub> by studying the kinetics of hydrolysis methyl acetate.
- c) Initial rate method: Iodide-persulphate reaction
- d) Integrated rate method: Saponification of ethyl acetate.
- e) Study the reaction kinetics of Iodination of acetone.

### **References:**

#### **Theory:**

1. Castellan, G.W. (2004), **Physical Chemistry**, Narosa.
2. Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol 5, 6<sup>th</sup> Edition, McGraw Hill Education.
3. Kapoor, K.L. (2013), **A Textbook of Physical Chemistry**, Vol 6, 3<sup>rd</sup> Edition, McGraw Hill Education.

#### **Practicals:**

1. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), **Senior Practical Physical Chemistry**, R. Chand & Co.

#### **Teaching Learning Process:**

- Teaching Learning Process for the course is visualized as largely student-focused
- Transaction through an intelligent mix of conventional and modern methods
- Engaging students in cooperative learning.
- Learning through quiz design.
- Problem solving to enhance comprehension.

**Assessment Methods:** Assessment will be done on the basis of regular class test, presentations and assignments as a part of internal assessment during the course as per the curriculum. End semester university examination will be held for both theory and practical. In practical,

assessment will be done based on continuous evaluation, performance in the experiment on the date of examination and viva voce.

**Keywords:** Rate Law, Rate constant. Arrhenius Equation, Lambert-Beer's law, Jablonski Diagram

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

## GENERIC ELECTIVES -16: BASICS OF POLYMER 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		
Basics of Polymer Chemistry (GE-10)	4	2	0	2	Class XII Pass	-----

#### Learning Objectives

- To help the student to know about the synthesis, properties and applications of polymers.

#### Learning outcomes

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

- Know about classification of polymeric material.
- Learn about different mechanisms of polymerization and polymerization techniques
- Evaluate kinetic chain length of polymers based on their mechanism
- Differentiate between polymers and copolymers
- Learn about different methods of finding out average molecular weight of polymer.
- Differentiate between glass transition temperature (T<sub>g</sub>) and crystalline melting point (T<sub>m</sub>)
- Learn properties and applications of various useful polymers in our daily life

#### Syllabus Theory:

##### Unit 1: Introduction to polymers

**10 Hours**

Different schemes of classification of polymers, Polymer nomenclature, configuration and conformation of polymers, Molecular forces and chemical bonding in polymers, Texture of Polymers

##### Functionality and its importance:

Criteria for synthetic polymer formation, basic methods of polymerization processes and their mechanism: addition, condensation, Relationships between functionality, extent of reaction and degree of polymerization.

## **Unit 2: Properties of Polymers**

**10 Hours**

Glass transition temperature ( $T_g$ ) and determination of  $T_g$ , Free volume theory, WLF equation, Factors affecting glass transition temperature ( $T_g$ ).

Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity,

Morphology of crystalline polymers, Factors affecting crystalline melting point.

Molecular weight distribution and determination of molecular weight of polymers ( $M_n$ ,  $M_w$ , etc.) by end group analysis, viscometry and osmotic pressure methods. Molecular weight distribution and its significance.

## **Unit 3: Preparation, properties and applications**

**10 Hours**

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride), poly(vinyl acetate), acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novolac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers: polyacetylene, polyaniline, poly(p-phenylene sulphide), polypyrrole, polythiophene

## **Practicals:**

**(60 Hours)**

### **Polymer Synthesis**

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA)/MethylAcrylate (MA).
2. Preparation of nylon 6,6
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resole resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

### **Polymer characterization**

1. Determination of molecular weight of polyvinyl propylidene in water by viscometry.
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of head-to-head monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis of polymethacrylic acid.

### **Polymer analysis**

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method.
2. Determine the melting point of crystalline polymer.
3. Measurement of glass transition temperature,  $T_g$ s

**References:****Theory:**

1. Carraher, C. E. Jr. (2013), **Seymour's Polymer Chemistry**, Marcel Dekker, Inc.
2. Odian, G. (2004), **Principles of Polymerization**, John Wiley.
3. Billmeyer, F.W. (1984), **Text Book of Polymer Science**, John Wiley.
4. Ghosh, P. (2001), **Polymer Science & Technology**, Tata Mcgraw-Hill.
5. Lenz, R.W. (1967), **Organic Chemistry of Synthetic High Polymers**, Interscience (Wiley).

**Practical:**

1. Allcock, H.R.; Lampe, F. W.; Mark, J. E. (2003), **Contemporary Polymer Chemistry**, Prentice-Hall.
2. Fried, J.R. (2003), **Polymer Science and Technology**, Prentice-Hall.
3. Munk, P.; Aminabhavi, T. M. (2002), **Introduction to Macromolecular Science**, John Wiley & Sons.
4. Sperling, L.H. (2005), **Introduction to Physical Polymer Science**, John Wiley & Sons.

**Teaching Learning Process:**

- Student centred teaching Learning process.
- Blend of conventional blackboard teaching and modern teaching learning tools
- Focus on real life applications of concepts
- Problem solving and quizzes for enhanced understanding of the concepts
- Engaging students in collaborative learning.
- Pre-lab learning of theoretical concept of the experiment.
- Performing the experiment, recording the data, calculating the result.
- Interpreting the result.
- Comparing the results of the class.
- Discussing the sources of error.

**Assessment Methods:**

- Class Tests at Periodic Intervals.
- Written assignment(s)
- Continuous evaluation of laboratory work and record file.
- Oral assessment, quizzes.
- Mock practical examination.
- Semester end University examination.

**Keywords:** Bonding, Texture, Polymerization, Crystallization, Properties, Applications.

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

**GENERIC ELECTIVES 17: CHEMISTRY: MOLECULAR MODELLING,  
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

**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: Molecular Modelling, Artificial Intelligence and Machine Learning (GE-14)	4	2	0	2	Class XII Pass	----

**Learning Objectives**

- To make students familiar with modern scientific machine (programming) language i.e., Python, Artificial Intelligence (AI) & Machine Learning (ML) and their potential applications in chemistry.
- To provide elementary ideas of the techniques prevailing in the field of AI and ML and their applications to research problems especially related to research and development of new materials and pharmaceutical compounds with desired properties.

**Learning outcomes**

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

- Conversant with the Python Programming Language.
- Familiar with Elementary techniques of AI and ML
- Able to apply techniques of AI & ML in basic problems of research in some important areas of research in Chemistry.

**Syllabus Theory:**

**Part A: Molecular Modelling**

**Introduction to computational chemistry:**

**7 Hours**

Overview of Computational Methods in Chemistry (Ab initio, DFT, Semi-empirical, Molecular Mechanics)

**Potential Energy Surfaces**

**4 Hours**

The concept of Potential energy surface, Intrinsic Reaction Coordinates, Stationary points,

Equilibrium points – Local and Global minima, Geometry optimization and energy minimization.

### **Molecular Mechanics**

**4 Hours**

Force Fields (A brief idea of a basic force field), Elementary idea of MM1, MM2, MM3, MM4, MM+, AMBER etc. A brief Idea of Molecular Docking

### **Part B: Artificial Intelligence & Machine learning in Chemistry**

**15 Hours**

An overview of computationally readable and processible representation of molecules, e.g., SMILES, mol files. Chemical space and access to chemical databases. Statistical treatment of data: regression analysis and types of regression. Elementary Idea of Quantitative structure-activity relationship (QSAR).

An insight into Artificial Intelligence & Machine learning and potential areas of applications in chemistry. Dimensional reduction; Principal Component Analysis (PCA) and the importance and necessity of nonlinearity in Artificial Intelligence.

Genetic algorithm, basics of random mutation hill climbing (RMHC) and simulated annealing.

### **Practicals:**

**(60 hours)**

#### **Molecular Modeling based Exercise**

- 1) Write the Z-Matrix of a given set of molecules.
- 2) Carry out geometry optimisation on H<sub>2</sub>O, H<sub>2</sub>S, H<sub>2</sub>Se molecules and compare the optimized bond angles and dipole moments from the results obtained. Obtain the ESP-mapped density surfaces and interpret the results obtained with reference to bonding in these molecules.

**Suggestive:** A comparative analysis of results of the above exercise may be carried out using different quantum mechanical methods.

- 3) Calculate the energy of the following chemical species and arrange them in order of increasing stability.

1-hexene, 2-methyl-2-pentene, (E)-3-methyl-2-pentene, (Z)-3-methyl-2-pentene, and 2,3-dimethyl-2-butene in order of increasing stability.

- 4) Carry out the geometry optimisation on the following chemical species and compare the shapes and dipole moments of the molecules.

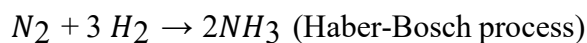
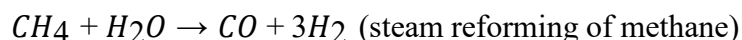
1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol.

Correlate the computationally obtained values of the dipole moments with the experimental values of the boiling points: (118 °C, 100 °C, 108 °C, 82 °C, of 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol respectively).

- 5) Based on the implicit electronic structure calculations, determine the heat of hydrogenation of Ethene.
- 6) Based on the calculations of enthalpies of the participating chemical species on



optimized geometry of the molecules, calculate the reaction enthalpy at 298 K for the following, industrially important reactions:



- 7) Carry out geometry optimisation and determine the energy of the participating chemical species in the following reactions Using these results calculate the resonance energy of thiophene.
- 8) Carry out geometry optimization & energy calculations on the following species and obtain Frontier Molecular Orbitals. Visualize the Molecular Orbitals of these species and interpret the results for bonding in these molecules.

Benzene, Naphthalene, and Anthracene.

- 9) Compare the gas phase basicities of the methylamines by comparing the enthalpies of the following reactions:
- 10) On the basis of results of geometry optimization and energy calculations, determine the enthalpy of isomerization of cis and trans 2-butene.
- 11) QSAR based exercise on problems of interest to chemist.
- 12) Perform a conformational analysis of butane. Plot the graph between the angle of rotation and the energy of the conformers using spreadsheet software.
- 13) Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.
- 14) Perform a geometry optimization followed by a frequency assessment (opt+freq keyword) using the B3LYP method and 6-31-G(d) basis set on a given set of small molecules i.e.  $\text{BH}_3$ ,  $\text{CH}_4$ .

**Suggestive:** A greater number of molecules may be studied as per instructions received from the concerned teacher.

- 15) Based on the fundamentals of conceptual DFT calculate the ionization potential (IP), electron affinity (EA), electronegativity and electron chemical potential of a given set of molecules.
- 16) Perform molecular docking of Sulfonamide-type D-Glu inhibitor into MurD active site using Argus lab.

**Artificial Intelligence (AI) and Machine Learning (ML) based exercise on problems of interest to chemist**

17. Travelling salesman problem and electrical circuit design (minimization of path-length).
- 18 Genetic algorithm, in solving matrix form of linear equations
- 19 Non-linear least-square fitting problem.
- 20 Particle Swarm Optimization on the sphere function.

**Important Instruction Note on working approach:**

- A student is required to perform/investigate a minimum of 10 exercises in total.
- The exercises mentioned above will be performed by the student strictly in accordance with the instructions received and only under the supervision of the teacher concerned.
- Any other exercise may be carried out with prior permission, input, discussion and instructions received from the teacher concerned.

### References:

1. Lewars, E. (2003), **Computational Chemistry**, Kluwer academic Publisher.
2. Cramer, C.J. (2004), **Essentials of Computational Chemistry**, John Wiley & Sons.
3. Cartwright C.; Khanna N., (2008), **Using artificial intelligence in chemistry and biology**, First Edition, CRC Press Taylor & Francis Group
4. Hippe; Z., **Artificial Intelligence in Chemistry: Structure Elucidation and Simulation of Organic Reactions**, (1991) Academic Press, Elsevier
5. Soft Computing in Chemical and Physical Sciences A Shift in Computing Paradigm (Kanchan Sarkar, Sankar Prasad Bhattacharyya) (z-lib.org)
6. Understanding Properties of Atoms, Molecules and Materials (PRANAB. SARKAR, Sankar Prasad Bhattacharyya) (z-lib.org)

### Web Resources:

1. [https://www.afs.enea.it/software/orca/orca\\_manual\\_4\\_2\\_1.pdf](https://www.afs.enea.it/software/orca/orca_manual_4_2_1.pdf)
2. <https://dasher.wustl.edu/chem430/software/avogadro/learning-avogadro.pdf>
3. <http://www.arguslab.com/arguslab.com/ArgusLab.html>
4. <https://barrett-group.mcgill.ca/tutorials/Gaussian%20tutorial.pdf>
5. <https://gaussian.com/techsupport/>
6. <https://gaussian.com/man/>
7. <https://gaussian.com/wp-content/uploads/dl/gv6.pdf>
8. <https://dasher.wustl.edu/chem478/software/spartan-manual.pdf>
9. <http://www.mdtutorials.com/gmx/>
10. <https://vina.scripps.edu/manual/>

**Teaching Learning Process:** Hands-on laboratory exercises Conventional teaching learning method. Engaging students in collaborative learning

**Keywords:** Molecular Modeling, Potential Energy Surface (PES), Geometry Optimization, Frequency calculation, Artificial Intelligence, Machine Learning, Neural Networks, Genetic Algorithm.

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

## GENERIC ELECTIVES 18: ROLE OF METALS IN MEDICINES

### 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		
Role of Metals in Medicines <b>(GE-16)</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII Pass</b>	----

#### Learning Objectives

- To make the learners familiar about role of metal ions in some commercially available medicines.

#### Learning outcomes

By the end of this course student will be able to learn:

- Role of metal ions in various biomolecules and their functions.
- Role of metals in commercially available medicines and their functions

#### Syllabus Theory:

##### Unit 1: Bio role of Metals

**04 Hours**

Brief introduction of following metals in biological system

Fe, Cu, Zn, Mn, Cr(III), V, Mo, W, Co, Ni, Na, K, Mg and Ca

*Chemical structure, Commercial name, Name of the disease it is made for and its brief mechanism of action shall be taught for all the mentioned metals below.*

##### Unit 2: Diagnostic and therapeutic agents

**08 Hours**

Diagnostic and therapeutic agents with Pt (Cisplatin) and Ga for cancer, Au (auranofin) for arthritis and V for diabetes.

##### Unit 3: Metals in drugs

**06 Hours**

Li<sub>2</sub>CO<sub>3</sub> (Camcolit) for manic-depressive illness, NaHCO<sub>3</sub> (Alka-seltzer) for heartburn, Al(OH)<sub>3</sub> (Gaviscon) for heartburn, As (melarsoprol) for sleeping sickness, Bi subsalicylate (pepto-Bismol) for heartburn and diarrhea, Bi subcitrate (De-nol) peptic ulcer, Zinc oxide with Fe<sub>2</sub>O<sub>3</sub> (Calamine lotion) as antimicrobial agent.

**Unit 4: Metals in Multivitamins****06 Hours**

Cyanocobalamin (Co), Ferrous fumerate (Fe), Magnesium oxide (Mg), Zinc Sulfate (Zn), Manganese sesulphate (Mn), Copper Sulfate (Cu), Sodium selenite (Se) and Chromium trichloride (Cr).

**Unit 5: Radiopharmaceuticals and MRI contrast agents****06 Hours**

$^{99m}\text{Tc}$  for heart, brain and bone imaging,  $^{123}\text{I}$  radiopharmaceuticals,  $\text{BaSO}_4$  for X-ray contrast agent, Gd (III) for MRI contrast agents.

**Practicals:****(60 hours)****Volumetric titrations:**

1. To estimate the acidity of commercially available antacids.
2. To estimate the concentration of Fe in commercially available medicines.
3. To estimate the concentration of Ca in commercially available medicines.
4. To estimate the strength of carbonate in tablets containing  $\text{Li}_2\text{CO}_3$
5. To estimate the sodium bicarbonate in synthetic/commercially available drug.
6. To estimate the zinc and iron present in Calamine lotion.
7. To estimate the Mg present in multivitamins.

**References:**

1. **Metals in Medicine**, John Wiley & Sons Ltd, Nov 2009
2. Chapter-9, **Metals in Medicine**, Stephen J. Lippard
3. Jones, Chris and Thornback, John, **Medicinal applications of coordination chemistry**, Cambridge, UK: Royal Society of Chemistry, 2007

**Teaching Learning Process:**

- Hands-on laboratory exercises
- Conventional teaching learning method. Engaging students in collaborative learning

**Assessment Methods:**

- Continuous evaluation of laboratory work and record file. Oral assessment, quizzes.
- Presentation on lab practices.
- Semester end examination.

**Key words:** Diagnostic, therapeutic agents, multivitamins, radiopharmaceuticals and MRI contrast agents.

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

## GENERIC ELECTIVES -19: ENERGY AND THE 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		
Energy and the Environment (GE-17)	4	3	0	1	Class XII Pass	---

### Learning Objectives

- To develop basic understanding of energy, issues related to energy, importance of energy in terms of economy, health and the environment.
- To understand different sources of energies, renewable and non-renewable sources of energy. To understand the importance of green fuels.
- To make the students understand the adverse effect of pollution, and possible remediations.

### Learning Outcomes

By the end of this course student will be able to learn:

- Describe basic energy concepts
- Account for conventional and renewable energy technologies and their application
- Reflect and evaluate the environmental impact of energy production and the relationship between energy production, consumption and climate change
- Reflect on energy costs, analyse the consequences of today's energy consumption
- Efficient use of energy, water and other resources, Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Good indoor environmental air quality, Use of materials that are non-toxic, ethical and sustainable
- Consideration of the environment in design, construction and operation

## **Syllabus Theory:**

### **Unit 1:**

**13 Hours**

Introduction, chemistry and energy, conversion of chemical energy to electrical energy, Carbon cycle, Greenhouse gases, Global warming and climate change, Carbon footprint, zero-carbon or low-carbon energy. Electrical energy and steam energy, Energy Alternatives, Hidden Costs of Energy.

### **Unit 2:**

**10 Hours**

Production methods for electric power: Non-Renewable (conventional) sources of energy: Fossil fuels: Coal, petroleum and Natural gas. Energy transformation. Renewable energy sources: solar, hydropower, wind, geothermal, wave, ocean thermal, tidal, ocean currents, nuclear energy, biomass.

### **Unit 3:**

**12 Hours**

Production methods for electric power: Renewable (green) energy, conversion and storage systems. Nuclear fusion, Hydrogen fuels, photovoltaic solar cells, hydroelectric. Sustainable energy, biomass, Biofuels, production of biofuels, advantages, blending of biofuels with conventional fuels, Carbon Capture and Reuse, Waste to Energy Technologies.

### **Unit 4:**

**10 Hours**

Air Pollution, Urban and Indoor Air Pollution, Pollution and waste reduction measures, chemical remediation of air pollution. Effect of pollution on health and economy.

### **Practicals:**

**(30 Hours)**

#### Tutorials

1. Conversion of biomass to biofuels (2-3 different biofuels)
2. Working on solar cell model.
3. Working on wind turbine model.
4. Working on geothermal energy model.
5. Working on hydroelectric plant model.
6. Presentations by students

### **References:**

#### **Theory**

1. Rao, C S., **Environment pollution control Engineering**, New Age International reprint 2015, 2<sup>nd</sup> edition
2. Bharucha, E., **Textbook of Environmental Studies**, Universities Press (2005)
3. Wright, R.T., **Environmental Science-Towards a sustainable Future**, Prentice Hall (2008) 9<sup>th</sup> edition.
4. Ahluwalia, V. K., **Energy and Environment**, The Energy and Resources Institute (TERI) (2019).

**References:****Practicals**

- Challapalli Narayan Rao, **Practical approach to implementation of Renewable Energy Systems**, Evincepub Publishing, 2022

**Keywords:** Energy, Renewable and non-renewable energy resources, Synthetic fuels, Biofuels, Carbon footprint, air pollution, remediation, pollution related health and economy.

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

**GENERIC ELECTIVES -20 : CHEMISTRY OF FRAGRANCES AND FLAVOURS:  
AN INDUSTRY'S PERSPECTIVE**

**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 Fragrances and Flavours: An Industry's Perspective <b>(GE-18)</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>Class XII Pass</b>	----

**Learning Objectives**

- To make the students understand the applications of chemistry in the world of flavours and fragrances. The use of fragrance is ubiquitous and is a global human phenomenon. Over the course of time, countless numbers of flavors and fragrances have found their way into everyday life, notably into foods, beverages and confectionery items; into personal care products (soaps, toothpastes, mouthwashes, deodorants, bath lotions and shampoos), perfumes, and other cosmetics as well as pharmaceutical formulations. Indeed, flavors and aromas are added to make such products more attractive or to mask the taste or smell of less pleasant ones.

**Learning Outcomes**

By the end of this course student will be able to learn:

- Synthesis of various fragrance and flavour ingredients
- Formulation methods, how different factors affects the formulation process in Fragrance and Flavour industry
- Uphold safety regulation and execute quality processes
- Quality control in manufacturing process, legal aspects, classification of odour and odorants.
- Different methods used for separation, purification and isolation of perfumes and flavours like distillation, extraction, crystallization, etc.



## Syllabus Theory:

### Unit 1: Fragrances

18 Hours

- Introduction to fragrances, types of fragrances (Fragrance families and classification)
- History of perfumes, Perfumery raw materials, classification of odour, odour type and odorants
- India in the context of Fragrance Industry
- ABCs of perfumery, odour aspects of perfumes, fragrance pyramid, fragrance families
- Some basic chemical knowledge to provide a better understanding of the structure of molecules possessing a sensory power, The volatility and solubility of sensory molecules
- Chemistry of aromatic compounds in perfume making, Composition of fragrances
- Current trends in fragrances, sensory analysis of different products
- Study of the raw materials used in perfumery (origin, extraction method, and olfaction)
- Key chemical reactions for conversion of raw materials to fragrances
- Extraction of essential oils used in perfumery
- Difference between alcohol and oil-based perfumes
- Outline of health, safety and sustainability parameters in perfumer

### Unit 2: Sustainable Fragrance by Design

4 Hours

- The challenges of sustainability and how it impacts the industry
- Sustainability charter
- Green chemistry principles
- Commitment to Biodiversity

### Unit 3: Flavours

18 Hours

- Introduction to flavours, types of flavours, flavour raw materials
- Understanding of terms like, Flavour and Flavouring agents. Attributes of flavour, taste, odour, odour stimulation, basic tastes and the human olfactory system.
- Stability of flavour in food, sensory evaluation of flavours in foods, Various flavour formulation
- Systematic approach to understanding flavour formation during food processing, food matrix, interaction of added flavours
- Flavour enhancers, modifiers, precursors, suppressors, solvents.
- Key chemical reactions for conversion of raw materials to flavours
- Forms of flavour and the manufacturing processes involving all types of flavours. Aroma recovery during processing.
- Biogenesis of flavours in fruits and vegetables, reaction flavours, off flavours.
- Stability of flavor in food, sensory evaluation of flavours in foods
- Selection and application of flavours in foods and beverages
- Legal aspects (natural flavours and natural flavouring substances, nature identical flavouring substances, artificial flavouring substances), and the FSSA act.

## Unit 4: Extraction, Isolation and Purification of Perfumes and Flavour Compounds

**05 Hours**

- Extraction techniques for the separation of volatile oils from natural source- including. Distillation, Evaporation, Crystallization and Adsorption, supercritical fluid extraction methods of isolation of important ingredients

### Practicals:

**(30 hours)**

1. Extraction of D-limonene from orange peel using liquid CO<sub>2</sub>.
2. Extraction of caffeine from coffee beans using liquid CO<sub>2</sub>.
3. Extraction of essential oils from lemon using steam distillation
4. Extraction of essential oils from lemon using liquid CO<sub>2</sub>.
5. Extraction of essential oils from fragrant flowers.
6. Determination of esters by Thin Layer Chromatography
7. Memorisation of different raw materials used in perfumery, perfume language, Memorisation of perfumes
8. Testing up of different flavours
9. Analysis of spectra of perfume formulations.

### References:

1. Arctander, S. (2008), **Perfume and flavour materials of Natural origin**, Allured Publishing Corporation, USA
2. Arctander, S. (2017), Volume I and II, **Perfume and Flavour Chemicals**, (Aroma Chemicals), Allured Publishing Corporation, USA
3. Curtis, T.; Williams, D. C. (2001) 2<sup>nd</sup> Edition, **An Introduction to Perfumery**, Micelle Press, USA.
4. Sell, C. (2008), **Understanding Fragrance Chemistry**, Allured Publishing Corporation, USA
5. Calkin, R.R., Jellinek, J.S., **Perfumery: Practice and Principles**, John Wiley & Sons Inc.
6. Gimelli, S.P. (2001), **Aroma Science**, Micelle Press, USA
7. Arctander, S. (2019), **Perfume and Flavour Materials of Natural Origin**, Orchard Innovations
8. <https://www.beyondbenign.org/lessons/essential-oil-extraction-using-liquid-co2/>

**Keywords:** Fragrances, Flavours, pharmaceutical formulation, distillation, extraction techniques

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

## GENERIC ELECTIVES -21 : GREEN 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		
Green Chemistry (GE-20)	4	2	0	2	Class XII Pass	----

#### Learning Objectives

Huge rise in environmental pollution, depleting resources, climate change, ozone depletion, heaps and heaps of landfills piling up has forced the society to become more and more environmentally conscious. Future chemists and innovators are compelled to work towards sustainable practices. Green chemistry has arisen from these concerns. It is not a new branch of chemistry but helps to improve the creative and innovative thinking in undergraduate students. Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Innovations and applications of green chemistry in education have helped companies to gain environmental benefits as well as to achieve economic and societal goals also. Undergraduate students are the ultimate scientific community of tomorrow. Training them to practice chemistry in the safest way possible is key towards safe working conditions in the laboratories as well as the chemical industry and extends to society in a sustainable future for the planet.

#### Learning Outcomes:

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

- Understand the twelve principles of green chemistry and also build the basic understanding of toxicity, hazard and risk related to chemical substances.
- Calculate atom economy, E-factor and relate them in all organic synthesis
- Appreciate the use of catalyst over stoichiometric reagents
- Learn to use green solvents, renewable feedstock and renewable energy sources for carrying out safer chemistry
- Appreciate the use of green chemistry in problem solving skills and critical thinking to innovate and find solutions to environmental problems.
- Learn to design safer processes, chemicals and products through understanding of inherently safer design (ISD)
- Appreciate the success stories and real-world cases as motivation for them to practice green chemistry

## Syllabus :

### Unit 1: Introduction

08 Hours

Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry.

- Need of green chemistry
- Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each).
- A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards).

### Unit 2: Twelve Principles of Green Chemistry

12 Hours

The twelve principles of the Green Chemistry with their explanation, Special emphasis on the following:

- Prevention of waste / byproducts, pollution prevention hierarchy.
- Green metrics to assess greenness of a reaction: environmental impact factor, atom economy and calculation of atom economy.
- Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources.
  - Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Green energy and sustainability.
- Real-time analysis for pollution prevention.
- Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation

### Unit 3:

10 Hours

The following Real-world Cases in green chemistry should be discussed: Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO<sub>2</sub> for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.

### Practical:

(60 Hours)

Characterization by melting point, UV-Visible spectroscopy, IR spectroscopy and any other specific method should be done (wherever applicable).

1. Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts.

2. Preparation of biodiesel from waste cooking oil and characterization (TLC, pH, solubility, combustion test, density, viscosity, gel formation at low temperature and IR can be provided).
3. Benzoin condensation using thiamine hydrochloride as a catalyst instead of cyanide.
4. Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared from dry ice.
5. Mechanochemical solvent free, solid-solid synthesis of azomethine using *p*-toluidine and *o*-vanillin/*p*-vanillin.
- 6 Microwave-assisted Knoevenagel reaction using anisaldehyde, ethylcyanoacetate and ammonium formate.
7. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.
8. Photochemical conversion of dimethyl maleate to dimethyl fumarate (*cis-trans* isomerisation)
9. Benzil- Benzilic acid rearrangement: Preparation of benzilic acid in solid state under solvent-free condition.

### References:

#### Theory:

1. Anastas, P.T., Warner, J.C. (2014), **Green Chemistry, Theory and Practice**, Oxford University Press.
2. Lancaster, M. (2016), **Green Chemistry: An Introductory Text**, 3<sup>rd</sup> Edition, RSC Publishing.
3. Cann, M. C., Connely, M.E. (2000), **Real-World cases in Green Chemistry**, American Chemical Society, Washington.
4. Matlack, A.S. (2010), **Introduction to Green Chemistry**, 2<sup>nd</sup> Edition, Boca Raton: CRC Press/Taylor & Francis Group publisher.
5. Alhuwalia, V.K., Kidwai, M.R. (2005), **New Trends in Green chemistry**, Anamalaya Publishers.
6. Sidhwani, I.T, Sharma, R.K. (2020), **An Introductory Text on Green Chemistry**, Wiley India Pvt Ltd.

#### Practical:

1. Kirchoff, M.; Ryan, M.A. (2002), **Greener approaches to undergraduate chemistry experiment**, American Chemical Society, Washington DC.
2. Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2013), **Green Chemistry Experiments: A monograph**, I.K. International Publishing House Pvt Ltd. New Delhi.
3. Pavia, D.L.; Lamponam, G.H.; Kriz, G.S.W. B. (2012), **Introduction to organic Laboratory Technique- A Microscale approach**, 4<sup>th</sup> Edition, Brooks-Cole Laboratory Series for Organic chemistry.
4. Sidhwani I.T. (2015), Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated. **DU Journal of Undergraduate Research and Innovation**, 1(1),131-151. ISSN: 2395-2334.
5. Sidhwani, I.T; Sharma, R.K. (2020), **An Introductory Text on Green Chemistry**, Wiley India Pvt Ltd.

6. **Monograph on Green Chemistry Laboratory Experiments**, Green Chemistry Task Force Committee, Department of Science and Technology, Government of India.

**Keywords:** Green chemistry, Twelve principles of green chemistry, Atom economy, Waste minimization, green metric, green solvents, Solvent free, Catalyst, Bio-catalyst, Renewable energy sources, Hazardous, Renewable feedstock, Ionic liquids, Supercritical fluids, Inherent safer design, green synthesis, combinatorial, Sustainable development, Presidential green chemistry awards.

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

**BHASKARACHARYA COLLEGE OF APPLIED SCIENCE**

**Category I**

**B.Sc. (Honours) 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		
Chemistry and Engineering of Polymer Reactions (CEPR)	4	3	0	1	12 <sup>th</sup> with PCM	--

**Learning Objectives**

- To learn about the different polymerizations
- To study kinetics of chain growth and step growth polymerization
- To understand general concepts, principles, kinetics and methodology of polymerization

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- Know about overview of aspects of polymer engineering
- Understand essential fundamentals and chemistry of the polymerization processes.
- Learn about various terms such as reaction initiation, propagation and termination

**SYLLABUS OF DSC-4**

**UNIT – I**

**06 Hours**

**INTRODUCTION**

Introduction to polymerization process, control of polymer synthesis; thermodynamic and kinetic control, diffusion control, polymer end chain control & control strategies, Introduction to reactor design, Interpretation of batch reactor data; design equations for ideal reactors, namely batch, CSTR, plug flow, design equation for single reaction systems using batch and semi batch, CSTR, PFR, Multiple reactor system; reactor in series and parallel, preference of type of reactor used

**UNIT – II**

**09 Hours**

**RADICAL CHAIN POLYMERIZATION**

Introduction, thermodynamic and kinetic aspect of radical chain polymerization, rate of polymerization, kinetic chain length, Mayo's equation, cage efficiency, selection criteria of initiators, ceiling temperature, Tromsdorff effect, inhibition and retardation Ziegler-Natta catalyst and stereoregular polymerizations, Radical chain copolymerization (reactivity ratio, copolymer equations)

### **UNIT – III**

**06 Hours**

#### **REDOX & OTHER INITIATIONS**

Initiation in aqueous media, initiation in non-aqueous media, rate of redox polymerization, photochemical initiation, rate of photo-polymerization, initiation by ionizing radiation, electrolytic polymerization, plasma polymerization.

### **UNIT – IV**

**09 Hours**

#### **IONIC CHAIN & CONTROLLED POLYMERIZATIONS**

Classification of ionic species, effect of solvents, initiation, propagation and termination in ionic polymerization, cationic polymerization, anionic polymerization, introduction of Atom Transfer Radical Polymerization (ATRP), Reversible Addition-Fragmentation Chain Transfer Polymerization (RAFT) and Nitroxide mediated polymerization (NMP)

### **UNIT – V**

**09 Hours**

#### **STEP GROWTH POLYMERIZATION**

Reaction engineering of step growth polymerization: basic properties & examples of commercially important polymers, reactivity of functional groups kinetics of step polymerization, self-catalyzed & external catalysis of polymerization, molecular weight distribution in linear & nonlinear polymerization, effect of non-equivalence of functional groups, equilibrium considerations,

### **UNIT – VI**

**06 Hours**

#### **POLYMERIZATION TECHNIQUES**

Bulk, solution, precipitation, suspension & emulsion polymerization.

### **Practical**

-

**30 Hours**

- To prepare polystyrene/poly(methyl methacrylate) by bulk polymerization and determine the rate of polymerization.
- To study the effect of reaction temperature on free radical polymerization of styrene/MMA.
- To study the effect on initiator concentration of free radical polymerization of styrene/MMA.
- Redox initiated polymerization of MMA & investigate the effect of viscosity on polymerization kinetics
- Redox polymerization of acrylamide
- To investigate Trommsdorff effect in bulk polymerization of MMA
- Solution polymerization of methyl methacrylate/styrene.
- Suspension polymerization of styrene/MMA.
- Emulsion polymerization of styrene/ methyl methacrylate.
- Preparation of Poly (vinyl butyral).



**Essential/recommended readings**

- Odian, G., (2004) Principles of Polymerization, Wiley-interscience.
- Billmeyer F.A., (2011) Textbook of Polymer Science, John-Wiley & Sons.
- Seymour R.B., Carraher C.E., (2003) Polymer Chemistry, Marcel Dekker.
- Flory P.J., (2007) Principles of Polymer Chemistry, Asian Books Private Limited.
- Levenspiel, O. (1998). Chemical reaction engineering. John Wiley & Sons.

**Suggestive readings**

- Brydson J.A., (2016) Plastics Materials, Butterworth Heinemann, 8<sup>th</sup> Edition.
- Lenz, R. W. (1967). Organic chemistry of synthetic high polymers.
- Gowarikar V.R., (2019) Polymer Science, New Age International Publishers Ltd, 3<sup>rd</sup> 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 – 5: POLYMER RHEOLOGY (PR)

### 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		
POLYMER RHEOLOGY (PR)	4	3	0	1	12 <sup>th</sup> Pass	---

### Learning Objectives

- To enhance fundamental knowledge of flow behaviour of polymer melts
- To understand the concept of mixing of polymers

### Learning outcomes

The Learning Outcomes of this course are as follows:

- Apply the knowledge of measurement of viscosity in handling of rheological instruments
- Interpret rheology of polymer melts by mechanical models

### SYLLABUS OF DSC- 5

#### UNIT – I

**(12 Hours)**

##### RHEOLOGICAL PRINCIPLES

Viscosity and polymer processing, rheological properties of fluids, shear stress in polymers, Newtonian & non-Newtonian flow, polymer melt viscosities (ideal molten chains, microscopic studies of melts), flow in channels, simple shear flow, melt-flow index, Weissenberg effect, die swell, melt fracture, creep & creep compliance, stress relaxation, isochronous stress-strain curves

#### UNIT – II

**(15 Hours)**

##### MELT FLOW ANALYSIS

Types of fluid & rheological models, rheological measurements by capillary, parallel plate and cone & plate viscometers, simple elongational flow and its significance, dynamic flow behavior, time dependent fluid behavior

#### UNIT – III

**(09 Hours)**

##### RHEOLOGICAL MODELS

The elastic and viscoelastic state of polymers – viscoelasticity, viscoelastic models: Maxwell model, Voigt-Kelvin model, Boltzmann superposition principle, dynamic mechanical testing

#### **UNIT – IV**

**(09 Hours)**

##### **MIXING OF POLYMERS**

Types of mixing, concept and importance of master batches, mixing of additives with the polymers, melt compounding

##### **Practical -**

**30Hours**

- Determination of melt flow index of a polymer such as PP, PS, LDPE etc.
- Determination of intrinsic viscosity by Ubbelohde viscometer.
- Determination of rheological properties of polymer melts by rheometers.
- Measurement of resin/paint viscosity by Ford cup 4.
- Measurement of dynamic viscosity by Brookfield Viscometer.
- Compounding of polymers and investigation of their rheological behavior.
- Industry/R&D organization visit.

##### **Essential/recommended readings**

- Gupta B.R., (2004) Applied Rheology in Polymer Processing, Asian Books.
- Rosen S.L., (2012) Fundamental Principles of Polymeric Materials, Wiley-Interscience.
- Ghosh P., (2010) Polymer Science and Technology of Plastic and Rubber, Tata McGraw Hill.
- Aklonis J., Macknight W.J., (2005) Introduction to Polymer Viscoelasticity, John Wiley & Sons
- Middleman, S. (1968). Flow of high polymers; continuum and molecular rheology.

##### **Suggestive readings**

- Bird R.B., Armstrong R.C., Hassager O., (1977) Dynamics of Polymeric Liquids (volume 1), John Wiley & Sons, New York.
- Shaw M.T., (2012) Introduction to Polymer Rheology, John Wiley & Sons.
- Dealy, J. M., & Wissbrun, K. F. (2012). Melt rheology and its role in plastics processing: theory and applications. Springer Science & Business Media.
- Hiemenz, P. C., & Lodge, T. P. (2007). Polymer chemistry. CRC press.

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

## DISCIPLINE SPECIFIC CORE COURSE – 6: POLYMER TECHNOLOGY(PT)

### 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		
POLYMER TECHNOLOGY(PT)	4	3	0	1	12 <sup>th</sup> Pass	-

### Learning Objectives

- To learn about the production, properties and applications of thermoset and thermoplastic polymers
- To learn about the chemistry and manufacturing of flexible and rigid polyurethane foams
- To understand the modification of unsaturated polymers

### Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn preparation of thermoplastic polymers
- Learn preparation of thermosetting polymers
- Apply the knowledge of polymer synthesis to obtain polymers with desired properties

### SYLLABUS OF DSC-6

#### UNIT – I

**(27 Hours)**

#### THERMOPLASTIC POLYMERS

Manufacturing process, properties and applications of the following polymers:

- Polyethylene ( LDPE,LLDPE,VLDPE, HDPE)
- Polypropylene and related copolymers
- Polystyrene ABS, HIPS and related copolymers
- Poly (vinyl chloride) and related copolymers
- Poly (vinyl acetate) and related polymers
- Acrylic polymers (PMMA,PEA, PAA, PAN, Polyacrylamide)
- Aliphatic polyamides ( Nylon 6, Nylon 66, Nylon 6,10)
- Polyester (PET, PBT)

#### UNIT – II

**(18 Hours)**

Manufacturing process, curing, properties, and applications of the following polymers:

- Unsaturated polyester resins

- Phenol formaldehyde resins (resols and novolacs)
- Urea and melamine formaldehyde resins
- Epoxides
- Polyurethanes (Flexible & Rigid foams)

#### Practical -

**30 Hours**

- Preparation of PMMA bone cement.
- Preparation and testing of epoxy resins
- Preparation of Nylon 6,10 by interfacial polymerization
- Preparation of phenolic resin for adhesive applications.
- Preparation of unsaturated polyester resin and determination of molecular weight by acid value/hydroxyl value.
- Synthesis of copolymer of styrene & maleic anhydride, and styrene & MMA and determination of reactivity ratios.
- To prepare melamine formaldehyde product viz. crockery etc.
- Synthesis of Polyurethane Foams
- Preparation of sodium polyacrylate salt and poly(acrylic acid) from polyacrylamide.

#### Essential/recommended readings

- Brydson J.A., (2016) *Plastics Materials*, Butterworth Heinemann, 8<sup>th</sup> Edition.
- Mittal Vikas, (2011) *High Performance Polymers and Engineering Plastics*, Wiley.
- Seymour R.B., Carraher C.E., (2003) *Polymer Chemistry*, Marcel Dekker.
- Billmeyer F.A., (2011) *Textbook of Polymer Science*, John-Wiley & Sons.
- Gowarikar V.R., (2019) *Polymer Science*, New Age International Publishers Ltd, 3<sup>rd</sup> Edition

#### Suggestive readings

- Flory P.J., (2007) *Principles of Polymer Chemistry*, Asian Books Private Limited.
- Mark J.E. Erman B., Eirich F.R., (2005) *The Science and Technology of Rubber*, Elsevier Academic Press.
- Sperling, L. H. (2005). *Introduction to physical polymer science*. John Wiley & Sons.
- Crompton R.T., (1989) *Molecular Motions in High Polymers*, Pergamon Press N.Y.
- Crompton T.R., (1989) *Analysis of Polymers*, Pergamon Press N.Y.
- Treloar, L. R. G. (1983). *Mechanical Properties of Solid Polymers*, IM Ward, John Wiley & Sons Ltd, Chichester.

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

## Category-IV

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY THE DEPARTMENTS

#### GENERIC ELECTIVES (GE-4): BIOMEDICAL APPLICATIONS OF POLYMERS(BAP)

#### 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		
BIOMEDICAL APPLICATIONS OF POLYMERS (BAP)	4	2	0	2	12 <sup>th</sup> Pass	---

#### Learning Objectives

- To acquire knowledge of biopolymer and biodegradation
- To gain knowledge of applications and testing of biopolymers

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basic concepts and requirement of biomaterials and biocompatibility
- Apply the knowledge of various biomaterials for a desired bio-application

#### SYLLABUS OF GE-4

##### UNIT – I

(06 Hours)

##### BASICS OF BIOMATERIALS

Concept of biocompatibility and biodegradability, responsiveness, estimations of degradation and biocompatibility, Important biomaterials: hydrogel, fibres, bio-ceramics, bio-elastomers and membranes

##### UNIT – II

(04 Hours)

##### POLYMERS AS BIOMATERIALS

Polyester and polysaccharides, natural gums, biodegradable polymers, polymers and hydrogels

**UNIT – III** **(10 Hours)**  
**BIOMATERIALS FOR ORGAN TRANSPLANTS AND TISSUE ENGINEERING**

Properties and applications of polymers for organ transplant e.g. dental cement, orthopedic, skin, artificial kidney etc., basic concepts of tissue engineering, Important polymers for tissue engineering: cellulose, chitosan and alginates

**UNIT – IV** **(10 Hours)**  
**DRUG DELIVERY AND WOUND CARE**

Introduction to drug delivery, polymers in controlled drug delivery, dressing strips, polymer drug vessels, core shell and nanogels, polymers for antimicrobial activity, bio-conjugates

**Practical** **- 60 Hours**

- Evaluate the biocompatibility of polymeric samples.
- Determination of the degradation behavior of polymers such as thermal, hydrolytic degradation etc.
- Preparation of membranes and measurement of absorption behavior.
- Preparation and characterization of dental cement.
- Preparation of a hydrogel and its characterization.
- Determination of tensile strength of biopolymers.
- Determine the swelling rate of biopolymers
- Preparation of nanogel and find its water absorption
- preparation and characterization of membrane for skin transplant

**Essential/recommended readings**

- Tiwari A., Tiwari A., (2013) Nanomaterials in drug delivery, Imaging and Tissue Engineering, Wiley.
- Pilla S., (2011) Handbook of Bioplastics and Biocomposites Engineering Applications, Wiley.
- Ratner, Buddy D., Allan S. Hoffman, Frederick J. Schoen, and Jack E. Lemons. "Biomaterials science: an introduction to materials in medicine." San Diego, California (2004): 162-4.
- Park, J. B., & Bronzino, J. D. (2002). Biomaterials: principles and applications. crc press.

**Suggestive readings**

- Ratner D., Hoffman A.S., (1996) An Introduction to Materials in Medicine, Academic Press.
- Saltzman W.M., (2001) Drug delivery–Engineering principles for drug therapy, Oxford University Press.
- Kalia S., Averous L., (2011) Biopolymers: Biomedical and Environmental Applications, John Wiley & Sons.

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

**GENERIC ELECTIVES (GE-5): POLYMERS FOR PACKAGING (PP)**

**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 FOR PACKAGING (PP)	4	2	0	2	12 <sup>th</sup> Pass	---

**Learning Objectives**

- To learn about the basic necessities and importance of packaging
- To acquire knowledge of various types of packaging materials

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- Apprehend the basic concepts of packaging and its utilization for desired applications
- Assess the quality of packaging material and packaged product

**SYLLABUS OF GE-5**

**UNIT – I**

**(06 Hours)**

**PACKAGING SYSTEMS**

Types of packaging systems: box, bottle, tetra, pouch, shrink, vacuum, gas, controlled atmosphere packaging (CAP), modified atmosphere packaging (MAP), and aseptic packaging

**UNIT – II**

**(08 Hours)**

**POLYMERS IN PACKAGING**

Properties and applications: LLDPE, LDPE, HDPE, HMHDPE, PP, PVC, nylons, polyester, polycarbonate, PS, EPS, PLA, PVA and Starch

**UNIT – III**

**(08 Hours)**

**PACKAGING PROCESS TECHNIQUES**

Preparation of packaging materials by thermoforming, co-extrusion, extrusion-stretch blow molding, injection molding, BOPP films

**UNIT – IV**

**(08 Hours)**

**TESTING OF POLYMER PACKAGING MATERIAL**

Bursting strength, tensile strength, tear strength, puncture test, impact test (Drop, falling dart), permeability test (water vapour, oxygen), biodegradability, sealing strength



**Practical -****60 Hours**

- To identify packaging materials with the help of FT-IR, DSC, TGA etc.
- Determination of physico-mechanical properties (density, burst strength, tensile strength, tear strength, puncture test strength, impact strength etc).
- Determination of water vapor transmission rate of packaging material.
- To test sealing strength integrity of packaging materials.
- To check biodegradability of packaging material.
- Preparation biodegradable packaging film
- Determination of water vapor transmission rate of packaging material.
- To test seal strength integrity of packaging materials.
- To check biodegradability of packaging material.
- To determine compatibility of film.

**Essential/recommended readings**

- Robertson G.L., (2005) Food Packaging Principles and Practice, CRC press.
- Paine F.A. and Paine H.Y., (1992) A Handbook of Food Packaging, Blackie Academic and Professional.
- Sharma S., Aggarwal M., Sharma D., (2019), Food Frontiers, New Delhi Publisher
- N. C. Saha, M. Garg, S. Dey Sadhu, A. K. Ghosh(2022) Food Packaging-Materials, Techniques and Environmental Issues” by published by Springer.
- Garg, M., Meena, P.L., Sadhu, S.D., Alam, T. (2019). Food Packaging: A Practical Guide : Viba Press Pvt. Ltd.

**Suggestive readings**

- Robertson G.L., (2012) Food Packaging–Principles and Practice, CRC Press.
- Coles R, McDowell D., Kirwan M.J., (2003) Food Packaging Technology, Blackwell.
- Sukhareva L.A., Yakolev V.S., Legonkova O.A., (2008) Polymers for packaging materials for preservation of foodstuffs, VSP.

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

**GENERIC ELECTIVES (GE-6): POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS (PEEA)**

**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 FOR ELECTRICAL AND ELECTRONIC APPLICATIONS (PEEA)	4	2	0	2	12 <sup>th</sup> Pass	----

**Learning Objectives**

- To learn about basic concepts of polymer electrical and electronic properties
- To gain knowledge of electrical and electronics applications of polymers

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- Synthesize a conducting polymer for a specific application
- Apply the knowledge of properties of polymers required for electrical and electronics applications

**SYLLABUS OF GE-6**

**UNIT – I**

**(08 Hours)**

**INTRODUCTION TO POLYMERS**

Petro polymers, conducting polymers, biopolymers, composites, Band diagram, processing of polymers, doping (chemical and ion), advantages and disadvantages of conducting polymers, limitations

**UNIT – II**

**(08 Hours)**

**PREPARATION OF CONDUCTING POLYMERS**

Synthetic methods: chemical, electrochemical, photochemical etc. (polyaniline, polypyrrole, polythiophene, polyacetylene, etc.), methods to enhance the processability of conducting polymers

**UNIT – III**

**(08 Hours)**

**PROPERTIES**

Dielectric strength, dielectric loss, charge storage capacity, electrical conductivity, heat capacity, magnetism, hysteresis loop, shape memory, mechanical properties, EMI shielding

**UNIT – III****(06 Hours)****ELECTRONIC APPLICATIONS**

Semiconducting organic materials, polymer based electronic devices, organic field effect transistor, organic transistors, plastic solar cell, light emitting diode, supercapacitor, sensors etc.

**Practical -****60 Hours**

- Preparation of conducting polyaniline and measurement of their conductivity.
- Preparation of polypyrrole and measurement of their conductivity.
- Preparation of polythiophene and measurement of their surface resistivity.
- Preparation and testing of conducting polymers for sensor applications.
- Measurement of multilayer insulation of a thin film.
- Measurement of dielectric strength of a polymer film.
- Measurement of mechanical properties of insulating cable
- Preparation polymer sample and analyzed its dielectric strength
- Preparation of a conducting polymer nanocomposites.
- Preparation polymeric semiconductor

**Essential/recommended readings**

- Skotheim T.A., Elsenbaumer R.L., Reynolds J.R., (1998) Handbook of conducting polymers, Vol. 1 and Vol. 2, Marcel Dekker.
- Nalwa H.S., (1977) Organic Conductive Molecules and Polymers, John Wiley & Sons.
- Bredas J.L., Silbey R., (1991) Conjugated Polymers: The Novel Science and Technology of Highly Conducting and Nonlinear Optically Active Materials, Kluwer Academic Publishers.
- Bikales M., Menges O.B., (1986) Encyclopedia of Polymer science and Engineering, Second Edition, Vol.5, John Wiley & Sons.

**Suggestive readings**

- Lyons M.E.O., (1994) Electroactive polymers, Plenum Press.
- Margolis J., (1993) Conducting Polymers and Plastics, Chapman & Hall.

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

## DEPARTMENT OF ANTHROPOLOGY

### Category-I

### BSc. (Hons.) Environmental Science

#### DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4) – : Human Origins 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		
Human Origins and Evolution	4	3	0	1	12 <sup>th</sup> Pass	----

#### Learning Objectives

1. The course will enhance students understanding of human variation in the light of human origins.
2. The course will help students to develop concepts pertaining to the relation of modern humans with living and non-living primates.

#### Learning Outcomes

Students will learn on evolutionary relationships of different extinct/hominids in the context of emergence of modern human beings. Students will also learn the gradual biological and behavioral processes of becoming human.

#### Syllabus:

##### Unit-1 (12 Hours)

Primate origins and radiation: phylogenetic relationships of living primates with special reference to Miocene hominoids

##### Unit-2 (12 Hours)

Australopithecines: distribution, features and their phylogenetic relationships. Appearance of genus Homo: Homo habilis  
Homo erectus from Asia, Europe and Africa: Distribution, features and their phylogenetic status

##### Unit-3 (12 Hours)

The origin of Homo sapiens: Fossil evidences of Neanderthals.  
Origin of modern humans (Homo sapiens sapiens): Archaic and Modern humans, Distribution and features

**Unit-4****(9 Hours)**

Hominization process: Bio-cultural Evolution

**Practical –****30 Hours****Craniometry:**

- a) Maximum Cranial Length
- b) Maximum Cranial Breadth
- c) Maximum Bizygomatic Breadth
- d) Maximum Frontal Breadth
- e) Minimum (Least) Frontal Breadth
- f) Nasal Height
- g) Nasal Breadth
- h) Bi-Mastoid Breadth
- i) Greatest Occipital Breadth
- j) Upper Facial Height
- k) Cranial Index
- l) Nasal Index

**Osteometry: Measurements of Human long bones (6)**

Identification of casts of fossils of family hominidae: Drawing and comparison of cranial characteristics.

**References**

1. Indera P. Singh and Bhasin, M.K. (1968) Anthropometry. Kamla-Raj Enterprises, Chawri Bazar, Delhi.
2. Buettner-Janusch, J. (1966). Origins of Man: Physical Anthropology. John Wiley & Sons, Inc., New York, London, Sydney.
3. Craig Stanford et al. (2013). Biological Anthropology. Pearson, New York. [Unit-1: Page-261-300; Unit-2: Page-324-335; Unit-3: Page-342-375; Unit-4: Page-382-412; Unit-5 and 6: Page-418-441]
4. Nystrom P. and Ashmore P. (2011). The Life of Primates. PHI Learning Private Limited, New Delhi.
5. Seth P. K. and Seth S. (1986). The Primates. Northern Book Centre, New Delhi, Allahabad.
6. Singh I. P. and Bhasin M.K. (1989). Anthropometry: A Laboratory Manual on Biological Anthropology.
7. Stanford C.; Allen J.S. and Anton S.C. (2012). Biological Anthropology: The Natural History of Mankind.
8. Swindler D. R. (2009). Introduction to the Primates. Overseas Press India Pvt. Ltd., New

**Keywords**

Human origin, Primates, Australopithecine, Homo erectus and evolution

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

**DISCIPLINE SPECIFIC CORE COURSE -5 (DSC-5) – : Fieldwork Traditions and Ethnography**

**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		
<b>Fieldwork Traditions and Ethnography</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>12<sup>th</sup> Pass</b>	<b>----</b>

**Learning Objectives:**

- How ethnographers conceptualize, conduct, and analyse their research;
- The types of research practices for generating data
- The ethics of ethnographic research, in relationship to disciplinary history

**Learning Outcomes:**

- Ability to conduct ethnographic research
- Generate data and write field notes
- Analyse and interpret ethnographic data

**Syllabus:**

**Unit 1 Fieldwork Tradition**

**(12 Hours)**

The emergence of fieldwork tradition in Anthropology; Ethnography, its Nature, Trajectories, Genres; Ethnography: Process and Product

**Unit 2 Idea of Field**

**(12 Hours)**

Concept of field: Idea of Place and Space, and its changing contours, Multi-sited Ethnography and Virtual Spaces.

**Unit 3 Doing ethnography**

**(12 Hours)**

Doing ethnographic Fieldwork: Fieldwork Identity; Rapport and Relations; Representation and Emotions; Ethical issues.

**Unit 4 Field Methods and Writing**

**(09 Hours)**

Observation, Interview, Case Study, Life History, Genealogy, Sensory Ethnography, Reflexivity and Ethnographic Writing

**Practical –**

**30 Hours**

Designing Ethnographic Research: Identifying a problem, Defining the universe, Literature Review, selecting appropriate methods; doing Fieldwork: field diaries and field notes; Analysis and Writings.

1. Students are required to visit different field sites and come up with observational and experiential learnings
2. Presentations based on a Research Project

## References

1. Clifford, J., & Marcus, G. E. (2011). *Writing culture: The poetics and politics of ethnography*. Berkeley, California: University of California Press.
2. O'Reilly, K. (2009). *Key Concepts in Ethnography (SAGE key concepts)*. Sage Publications.
3. Narayan, K. (2012). *Alive in the writing: Crafting ethnography in the company of Chekhov*. Chicago: University of Chicago Press.
4. Robben, C.G.M. and Jeffrey A. Sluka. (2012). *Ethnographic Fieldwork: An Anthropological Reader*. Oxford: Wiley-Blackwell.
5. Srinivasa, M. N., Shah, A. M., & Ramaswamy, E. A. (2008). *The fieldworker and the field*. New Delhi: Oxford University Press.
6. Srivastava, V. K. (2005). *Methodology and fieldwork*. New Delhi: Oxford University Press.

**Keywords:** Fieldwork, Ethnography, Ethics, Writing, Reflexivity

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

**DISCIPLINE SPECIFIC CORE COURSE -6 (DSC-6) – : Human ecology and biological adaptation**

**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		
<b>Human ecology and biological adaptation</b>	4	3	0	1	12 <sup>th</sup> Pass	----

**Learning Objectives**

1. To introduce human ecology through biological perspectives where impetus will be laid on building a sense of awareness, empathy and understanding of existing environmental problems at various subsistence levels.
2. The course focuses on environmental matters that need attention on imperative basis.

**Learning Outcomes**

1. The students will be trained to identify biological adaptation strategies that can throw light on the resilient measures in different environmental stresses.
2. The students can be better equipped to understand the impact of various environments on everyday human life and can critically reflect on adoption of a healthy and sustainable environment.
3. The students can be encouraged to come up with innovative strategies to reduce the environmental menace created by humankind and aim towards a sustainable future.

**Syllabus:**

**Unit I: Fundamentals of Human ecology (12 Hours)**

- Human ecology and its interdisciplinary approaches
- Complexity and diversity of human population with respect to environment
- Concepts of human ecology and adaptation with special emphasis on biological dimensions

**Unit II: Tools to understand human ecology (12 Hours)**

- Methods of studying human ecology
- Indigenous knowledge for sustainability in various environments

**Unit III: Human adaptation: Population and environment (12 Hours)**

- Adaptation to various ecological stresses
- Ecological rules and their applicability to human populations



#### **Unit IV: Human health and environment (09 Hours)**

- Impact of various environments on human health
- Impact of urbanization and industrialization on humans

#### **Practical –**

**30 Hours**

##### *A. Size and Shape Measurements:*

1. Stature
2. Sitting Height
3. Body Weight
4. Total Upper Extremity Length
5. Total Lower Extremity Length
6. Nasal Breadth
7. Nasal Height

##### *B. Size and Shape Indices:*

1. Body Mass Index
2. Relative Sitting Height
3. Relative Upper Extremity Length
4. Relative Total Lower Extremity Length
5. Nasal Index

- C. 1-2 public talks/workshops/project over the academic semester on research topics on human ecology and biological adaptation. These talks would bring students with brainstorming discussion on current issues.

#### **References**

1. H. Schutkowski. (2006) Human Ecology: Biocultural adaptations in Human communities, Springer Verlag, Germany (Unit 1).
2. Wilk. Richard and Haenn Nora (2006). The environment in Anthropology. New York University Press. NY. (Unit 2).
3. Ember and Ember (2014) Anthropology, Pearson publication, Hudson Avenue, New Jersey. (Unit 3)
4. Wilk. Richard and Haenn Nora (2006): The environment in Anthropology. New York University Press. NY. (Unit 4)

#### **Teaching Learning Process**

1. Classroom teachings
2. Seminars and presentations
3. Practical classes
4. Workshop

**Keywords:** adaptation, human ecology, ecological stresses, health

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

## CATEGORY-IV

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY DEPARTMENT OF ANTHROPOLOGY

#### Credit distribution, Eligibility and Pre-requisites of the Course

#### GENERIC ELECTIVES (GE-7): Physical fitness, Activity and Performance

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Physical fitness, Activity and Performance	4	3	0	1	12 <sup>th</sup> Pass	---

#### Learning Objectives:

The course is structured around the relevance of being physically fit in today's environment. It will further focus on increasing one's performance and activity through anthropological knowledge.

#### Learning Outcomes:

1. The students will learn about various components of health-related and skill related physical fitness.
2. The students will learn about the importance of physical fitness in performing and sustaining daily activities.
3. They will also learn about the relevance of physical fitness and performance in sports science and how it helps in designing the most appropriate athletic training program.
4. They will learn how anthropological knowledge is of immense importance in fitness and performance.

#### Syllabus

#### Unit I: Introduction to physical fitness and performance (12 Hours)

Definition, scope, and relevance of physical fitness and performance, ways to improve physical fitness and performance, various types of physical fitness and performance test

#### Unit II: Measure of physical fitness and performance (12 Hours)

Cardiovascular endurance, Muscular strength, Muscular endurance, Flexibility, Body composition, skill related components of physical fitness

**Unit III: Physical fitness and performance in sports and health science (12 Hours)**

Importance of physical fitness and performance in preventing chronic and lifestyle disease, talent identification in sport science by determining an athlete's strengths and weaknesses, doping and performance.

**Unit IV: Anthropological knowledge in physical fitness and performance (09 Hours)**

Relevance of anthropology in studying physical fitness, activity and performance, understanding physical fitness and performance by taking into consideration the ethnic and racial differences

**Practical – 30 Hours**

1. Physical fitness and performance test
2. **Physiological Measurements-** Blood pressure, Heart rate, Pulse rate
3. **Somatometric Measurements-** Height, weight, skinfolds, hip circumference, waist circumference, mid-upper arm circumference, neck circumference, calf circumference, thigh circumference

1-2 workshops/projects over the academic semester on topics related to anthropology. It would bring students to brainstorming discussions on current issues and help them develop innovative ideas.

**References:**

1. Physical working capacity and physical fitness; relationship of body measurements with cardio-vascular and respiratory functions- Physical Activity and Health by C. Bouchard, S.N Blair, W.L Haskell Chapter 3 (Page 37-42)
2. Iurrtia, Alfredo, Víctor M. Torres-Mestre, Álex Cebrián-Ponce, Marta Carrasco-Marginet, Albert Altarriba-Bartés, Marc Vives-Usón, Francesc Cos, and Jorge Castizo-Olier. "Physical Fitness and Performance in Talented & Untalented Young Chinese Soccer Players." In *Healthcare*, vol. 10, no. 1, p. 98. MDPI, 2022.
3. Vaara, Jani P., Heikki Kyröläinen, Jaakko Niemi, Olli Ohrankämmen, Arja Häkkinen, Sheila Kocay, and Keijo Häkkinen. "Associations of maximal strength and muscular endurance test scores with cardiorespiratory fitness and body composition." *The Journal of Strength & Conditioning Research* 26, no. 8 (2012): 2078-2086.
4. Pate, Russell, Maria Oria, and Laura Pillsbury. "Health-related fitness measures for youth: flexibility." In *Fitness Measures and Health Outcomes in Youth*. National Academies Press (US), 2012.
5. Chen, W., Hammond-Bennett, A., Hypnar, A., & Mason, S. (2018). Health-related physical fitness and physical activity in elementary school students. *BMC public health*, 18(1), 195. <https://doi.org/10.1186/s12889-018-5107-4>

6. Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., Tomporowski, P., Lambourne, K., Szabo-Reed, A. N., & This summary was written for the American College of Sports Medicine by (2016). Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. *Medicine and science in sports and exercise*, 48(6), 1223–1224. <https://doi.org/10.1249/MSS.0000000000000966>
7. Eston, R. and Reilly, T. (2009). KINANTHROPOMETRY AND EXERCISE PHYSIOLOGY LABORATORY MANUAL Volume One: Anthropometry. Tests, procedures and data. Routledge.

**Teaching Learning Process**

- Classroom teachings
- Seminars and Interactive sessions
- Practical classes/ Field work

**Keywords:** Physical fitness, performance, health science

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

## GENERIC ELECTIVES (GE-8): CUSTOMARY LAW

### 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		
Customary Law	4	3	0	1	12 <sup>th</sup> Pass	---

#### Learning objectives:

The course is designed to help students understand the approaches to the study of different types of law, particularly customary law. It will also help students to learn the contradictions, inconsistencies inherent in the interface between customary law and the state law.

**Learning Outcomes:** On completion of the course, students will be able to:

- Locate nuances of diverse customs from around the world based on ethnographic works.
- Make critical evaluation of gendered laws which are intricately enmeshed within the social fabric.
- Gain insights into the workings of state agency that blurs the boundary of customary law and the state.

#### Syllabus:

#### Unit 1: Understanding Customary Law (12 Hours)

Customary Law: Concepts and Approaches; Types of Customary Law: Restitutive, Repressive; Anthropological literature: Bronislaw Malinowski, Evans-Pritchard, Meyer Fortes, Max Gluckman, Leopold Pospisil

#### Unit 2: Custom, Crime and Justice (12 Hours)

Law and Justice in simple societies; Classification of Crimes among indigenous communities; Oath taking and Ordeal; modes of dispute settlement

#### Unit 3: Gender and Customary Law (12 Hours)

Gendered laws, Inheritance, Succession, Custody of Children and Properties, Political Representation

#### Unit 4: Customary Law and the State Law (09 Hours)

Interface between customary law and state law; Codification of customary law and its implications

**Practical – 30 Hours**

- Review of ethnographic works and find out: (i) types of crime, (ii) modes of dispute settlement, (iii) rationale behind ordeals/oaths.
- Project report on (i) customary law and the state law interface, or (ii) Cultural context of a dispute and search for its settlement in one or other legal domains.

### **References:**

1. Evans-Pritchard, E. E and Meyer Fortes. 1940. *African Political Systems*. London: Oxford University Press.
2. Gluckman, Max. 1956. *Custom and Conflict in Africa*. Basil Blackwell Ltd.
3. Malinowski, B. 1926. *Crime and Custom in Savage Society*. London: Routledge & Kegan Paul Ltd.
4. Pospisil, Leopold. 1971. *Anthropology of Law: A comparative theory*. New York: Harper and Row Publishers.
5. Srivastava, Vinay Kumar. 2021. *India's Tribes: Unfolding Realities*. New Delhi: Sage Publications Indian Pvt. Ltd.
6. Zhimo, A.G. 2019. 'Indigenous system of Governance and its implication: The case of Sumi Naga. *Indian Anthropologist*. 49 (2): 41-56.

### **Keywords:**

Customary law, oath taking, custom, dispute, state law

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

## GENERIC ELECTIVES (GE-9): Ethics and Legality in Human Research

### 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		
Ethics and Legality in Human Research	4	3	0	1	12 <sup>th</sup> Pass	---

#### Learning Objectives

- To understand bio-social ethical aspects of human research
- To understand aspects of health research from ethical and legal perspectives

#### Learning Outcomes

The students will learn the basic understanding of ethics in different types of human research and learn the skills to assess ethical dimensions of research works based on human populations

#### Syllabus:

**Unit 1:** Introduction to the ethical dimensions of human research; history of ethics in human research; Ethical vs legal regulations **(12 Hours)**

**Unit 2:** Research Disclosure; Importance of Truth telling; Participant Information sheet; Participant's Capacity to understand human research, Voluntariness and Consent, **(12 Hours)**

**Unit 3:** Human rights; Confidentiality of participant's information; Risks and benefits, Vulnerability, research integrity **(12 Hours)**

**Unit 4:** Ethical guidelines of Indian Council of medical Research; Regulatory framework **(9 Hours)**

#### Practical: (30 Hours)

Report of ethical assessment based on research work related to human research.

#### References

- Macklin R. Ethics in global health: research, policy, and practice [1 ed.]. Oxford University Press, 2012
- Stephen Garrard Post Encyclopedia of bioethics [Volume 3, 3rd ed]. Macmillan Reference USA, 2004
- Alastair V. Campbell. Bioethics: The Basics [1 ed.]. Routledge, 2013

#### Keywords

Ethics, human, participants, consent, confidentiality

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

## GENERIC ELECTIVES (GE-10): Quality of life and 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		
Quality of life and well-being	4	3	0	1	12 <sup>th</sup> Pass	----

#### Learning Objectives:

- To understand the concept of QoL and well-being.
- To learn about various domains and indicators related to QoL and well-being.
- To know the measures of QoL and well-being as per different community or geographical setting.
- To identify the similarity and differences in these two concepts.
- To understand the change in QoL and well-being as per disease severity and duration of symptoms in different age group and gender.

#### Learning outcomes:

- Learner will be able to understand the basic concept of QoL and well-being.
- Information about measures of well-being and QoL will be instilled.
- Learners will get to know about indicators and theoretical models of well-being and QoL
- Knowledge about evaluation of chronic illness treatment through wellbeing and HRQoL will be imparted.

#### Syllabus:

#### **Unit 1: Fundamentals of quality of life and well being (12 Hours)**

Concept of Quality of life (QoL), subjectivity and multidimensionality models, standard of living, life satisfaction, philosophical foundation, definitions and measures of QoL and well being

#### **Unit 2: QoL and Chronic illness (12 Hours)**

Quality of life as an evaluation tool for the treatment (HRQoL), functioning domains under QoL: physical, mental, emotional, intellectual, spiritual, and social functioning, impact of Covid-19 on QoL and well-being

#### **Unit 3: Theories and indicators of QoL and well-being (12 Hours)**



Hedonic and Eudaimonic well-being, objective, subjective and relational well-being, integrative theories of subjective QoL. Effect of technology, economic, political, socio-cultural, resource, domain dynamics on QoL and well-being.

#### **Unit 4: Types of well-being**

**(09 Hours)**

Work, residential, material, social, family, marital, health, leisure. quality of life and well-being of Women, older adults, children, youth, geographic population segments etc.

#### **Practical:**

**(30 Hours)**

To assess QoL and wellbeing of different population at different age groups.

1-2 workshops/projects over the academic semester on topics related to quality of life and wellbeing in anthropology. It would bring students to brainstorming discussions on current issues and help them develop innovative ideas.

#### **References:**

1. An Interdisciplinary Perspective edited by Shruti Tripathi, Rashmi Rai, Ingrid Van Rompay-Bartels, 1<sup>st</sup> edition, 2021, CRC press, Boca Raton <https://doi.org/10.1201/9781003009139>
2. <https://www.springer.com/series/8365>
3. Handbook of Active Ageing and Quality of Life,2021, ISBN: 978-3-030-58030-8
4. Well-Being as a Multidimensional Concept: Understanding Connections among Culture, Community, and Health, 2019, EDITED BY JANET M. PAGE-REEVES
5. Upton, D., Upton, P. (2015). Quality of Life and Well-Being. In: Psychology of Wounds and Wound Care in Clinical Practice. Springer, Cham. [https://doi.org/10.1007/978-3-319-09653-7\\_4](https://doi.org/10.1007/978-3-319-09653-7_4)
6. <https://www.cdc.gov/hrqol/wellbeing.htm>

#### **Teaching Learning Process**

1. Classroom teachings
2. Seminars and Interactive sessions
3. Practical classes/ Field work

**Keywords:** Quality of life, wellbeing, Hedonic, Eudaimonic

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

## GENERIC ELECTIVES (GE-11): Tribes of India

### 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		
Tribes of India	4	3	0	1	12 <sup>th</sup> Pass	---

**Learning Objectives:** The course is designed to help students understand the contested and problematic nature of the term ‘tribe’ and its definitional attributes. It also seeks to elucidate pressing issues faced by the tribes in India by focus on the contemporary issues, challenges and crisis that confront the rural and tribal communities in India.

**Learning outcomes:** At the end of the course, the student will be able to:

1. Comprehend the problematic nature of the concepts of tribe and indigenous; how it differs from caste.
2. Understand critical issues, problems and challenges related to tribal societies both in historical and contemporary perspectives.
3. Evaluate, plan and implement any project work in rural and tribal areas and be able to suggest remedial measures for critical issues.

#### Syllabus:

#### Unit 1: On the concept of tribe (12 Hours)

Concept and approaches to the study of tribes; classification, distribution and cosmogeny of tribes in India; Scheduled Tribe and Indigenous people; Particularly Vulnerable tribal groups

#### Unit 2: Tribes and institution (12 Hours)

Tribal kinship system, types of family, rules of marriage, tribal polity and governance, subsistence economy and tribal market, tribal religion: nature-man-spirit complex, witchcraft

#### Unit 3: Tribes, Development, and Globalization: (12 Hours)

Impact of development schemes on tribal societies; Displacement caused by large infrastructure projects; Globalization and the shift from isolation to integration.

#### Unit 4: Tribes and Policy (09 Hours)

National Tribal Policy; Forest Rights, Food security, land acquisition, mining, tribal migrants

**Practical –****30 Hours**

Practical would involve examination of material culture including technologies used by the hunter and gatherers, horticulturalist pastoral and agriculture communities. Functional analysis of traps for fishing, hunting, digging stick, sickle and different types of knives and other equipment used for hunting. Different types of house forms, dress patterns etc. and their ecological adaptation in different climatic zones will also be required to studied functionally as well structural point of view. Student would also prepare a project report based upon empirical data collected on tribal issues

**References:**

Bailey, F.G. 1960. Tribes, caste and Nations: A study of political activity and political change inttighland Orissa.

Béteille, André. 1998. The Idea of Indigenous People. *Current Anthropology*, Vol. 39, No. 2 (April 1998), pp. 187-192.

Bhandari, J. S., and Subhadra Channa. 1997. Tribes and government policies. New Delhi: Cosmo Publications

Channa, Subhadra Mitra. 2020. Anthropological Perspectives on Indian Tribes. New Delhi: Orient Blackswan Private Limited

Chaudhury, Sukant K., and Patnaik, Soumendra Mohan. 2008. Indian Tribes and the `Mainstream. New Delhi. Rawat Publisher

Fürer-Haimendorf, Christoph von. 1985. Tribal populations and cultures of the Indian subcontinent. *Handbuch der Orientalistik*, Bd. Leiden: E.J. Brill.

Miri, Mrinal. 2003. Identity and the moral life. New Delhi: Oxford University Press.

Vidyarthi, L.P. 1977. Tribal Culture of India: concept publishing company.

Xaxa, Virginius. 2008. State, society, and tribes: issues in post-colonial India. New Delhi: Dorling Kindersley (India)

**Teaching Learning Process**

Lectures and Discussions

Seminars and Presentations

**Keywords:** Scheduled Tribe, Caste, Tribal Development, Tribal Policy, Indigenous People

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

## GENERIC ELECTIVES (GE-12): Environment and Health

### 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		
Environment and Health	4	3	0	1	12 <sup>th</sup> Pass	----

### Learning Objectives

1. To understand basic concepts of environmental health
2. To assess environmental pollutant classes
3. To assess the risk of environmental exposures and health impacts

### Learning Outcomes

The students will learn the basic concepts of environmental and health, various exposures and pollutant classes, burden of disease and health impacts of ecological exposures

### Syllabus:

**Unit 1:** Introduction to environment health. Epidemiological studies related to environmental health **(12 Hours)**

**Unit 2:** Water, Sanitation and Hygiene; impact of air pollution (ambient and indoor), water pollution and noise pollution on human health **(12 Hours)**

**Unit 3:** Human health under different socio-cultural environment, Built environment, Urban environment, Green spaces and occupational hazards, hygiene and health **(12 Hours)**

**Unit 4:** Food safety, toxins and waste management, chemicals and heavy metals **(09 Hours)**

**Practical:** **30 Hours**

Project report based on data collection related to environmental health

### References

1. Hermen Koren. Handbook of environmental health and safety [volume\_II, 4th ed.]. CRC Press, 2002
2. Morton Lippmann. Environmental toxicants: human exposures and their health effects [3rd ed.]. John Wiley & Sons, 2009
3. B. Wisner J. Adams. Environmental Health in Emergencies and Disasters [1 ed.]. World Health Organization, 2003
4. Bernard J. Healey, Kenneth T. Walker. Introduction to Occupational Health in Public Health Practice (Public Health Environmental Health) [1 ed.]. Jossey-Bass;2009

**Teaching Learning Process**

The process of learning will involve acquisition of domain knowledge and understanding of skills required for conducting research in environmental health. Process will involve lectures and presentations and report submission.

**Keywords**

Pollutants, Environment, Exposure, Assessment, Water and Air pollution, social environment.

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

### Category I

#### **BSc. (Honours) Biological Science (Sri Venkateswara College)**

#### **DISCIPLINE SPECIFIC CORE COURSE – 4:**

#### **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		
Cell Biology (BS-DSC-201)	4	2	0	2	Class XII pass with Biology and chemistry, as one of the papers in Class XII	NIL

#### **Learning Objectives**

The Learning Objectives of this course are as follows:

- To introduce the students to the basic concepts and processes in cyto-biology.
- To understand the structure and function of cell organelles, how they communicate with each other and how division and regulation takes place in cells.
- The practical content of this course is designed to understand the cell measurement methods, cell division, staining procedure and tonicity through different laboratory exercises.

#### **Learning outcomes**

On successful completion of course, the student will:

- Understand the cell and its biology which will help them to get an insight into the origin of cells, cellular structure, various components of cells and functions.
- Understand the chemical composition, physicochemical and functional organization of organelle.
- Demonstrate the knowledge of common and advanced laboratory practices in cyto-biology.
- Acquire knowledge about how cells divide by means of meiosis and mitosis and will be able to correlate different factors which control cell cycle progression.

## **SYLLABUS OF DSC-1**

### **UNIT – I Overview of Cell and Cell membrane**

**(07 Hours)**

History of cell biology, cell theory, Structure and functions of membrane, models of membrane structure, transport across membranes (with examples): simple diffusion, facilitated diffusion, active transport ( $\text{Na}^+/\text{K}^+$  pumps, Co-transport, proton pumps) and passive transport. Phagocytosis, pinocytosis, exocytosis.

### **UNIT – II Cell Organelles**

**(13 Hours)**

Mitochondria, chloroplast and nucleus: Ultrastructural organization and functions, marker enzymes, transport mechanisms in mitochondria and chloroplasts (Tim/Tom; Tic/Toc); and transport via nuclear pore complex.

Endomembrane system: Ultrastructural organization and functions of Rough and smooth endoplasmic reticulum, Golgi apparatus and lysosomes (GERL complex), tonoplast.

Glyoxysomes and Peroxisomes: Structure and function.

### **UNIT – III Cytoskeletal System**

**(03 Hours)**

Structure and organization of microfilaments, intermediate filaments, microtubules, their functions in plants and animals (in brief).

### **UNIT – IV Cell wall and extracellular matrix**

**(04 Hours)**

Cell wall organization (Primary and secondary cell wall), components of cell wall, Extracellular Matrix and Cell junctions, adhesive junctions, gap junctions and tight junctions, plasmodesmata. Function of cell wall.

### **UNIT – V Cell Division**

**(03 Hours)**

Overview of cell cycle. Regulation: Various checkpoints and the role of cyclins and Cdk's (Cyclin dependent kinases). Overview of mitosis and meiosis and their significance

### **Practical component – 60 Hours**

1. Estimation of cell size by micrometry/ camera lucida
2. To study plasmolysis and deplasmolysis in a cell/ Isolation of protoplast from tomato and its survival in hypo, hyper and isotonic solution
3. Study the effect of organic solvent/temperature on membrane permeability.
4. Demonstrate the phenomenon of protoplasmic streaming.
5. Study of ultrastructure of a cell (Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Endoplasmic reticulum, Lysosomes) through electron micrographs.

6. Study of cytoskeletal structures through photographs.
7. Study of different stages of mitosis by temporary preparation of onion root tips.
8. Study of different stages of meiosis by temporary preparation /permanent slides.
9. Staining and visualisation of mitochondria by Janus green stain

### Essential/recommended readings

1. Becker, W. M., Kleinsmith, L. J., Bertni, G. P. (2009). *The World of the Cell* (7thEd.). Pearson Benjamin Cummings Publishing, San Francisco.
2. Cooper, G.M. and Hausman, R.E., (2009). *The Cell: A Molecular Approach*.(7thed.). ASM Press & Sunderland (Washington DC), Sinauer Associates, MA.
3. Karp, G., (2010). *Cell and Molecular Biology: Concepts and Experiments* (8thed.). John Wiley & Sons  
A Guidebook to mechanism in organic chemistry (2003) 6 th ed., Sykes, P. NewYork: John Wiley & Sons. Inc

### Suggested readings

1. EDP De Robertis, and RE De Robertis (2009). *Cell and Molecular Biology* (8th Ed.).Lippincott Williams and Wilkins, Philadelphia.
2. Nelson, D.L. and Cox, M.M. (2017). *Lehninger: Principles of Biochemistry* (7<sup>th</sup>ed.).  
W.H. Freeman & Company (New York).

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

## DISCIPLINE SPECIFIC CORE COURSE – 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 (if any)
		Lecture	Tutorial	Practical/ Practice		
Diversity of Life Forms-II (BS-DSC-202)	4	2	0	2	Class XII pass with Biology and chemistry, as one of the papers in Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:



- Designed with an aim to provide scope and historical background of evolution and diversity in plants and animals.
- impart knowledge regarding basic concepts of origin of chordates and make the students understand the characteristics and classification of animals with notochord.
- Outline various mechanisms involved in thriving/survival of the animals within their geographic realms.
- Understand important aspects of Gymnosperm classification, structure and economic importance.
- Provide an adequate exposure to fundamentals of plant systematics and most practiced classification systems.
- Emphasis will be on developing interest and invoking a sense of responsibility among students toward sustenance of plant and animal biodiversity.

### **Learning outcomes**

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

- Understand different characteristic features of different plant and animal life forms, classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum.
- Study about diversity in animals and plants making students understand about their distinguishing features.
- Appreciate similarities and differences in life functions among various groups of animals and plants.
- Know about the habit and habitat of animals in marine, freshwater and terrestrial ecosystems.
- Understanding of systematics its importance in biodiversity management, nomenclature and classification systems of the plants.

## **SYLLABUS OF DSC- 2**

### **UNIT – I Gymnosperms**

**(04 Hours)**

Position of Gymnosperms in five kingdom classification. General characteristics, Outline classification and economic importance. Morphology, structure and reproduction of *Pinus* and *Ginkgo*. Evolutionary tendencies in Gymnosperms-a comparative study

### **UNIT – II Plant taxonomy**

**(07 Hours)**

Angiosperm systematics: Fundamental concept of Plant Taxonomy (Identification, nomenclature, classification); Taxonomic resources; Herbarium- functions and important herbaria of India and world, Botanical gardens, Flora, monographs and keys (Single-access and multi-access) herbaria of India and world, Botanical gardens, Flora, monographs and keys (Single access and multiple access)

**UNIT – III Classification (04 Hours)**

Historical background of plant classification; Artificial (Linnaeus), Natural (Bentham and Hooker), Phylogenetic system of classification; APG system.

**UNIT – IV Diversity of Chordates (11 Hours)**

Introduction to Biodiversity, types of Biodiversity, General characteristics and Classification of chordates (upto order): Protochordata, Aganatha, Pisces: Osteichthyes, Chondrichthyes, Amphibia, Reptilia, Aves and Mammals.

**UNIT – V Biogeography (04 Hours)**

Zoogeographical realms, Distribution of vertebrates in different realms

**Practical component: 60 Hours**

**FLORA**

1. *Cycas*: T.S (temporary mount) leaf, specimen: male cone and megasporophyll; T.S.corolloid root (temporary mount), T.S. microsporophyll, L.S. ovule (permanent slides).
2. *Pinus*: Study of morphology, dwarf and long shoots, male and female cone, T.S. needle(temporary mount), L.S. male and female cone (permanent slides).
3. Study the characteristic features of **any one** member of the family:
  - (a) Malvaceae
  - (b) Fabaceae/Lamiaceae
  - (c) Euphorbiaceae
  - (d) Asteraceae
  - (e) Liliaceae
4. Mounting of a properly dried and pressed specimen of any wild plant with herbariumlabel (to be submitted on the herbarium sheet with appropriate label)

**FAUNA**

5. Study of following specimens: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Draco, Naja, any two common birds.
6. Slide/ Virtual demonstration of Placoid, Ctenoid and Cycloid scales
7. Identification and classification of one endangered amphibian, reptile, bird and mammal of any one zoogeographical region in Indian.
8. Report on: Biodiversity Park/reserve/ NBPGR.

**Essential/recommended readings**

1. Young, J. Z., (2004). The Life of Vertebrates. III Edition. Oxford university press.

- Parker T.J. and Haswell W.A. Textbook of Zoology Vertebrates. VII Edition, Volume II
- Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
- Kaur I., Uniyal P.L. (2019). *Text Book of Gymnosperms*. New Delhi, Delhi: Daya Publishing House.
- Vashistha, B.R., Sinha, A.K., Kumar, A. (2010). *Botany For Degree Students, Gymnosperms*. New Delhi, Delhi: S Chand Publication.
- Bhatnagar, S.P., Moitra, A. (1996). *Gymnosperms*. New Delhi, Delhi: New Age International (P) Ltd Publishers.
- Singh, G., (2018). *Plant Systematics: Theory and Practice*. Oxford & IBH Publishing Co. Pvt. Ltd.

### Suggested readings

- Ennos, R., & Sheffield, E., (2000). *Plant Life*. UK: University Press, Cambridge.
- Ingrowille, M., (1992). *Diversity and Evolution of land plants*. Chapman and Hall
- Wilson, E. O., (1998). *Biodiversity*. National Academic Press.
- Pough H. *Vertebrate life*. VIII Edition, Pearson International.
- Simpson, M.G. (2010). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.SA

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

### DISCIPLINE SPECIFIC CORE COURSE –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 (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Chemical Energetics, Ionic Equilibria and Nanomaterials, (BS-DSC-203)</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	Class XII pass with Biology and chemistry, as one of the papers in Class XII	<b>Nil</b>

## Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce materials at nanoscale, their preparation, characterization techniques and applications in real life.
- Develops basic understanding of the chemical energetics, laws of thermodynamics, chemical and ionic equilibrium.
- It provides basic understanding of the behaviour of electrolytes and their solutions.
- The course will also cover thermodynamic studies with the calculation of energies and interaction of biomolecules with their neighbouring environment.

## Learning outcomes

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

- Understand the concept of nano-dimensions.
- Know the various methods of preparation of nanomaterials.
- Know the different characterization techniques used for the analysis of nanomaterials and understand the basic principle behind these techniques.
- Understand the diverse properties of nanostructures.
- Appreciate the real-world applications of nanomaterials.
- Understand the laws of thermodynamics, basic principles of thermochemistry and equilibria and successfully extend the concepts learnt in this course to biological systems.
- Understand concept of pH and its effect on the various physical and chemical properties of the compounds.
- Use the concepts learnt to predict feasibility of chemical reactions and to study the behaviour of reactions in equilibrium.
- Explain the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.
- Apply the concepts of pH and electrolytes while studying other chemistry courses and everyday life.

## SYLLABUS OF DSC-3

### UNIT – I Nanomaterials of Biological importance

(15 Hours)

Overview of nanomaterials, classification, properties, role of size, methods of synthesis (Chemical methods: chemical reduction, coprecipitation, sol-gel, microemulsions or reverse micelles, solvothermal synthesis, Green or biological methods using bacteria, Fungi, etc, Plants based methods using tea leaves, cinnamon bark, etc), characterization techniques (UV-Vis, IR, SEM, TEM, XRD), optical properties of gold and silver metallic nanoparticles, concept of surface plasmon resonance, carbon nanotubes, inorganic nanowires, quantum dots & semiconductor nanoparticles, metal-based nanostructures (Iron Oxide & ZnO nanoparticles), polymer-based nanostructures, protein-based Nanostructures, natural and artificial nanomaterials, bionanomaterials and bio-nanocomposites, bioinorganic nanomaterials, DNA and its nanomaterials, biomimetics, self-assembled nanostructures, control of nanoarchitecture, Applications of nanomaterials in drug delivery, tissue engineering,

medicine, orthopaedics, bioimaging, dental implants and biosensors

## UNIT – II Chemical energetics

(05 Hours)

Review of laws of thermodynamics, important principles and definitions of thermochemistry, concept of standard state and standard enthalpies of formations, enthalpy of neutralization, integral and differential enthalpies of solution and dilution, calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Statement of third law of thermodynamics and calculation of absolute entropies of substances.

## UNIT – III Ionic Equilibria

(10 Hours)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, Ostwald's dilution law, ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect, salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions and their applications in biological systems, Henderson-Hasselbalch equation. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

### Practical component: TOTAL HOURS: 60

1. Synthesis of silver nanoparticles (AgNPs) by chemical reduction method and their spectroscopic characterization using UV-visible spectrophotometer.
2. Green synthesis of silver nanoparticles (AgNPs) using soluble starch or cinnamon bark and their characterization using UV-visible spectroscopy.
3. Phytochemicals mediated synthesis of gold nanoparticles (AuNPs) using tea leaves and to study the effect of size on color of gold nanoparticles.
4. Preparation of magnetic nanoparticles (MNPs) of  $\text{Fe}_3\text{O}_4$  using green tea leaf extract.
5. Synthesis of pure ZnO and Cu-doped ZnO nanoparticles by precipitation method and its characterization using UV-visible spectroscopy.
6. XRD pattern of nanomaterials and estimation of particle size. (Students can be provided with XRD patterns of known materials and asked to interpret the data.)
7. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
8. Determination of integral enthalpy (endothermic and exothermic) solution of salts.
9. Preparation of buffer solutions: (i) Sodium acetate-acetic acid or (ii) Ammonium chloride-ammonium acetate.
10. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

11. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base and determination of dissociation constant of a weak acid.

### Essential/recommended readings

1. Atkins, P., Overton, T., Rourke, J., Weller, M. & Armstrong, F. (2011-12).
2. Shriver and Atkins' Inorganic Chemistry. Oxford, UK: Oxford University Press.
3. Poole Jr.; Charles P.; Owens, Frank J. (2003), Introduction to Nanotechnology, John Wiley and Sons.
4. Malhotra, P.; Gulati, S., Novel Inorganic Solids and Nanomaterials, (2022) I.K. International Pvt Ltd.
5. Gulati, S., Sharma, J. L., Manocha, S. (2017). Practical Inorganic Chemistry. New Delhi, India: CBS publishers and distributors Pvt. Ltd.
6. Orbaek, W.; McHale, M.M.; Barron, A. R.; Synthesis and Characterization of Silver Nanoparticles for An Undergraduate Laboratory, J. Chem. Educ. 2015, 92, 339–344.
7. Gulati, S.; Shukla, S.; Kumar, S., Practical Green Chemistry, Strategies, Tools & Experiments, SKP Publishers and Distributors, 2019.
8. Shukla, S.; Gulati, S.; Kumar, S., A textbook of Green Chemistry, Benign by Design, SKP Publishers and Distributors, 2019.
9. Ghorbani H.R.; Mehr, F.P; Pazoki, H; Rahmani, B.M.; Synthesis of ZnO Nanoparticles by Precipitation Method, Orient J Chem 2015, 31(2).
10. Kumar, S., Kapoor, V, Gulati, S, Experiments in Physical Chemistry, (2017), Book Age Series.
11. Kapoor, K.L. (2017). A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium, Vol. 2. India: McGraw-Hill Education.
12. Khosla, B. D., Garg, V. C., Gulati, A. (2011). Senior Practical Physical Chemistry. New Delhi, India: R. Chand & Co.
13. Rastogi, R. P., Mishra, R. R. (2009). *An Introduction to Chemical Thermodynamics*. India: Vikas Publication.
14. Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.
15. Ball, D. W. (2017), Physical Chemistry, 2<sup>nd</sup> Edition, Cengage Learning, India.
16. Castellan, G. W. (2004), Physical Chemistry, 4<sup>th</sup> Edition, Narosa.

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

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Category-I  
BSC (H) ENVIRONMENTAL SCIENCE

DISCIPLINE SPECIFIC CORE COURSE – 4 (DSC-EVS-4): WATER AND WATER RESOURCES

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		
WATER AND WATER RESOURCES	4	2	0	2	Class XII pass	NIL

**Learning objectives**

The Learning Objectives of this course are as follows:

- Gain insights into the hydrological cycle, properties of water, physico-chemical and biological
- Understand parameters and indices of water quality
- Classify types of water resources and thus develop practices for their sustainable use and management
- Investigate problems associated with water shortages in India and familiarize with case studies on international and national conflicts on water.

**Learning outcomes**

After this course, students will be able to learn the following skills.

- Acquire skills to identify potential water resources in a given region and manage existing water resources
- Analyze data on water resources to understand the current environmental challenge and prevent the future ones
- Make informed decisions on using and choosing appropriate methods for water resource management and develop nature-based methods to improve the health of water bodies
- Develop low-cost methods for purifying drinking and natural water
- Correlate water resource management practices with socio-economic challenges and prospects
- Relate and interpret the data on water resources data with other related sustainability challenges

**SYLLABUS OF DSC-4**

Theory (02 Credits: 30 lectures)

**UNIT – I Introduction (2 Hours)**

Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapo- transpiration; classification of water resources (oceans, rivers, lakes and wetlands).

### **UNIT – II Properties of water (4 Hours)**

Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.

### **UNIT – III Surface and subsurface water (6 Hours)**

Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings.

### **UNIT – IV Wetlands and their management (4 Hours)**

Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India.

### **UNIT – V Marine resource management (3 Hours)**

Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approach, construction techniques and monitoring of coastal zones).

### **UNIT – VI Water resources in India (4 Hours)**

Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management.

### **UNIT – VII Water resource conflicts (4 Hours)**

Water resources and sharing problems, case studies on Kaveri and Krishna River water disputes; Multipurpose River valley projects in India and their environmental and social impacts; case studies of dams; Narmada and Tehri dam – social and ecological losses versus economic benefits; International conflicts on water sharing between India and her neighbours; agreements to resolve these conflicts.

### **UNIT – VIII Major laws and treaties (3 Hours)**

National water policy; water pollution (control and prevention) Act 1972; Indus water treaty; Ganges water treaty; Teesta water treaty; National River linking plan: ecological and economic impacts.

### **Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)**

1. Estimate water quality based on physico-chemical parameters, such as pH, electrical conductivity, salinity, total dissolved and suspended solids, iron contents, and dissolved oxygen
2. Classify and characterize aquifers of Indian states and analyse “Safe” and “Over-exploited” zones of two states based on groundwater use.



3. Determine alkalinity, alkalinity hazard and SAR of water samples and recommend their use for various purposes.
4. Identify and map water resources in NCT Delhi and correlate its current status with changing land use in past 60 years
5. Estimate sediment load in Yamuna River at different sections of its course in Delhi regions
6. Assess water quality (pH, TDS, TH, EC, BOD, Heavy Metals) and determine the water portability of samples collected from different sites of NCT Delhi.
7. Conduct an online survey to assess people's knowledge, perception and attitude towards water quality issues and their impact on the environment and health.
8. Analyze water conservation strategies in North-eastern and Western states of India from the data available from State Government Agencies.
9. Document and compare water conservation strategies in different agroclimatic zones of India
10. Analyze watershed management strategies in selected river basins of India.
11. Develop integrated water management strategies for two contrasting river basin of India.

### **Essential/recommended readings**

- McNabb, D.E., 2017. *Water Resource Management: Sustainability in An Era of Climate Change*. Springer.
- Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. *Water Resource Systems Planning and Analysis*. Englewood Cliffs, NJ, Prentice Hall.
- Brebbia, C.A. 2013. *Water Resources Management VII*. WIT Press.
- CEA. 2011. *Water Resources and Power Maps of India*. Central Board of Irrigation & Power.
- Bogardi, J.J., Gupta, J., Nandalal, K.W., Salamé, L., van Nooijen, R.R., Kumar, N., Tingsanchali, T., Bhaduri, A. and Kolechkina, A.G. eds., 2021. *Handbook of Water Resources Management: Discourses, Concepts and Examples*. Springer International Publishing.
- de Oliveira Vieira, E., Sandoval-Solis, S., de Albuquerque Pedrosa, V. and Ortiz-Partida, J.P., 2020. *Integrated Water Resource Management*. Springer International Publishing.
- Garg, V., Singh, V.P. and Raj, V. eds., 2017. *Development of Water Resources in India*. Springer International Publishing.
- Grigg, N.S., 2016. *Integrated Water Resource Management: An interdisciplinary Approach*. Springer.
- Mimikou, M.A., Baltas, E.A. and Tsihrintzis, V.A., 2016. *Hydrology and Water Resource Systems Analysis*. CRC Press.
- Vickers, A. 2001. *Handbook of Water Use and Conservation*. WaterPlow Press.

### **Suggested readings**

- Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, India.
- Hidalgo, M.E.A., 2013. A Decision Framework for Integrated Wetland-River Basin Management in a Tropical and Data Scarce Environment: UNESCO-IHE PhD Thesis. CRC Press.
- Information Resources Management Association (Editor) (2017). *Hydrology and Water Resource Management: Breakthroughs in Research and Practice*, 1st edition IGI Global.

- Mays, L.W. 2006. *Water Resources Sustainability*. The McGraw-Hill Publications.
- McNabb, D.E., 2017. *Water Resource Management: Sustainability in An Era of Climate Change*. Springer.
- Schward & Zhang, 2003. *Fundamentals of Groundwater*. John Willey and Sons.
- Souvorov, A.V. 1999. *Marine Ecogonomics: The Ecology and Economics of Marine Natural Resource Management*. Elsevier Publications.

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

**DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-EVS-5): LAND AND SOIL:  
CONSERVATION AND 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		
<b>LAND AND SOIL: CONSERVATION AND MANAGEMENT</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass</b>	<b>NA</b>

**Learning objectives**

The Learning Objectives of this course are as follows:

- Gain insights into fundamentals of land and soil degradation
- Understand deeply the properties of soil and how the quality of land and soil degrades due to anthropogenic activities
- Develop solutions to combat land and soil degradation based on natural processes

**Learning outcomes**

After this course, students will be able to

- Acquire skills in managing soil and land sustainably
- Analyze data on soils and land use to identify the principal factor(s) governing sustainability
- Develop methods to address environmental issues related to soil health and changing land use
- Correlate positive or negative impacts of soil and land use on ecosystems and society
- Relate and interpret the soil and land use data with the sustainability of a region
- Use soil and land use data to develop evidence-based land use guidelines

**SYLLABUS OF DSC-2**

Theory (02 Credits: 30 lectures)

### **UNIT – I Introduction (3 Hours)**

Land as a resource, soil health; ecological and economic importance of soil; types and causes of soil degradation; impact of soil loss and soil degradation on agriculture and food security; need for soil conservation and restoration of soil fertility.

### **UNIT – II Fundamentals of soil science (5 Hours)**

Soil formation; classification of soil; soil architecture; physical properties of soil; soil texture; soil water holding capacity; soil temperature; soil colloids; soil acidity and alkalinity; soil salinity and sodicity; soil organic matter; micronutrients of soil; nitrogen, sulphur, potassium and phosphorus economy of soil; soil biodiversity; soil taxonomy maps.

### **UNIT – III Soil degradation – causes (5 Hours)**

Soil resistance and resilience; nature and types of soil erosion; non-erosive and erosive soil degradation; losses of soil moisture and its regulation; nutrient depletion; soil pollution due to mining and mineral extraction, industrial and urban development, toxic organic chemicals, and organic contaminants in soils; fertilizers and fertilizer management; recycling of soil nutrients.

### **UNIT – IV Land use changes and land degradation (7 Hours)**

Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradation - deforestation, desertification; habitat loss, loss of biodiversity; range land degradation; land salinization; human population pressure, poverty, socio-economic and institutional factors; drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats.

### **UNIT – V Costs of land degradation (7 Hours)**

Economic valuation of land degradation; onsite and offsite costs of land degradation; loss of ecosystem services; effects on farming communities; effects on food security; effects on nutrient cycles; future effects of soil degradation; emerging threats of land degradation to developing countries.

### **UNIT – VI Controlling land degradation (3 Hours)**

Sustainable land use planning; role of databases and data analysis in land use planning control and management; land tenure and land policy; legal, institutional and sociological factors; participatory land degradation assessment; integrating land degradation assessment into conservation.

### **Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)**

1. Determine and assess soil texture, color, structure, water, and temperature using the jar test and soil textural triangle. Discuss and describe the soil profiles for different types of ecosystems.
2. Characterize the given soil samples for the proportion of soil particle size fractions.
3. Determine bulk density, moisture content, and water holding capacity of garden soil and compare it with other soil types

4. Estimate variations in pH, alkalinity, acidity, and salinity of the given soil sample. Establish the relationship between soil quality and crop productivity.
5. Evaluate given soils samples for soil organic matter contents and comment on their productivity
6. Calculate permeability of soil samples and comment on its impact on plant growth
7. Separate minerals using the selective dissolution method
8. Estimate PO<sub>4</sub>-P of soils using ammonium molybdate reactions by spectrophotometric analysis
9. Estimate SO<sub>4</sub>-S contents of soils by titrating with the barium chloride solution
10. Extract, investigate and interpret soil health data (micronutrient status, macronutrient status, and pH) for Northern, Western, and North-Eastern states of India. For the selected states, discuss the various soil types, agriculture practices, cropping patterns, crop production, conservation, and management strategies.
11. Extract, investigate and interpret the available datasets on soil maps, soil databases, and land degradation maps for India and draw suitable inferences. Conduct a perception-based study on the importance of soils and various impacts of soil and land degradation through an online survey.
12. Assessment of fertilizer management and integrated nutrient management practices for selected crops in India.

#### **Essential/recommended readings**

- Brady, N.C. & Well, R.R. 2007. *The Nature and Properties of Soils* (13<sup>th</sup> edition), Pearson Education Inc.
- Hazelton, P. and Murphy, B., 2021. *Understanding Soils in Urban Environments*. CSIRO publishing.
- Johnson, D.L. 2006. *Land Degradation* (2<sup>nd</sup> edition). Rowman & Littlefield Publishers.
- Kutz, M., 2018. *Handbook of Environmental Degradation of Materials*. William Andrew.
- Mir, B.A., 2021. *Manual of Geotechnical Laboratory Soil Testing*. CRC Press.
- Pansu, M. and Gautheyrou, J., 2007. *Handbook of Soil Analysis: Mineralogical, Organic and Inorganic Methods*. Springer Science & Business Media.
- Peterson, G. D., Cumming, G. S. & Carpenter, S. R. 2003. Scenario planning: a tool for conservation in an uncertain world. *Conservation Biology* 17: 358-366.

#### **Suggested readings**

- Fahad, S., Sonmez, O., Saud, S., Wang, D., Wu, C., Adnan, M. and Turan, V. eds., 2021. *Sustainable Soil and Land Management and Climate Change*. CRC Press.
- Jones, J.B., 2001. *Laboratory Guide for Conducting Soil Tests and Plant Analysis*. CRC press.
- Loconto, P.R., 2022. *Laboratory Experiments in Trace Environmental Quantitative Analysis*. CRC Press.
- Marsh, W. M. & Dozier, J. 1983. *Landscape Planning: Environmental Applications*. John Wileyand Sons.
- Patnaik, P., 2017. *Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes*. CRC Press.

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## DISCIPLINE SPECIFIC CORE COURSE – 6 (DSC-EVS-6): ECOLOGY AND ECOSYSTEMS

### 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		
<b>ECOLOGY AND ECOSYSTEMS</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass</b>	<b>NIL</b>

#### Learning objectives

The Learning Objectives of this course are as follows:

- Develop an understanding of ecosystems and their structural and functional aspects
- Reveal interconnectedness and interdependentness among all the biotic and abiotic components of the environment
- Gain insights into the dynamic nature of the ecological processes in maintaining equilibrium in nature.

#### Learning outcomes

After this course, students will be able to

- Acquire skills in ecological census techniques
- Analyze the status of biodiversity and ecosystem structure
- Develop methods to assess the changes in ecosystems with time and space
- Correlate effects of anthropogenic factors on ecosystem stability
- Relate and interpret the connections between environmental factors and ecosystem changes
- Use ecological data to predict the impact of a given factor on ecosystem and biodiversity

#### SYLLABUS OF DSC-6

Theory (02 Credits: 30 lectures)

##### UNIT – I Introduction (3 Hours)

Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes.

##### UNIT – II Ecology of individuals (5 Hours)

Ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity; ecotypes; ecoclines; acclimation; ecological niche; types of niches: Eltonian niche, Hutchinsonian niche, fundamental niche, realized niche; niche breadth; niche partitioning; niche differentiation; thermoregulation; strategies of adaptation in plants and animals.

### **UNIT – III Ecology of populations (5 Hours)**

Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent; limits to population growth; deterministic and stochastic models of population dynamics; ruderal, competitive and stress-tolerance strategies.

### **UNIT – IV Ecology of communities (5 Hours)**

Discrete versus continuum community view; community structure and organization: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, proto-cooperation, predation, competition, parasitism, mimicry, herbivory; ecological succession: primary and secondary successions, models and types of successions, climax community concepts, examples of succession.

### **UNIT – V Ecosystem ecology (5 Hours)**

Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands; ecosystem structure and function; abiotic and biotic components of ecosystem; ecosystem boundary; ecosystem function; ecosystem metabolism; primary production and models of energy flow; secondary production and trophic efficiency; ecosystem connections: food chain, food web; detritus pathway of energy flow and decomposition processes; ecological efficiencies; ecological pyramids: pyramids of number, biomass, and energy.

### **UNIT – VI Biogeochemical cycles and nutrient cycling (4 Hours)**

Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake; role of mycorrhizae; decomposition and nutrient release; nutrient use efficiency; nutrient budget; nutrient conservation strategies.

### **UNIT – VII Biological invasions (3 Hours)**

Concept of exotics and invasives; natural spread versus man-induced invasions; characteristics of invaders; stages of invasion; mechanisms of invasions; invasive pathways; impacts of invasion on ecosystem and communities; invasive ecogenomics – role of polyploidy and genome size in determining invasiveness; economic costs of biological invasions.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Using and choosing quadrat types for vegetation analyses
2. Carry out vegetation analysis using line-transect techniques
3. Estimate the populations of aquatic beetles and bugs in ponds by the mark-capture method
4. Conduct bird surveys in your college/nearby garden using the point transect method
5. Determine the variations in abundance of micro-, meso-, and macrofauna in soils of different land use
6. Estimate the diversity of species within a community or habitat and comment

- on alpha diversity
7. Analyze the rate and extent of change in species along a gradient from one habitat to others and comment on beta diversity
  8. Considering the analyses of practicals 6 and 7, estimate the gamma diversity and comment.
  9. Prepare and interpret the species accumulation curve for the total species richness of an area
  - 10-13 Compare and classify communities for (a) similarity and differences, (b) influential environmental variables, (c) interspecific association

### Essential/recommended readings

- Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2020. *The Ecology of Plants*. 3<sup>rd</sup> Ed. Sinauer associates incorporated.
- Henderson, P.A., 2009. *Practical Methods in Ecology*. John Wiley & Sons.
- Jorgensen, S.E. ed., 2009. *Ecosystem Ecology*. Academic press.
- Morin, P.J., 2009. *Community Ecology*. John Wiley & Sons.
- Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders.
- Rockwood, L.L., 2015. *Introduction to Population Ecology*. John Wiley & Sons.
- Sutherland, W.J. ed., 2006. *Ecological Census Techniques: A Handbook*. Cambridge university press.

### Suuggested readings

- Groom. B. & Jenkins. M. 2000. *Global Biodiversity: Earth's Living Resources in the 21<sup>st</sup> Century*. World Conservation Press, Cambridge, UK.
- Loreau, M. & Inchausti, P. 2002. *Biodiversity and Ecosystem Functioning: Synthesis and Perspectives*. Oxford University Press, Oxford, UK.
- Pastor, J., 2008. *Mathematical Ecology of Populations and Ecosystems*. John Wiley & Sons.
- Pimentel, D. (Ed.). 2011. *Biological invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species*. CRC Press.
- Ranta, E., Lundberg, P. and Kaitala, V., 2005. *Ecology of Populations*. Cambridge University Press.
- Wilson, E. O. 1985. The biological diversity crisis. *BioScience* **35**: 700-706.

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**GENERIC ELECTIVES (GE-EVS-05): CIRCULAR ECONOMY AND ENVIRONMENTAL SUSTAINABILITY**

**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		
<b>CIRCULAR ECONOMY AND ENVIRONMENTAL SUSTAINABILITY</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass</b>	<b>NIL</b>

**Learning objectives**

The Learning Objectives of this course are as follows:

- Critically evaluate five mega trends involving climate, development, ecology, economy, and technology and their linkages with energy and resources
- Inculcate principles and methods of circular economy and design resource-efficient, low carbon paradigm.
- Analyze business models/institutes/communities and associated processes and services and develop recommendations for integrating principles of circular economy
- Adopt routes of circular economy in personal, family, community, and institutional settings.

**Learning outcomes**

After the course, the students will be

- Equipped with tools and techniques of circular economy to develop a sustainable institute or community
- Acting as a consultant to industries and international organizations aiming for a circular economy
- Serving as a catalyst in evolving an ecoliterate society and industry and promoting sustainable polices

**SYLLABUS OF GE-1**

**Theory (02 Credits: 30 lectures)**

**UNIT – I Circular economy (3 Hours)**

Concept and definitions; Closed loop ecosystems; Systems thinking; Benefits to environment, economy and society (03 lecture)

**UNIT – II Principles of circular economy (4 Hours)**

Sustainable procurement; Ecodesign; Industrial and territorial ecology; Economics of functionality; Responsible consumption; Extending the duration of use; Recycling (04 lecture)



### **UNIT – III Steps for transition towards a circular economy (7 Hours)**

Large-scale transition to non-polluting sources of energy; Durable products requiring less materials and energy; Incentivization of recycling, re-use, and repair; Replacement of hazardous materials with safer alternatives (07 lecture)

### **UNIT – IV Circular economy implementation (7 Hours)**

Micro-level: Firm-level engineering and managerial level; Meso-level: Industrial ecology, Industrial symbiosis, Eco-clusters, Eco-industrial parks; and Macro level: General policies, Plans, Green and sustainable entrepreneurship. (07 lecture)

### **UNIT –V Challenges in implementing circular economy (7 Hours)**

Achievability and desirability; Disrupting consumer's convenience; Local regulations versus the circular economy concept; Lack of infrastructure for waste treatment; Lack of recycling technology; Poor business model plan (07 lecture)

### **UNIT –VI Case studies from India and other parts of the world (2 Hours)**

#### **Practicals/Hands-on Exercises – based on theory (60 hours)**

1. Evaluate the status of your institute with respect to efforts on circular economy using qualitative and quantitative surveys
2. Survey your institute and depict the journey of waste in your institute highlighting the factors/actors that are barrier to and facilitator of complete waste recycling
3. Collect spatial and temporal data on types of wastes being generated and identify the recycling hotspots and the gap in adopting circular economy principles
4. Based on activities 1 – 3, develop a consolidated waste recycling plan highlighting targets for Institute and each Department
5. Recycle and reuse the waste clothes produced at home and make a presentation in the class to increase their lifecycle and estimate its impact on ecological footprint of the family/institute
6. Coordinate with different groups working on waste recycling focusing on different types of wastes segregated at home/institute, for example, plastics/ glass/furniture/ metal/cans/paper waste and present as group activity
7. Visit an industrial area to analyse the status of circular economy concepts being practiced and give recommendations to improve the industrial sustainability (submit the report)
8. Conduction workshop in the Institute to educate students of other courses for converting wastes into useful products
9. Run a repair café where students and staff bring their broken stuff and get it repaired with the help of experts available at the Institute
10. Conduct a swap shop and swap party where people bring their old clothes for exchange
11. Estimate the impact of activities 8–10 reduction in ecological footprints
12. Conduct a drive to collect e-waste from the institute and the neighbourhood localities and donate it to the recycling facilities and estimate its impact on environment.
13. Based on the activities 1–12, plan and conduct awareness camps in the neighbourhood to educate and motivate people about importance of reuse and recycling and empower them with recycling methods

#### **Essential/recommended readings**

- Charter, M. ed., 2018. *Designing for the Circular Economy*. Routledge, London, UK.
- Hawken, P., Lovins, A.B. and Lovins, L.H., 2013. *Natural Capitalism: The Next Industrial Revolution*. Routledge.
- Lacy, P. and Rutqvist, J., 2015. *Waste to Wealth: The Circular Economy Advantage*. London: Palgrave Macmillan.
- Mavropoulos, A. and Nilsen, A.W., 2020. *Industry 4.0 and Circular Economy: Towards a Wasteless Future or A Wasteful Planet?* John Wiley & Sons.
- Stahel, W.R. and MacArthur, E., 2019. *The Circular Economy: A User's Guide*. Routledge, NY, USA.

#### **Suggested readings**

- Crocker, R., Saint, C., Chen, G. and Tong, Y. eds., 2018. *Unmaking Waste in Production and Consumption: Towards the Circular Economy* (pp. 1-353). Bingley, UK: Emerald Publishing Limited.
- Delchet-Cochet, K. ed., 2020. *Circular Economy: From Waste Reduction to Value Creation*. John Wiley & Sons.
- Frodermann, L., 2018. *Exploratory Study on Circular Economy Approaches*. Springer, Fachmedien Wiesbaden.
- Ghosh, S.K., Samanta, S., Hirani, H. and da Silva, C.R.V. eds., 2022. *Effective Waste Management and Circular Economy: Legislative Framework and Strategies*. CRC Press.

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## Credit distribution, Eligibility and Pre-requisites of the Course

### GENERIC ELECTIVES (GE-EVS-6): WETLANDS FOR INDUSTRIES AND ENVIRONMENT

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
<b>WETLANDS FOR INDUSTRIES AND ENVIRONMENT</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass</b>	<b>NIL</b>

#### Learning objectives

The Learning Objectives of this course are as follows:

- Delineate, and classify the target wetland
- Identify common wetland plants and indicators of wetlands
- Assess landscape for wetland management and conservation
- Evolve a wetland construction and restoration plan
- Suggest appropriate changes for effective wetland regulation law and policy

#### Learning outcomes

After successful completion of this course, students will be able to:

- Apply basic principles of wastewater treatment for environmental and industrial applications
- Develop plans for monitoring wetland health and designing a constructed wetland
- Assess the feasibility of constructed wetlands for wastewater treatment
- Operate and maintain wetlands in nature and industries

### SYLLABUS OF GE-EVS-6

#### Theory (02 Credits: 30 lectures)

#### UNIT – I Ecology and socio-economy of wetlands (11 Hours)

Wetland types and functions; Ramsar Convention, Vegetation type and dynamics; Soil types; Geology and geomorphology; Hydrological regimes: Water quality and balance, Sedimentation; Indicators; Biodiversity and its significance; Ecological and economic benefits: Provisioning, Regulating, Cultural and Supporting services, Socio-economic and cultural diversity in human society living in and around wetlands; Income and employment generation by wetlands; Community resource use and management practices. (11 lectures)

#### UNIT – II Wetlands and water treatments (8 Hours)

Principles and efficacy of natural wetlands; Economics of treatment; Case studies from India and other countries; Types of constructed wetlands and their principles; Potential of constructed wetlands for treating different types of wastewaters (agriculture, domestic,

industry, municipal, runoff, and sludge); Operation and maintenance; Case studies from India and other countries (8 lectures)

### **UNIT – III Wetland management (11 Hours)**

Delineation and mapping; Features and associated factors; Monitoring ecosystem health; Major threats; Setting up goals and objectives; Institutional arrangements, Wetlands ecosystem services maps; Ecosystem services trade-offs; Landscape-scale Management; Interventions to sustain biodiversity and ecosystem services; Mobilizing community participation and generating finance; Cross-sectoral integration; Integration of wetland conservation in development plans, acts, and rules; Adaptive management. (11 lectures)

### **Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)**

1. Identify a potential area for wetland construction, propose its purpose and goal, and develop the construction plan giving details of location, type, current land use, biodiversity, and hydrologic regime
1. Prepare water budgets and hydrographs of the selected area based on the data on water inputs and outputs collected from concerned institutes
2. Field surveys and analyze vegetation characteristics of a pristine wetland present in the nearby location of the study site
3. Analyze adaptive strategies of selected native plants to hydrologic regime suitable for wetland construction and develop planting strategies of species assemblage
4. Analyze soil type and determine its physico-chemical properties (pH, TDS, EC, CEC, Redox potential, etc.)
5. Evolve soil amendment method to improve texture, percolation, and nutrient composition. suitable for the hydrogeomorphic model and selected plant species
6. Surveying wetlands to identify suitable indicators for mapping and delineating wetlands zone of influence and evaluate anthropogenic activities as major threats to wetlands
7. Develop wetlands ecosystem services (ES) potential maps and evaluate ES trade-offs
8. Analyze different models for wetland construction and, based on the nature of the water regime and basic methods of wetland construction, recommend the hydrogeomorphic model suitable for the selected landscape

### **Essential/recommended readings**

- Aber, J.S., Pavri, F. and Aber, S., 2012. *Wetland Environments: A Global Perspective*. John Wiley & Sons.
- Keddy, P.A., 2010. *Wetland Ecology: Principles and Conservation*. Cambridge University Press.
- Shuqing, An., and Jos, T.A. Verhoeven (Eds.), 2019. *Wetlands: Ecosystem Services, Restoration and Wise Use Series: Ecological Studies*, Volume 238, Springer, Cham.
- Stefanakis, A.I. ed., 2018. *Constructed Wetlands for Industrial Wastewater Treatment*, Wiley, Blackwell.
- Tiner, R.W., 2016. *Wetland Indicators: A Guide to Wetland Formation, Identification, Delineation, Classification, and Mapping*. CRC Press.

**Suggested readings**

- Austin, G. and Yu, K., 2016. *Constructed Wetlands and Sustainable Development*. Routledge.
- Lopez, R.D., Lyon, J.G., Lyon, L.K. and Lopez, D.K., 2013. *Wetland Landscape Characterization: Practical Tools, Methods, and Approaches for Landscape Ecology*. CRC Press.
- Windham-Myers, L., Crooks, S. and Troxler, T.G. eds., 2018. *A Blue Carbon Primer: The State of Coastal Wetland Carbon Science, Practice and Policy*. CRC Press.

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

**GENERIC ELECTIVES (GE-EVS-7): CORPORATE, SOCIAL, AND ENVIRONMENTAL RESPONSIBILITIES FOR CONSERVATION AND SUSTAINABLE DEVELOPMENT**

**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		
<b>CORPORATE, SOCIAL, AND ENVIRONMENTAL RESPONSIBILITIES FOR CONSERVATION AND SUSTAINABLE DEVELOPMENT</b>	4	2	0	2	Class XII pass	NIL

**Learning objectives**

The Learning Objectives of this course are as follows:

- Inculcate interdependent and interrelated theories of corporate branding, environmental sustainability, and social equity
- Understand the working and driving forces of CSR and its significance as a stepping stone to Sustainable Business Models
- Gain insights into CSR as a tool to ensure social justice and adopt environmental wisdom from industries
- Empower with emerging frameworks and practices in CSR for environmental sustainability and improve quality of life

**Learning outcomes**

After the course, students will be able to:

- Explain the concept of CSR from an environmental sustainability perspective and its significance in next-generation marketing strategies
- Apply concepts of CSR to develop strategies for responsible marketing, business success, and environmental protection.
- Develop systems thinking and evolve as a responsible consumer
- Decipher linkages between concepts of circular economy, sharing economy, and carbon/ecological footprints, and identify opportunities and challenges to specific businesses and target consumers.
- Gain insights into five dimensions of sustainability performance: economic, environmental, governance, social and ethical
- Practice sustainability management, implement cleaner technologies, and argue in favour of environmental protection.

## **SYLLABUS OF GE-EVS-7**

Theory (02 Credits: 30 lectures)

### **UNIT – I Sustainable Development (8 Hours)**

Definitions, goals and frameworks; Sustainability: Definition and concept, Bottom of the pyramid and fairtrade; Evolution of concepts, Socio-ethical and environmental aspects, Benefits in strategic planning; Associated world's leaders and corporations, Financial, social and reputational benefits, Circular and share economy (8 lectures)

### **UNIT – II Corporate social responsibility (CSR) (6 Hours)**

CSR: Definition and concept, Philosophy and practices of CSR; Measuring CSR; Impact of CSR on rural livelihoods, natural resources management, biodiversity conservation; Carbon footprint; Cleaner technologies; Emerging CSR policies in India

### **UNIT – III CSR and Sustainability (9 Hours)**

Why and when to apply CSR activities, Competitiveness vs Ethical, Green markets and budget, Bottlenecks of being sustainable, Public-private partnerships for socio-ecological entrepreneurship, Vocal for local embedding sustainability; Business strategies for sustainable individuals, firms, and industries, Power-Inequality-Environment-CSR nexus, Managing, Monitoring, and Reporting CSR, Beyond framing CSR as strategic, political or utopian (9 lectures)

### **UNIT – IV Case studies (7 Hours)**

CSR applications for improving livelihoods, enhancing soil health and crop productivity in stress environment, adaptation to climate change, and diversification of crop patterns improving rural wastewater management (7 lectures)

### **Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)**

1. Analyze variations in CSR efforts in saving the environment by countries differing in biodiversity and ecosystem diversity
2. Critically analyze OECD Guidelines for Multinational Enterprises on corporate responsibility
3. Select a company/business organization and, based on its activities and products, identify the environmental issues that need to be addressed for societal need
4. Evaluate diverse environmental issues based on their impact on society and organizational brand value and develop its vision document and a CSR plan for environmental conservation
5. Determine priorities and evolve a code of conduct document for the selected company to maximize its CSR for environmental issues
6. Based on the activities of the target business organization, develop an action plan and policies to suit the international guidelines and standards of CSR for environmental conservation

7. Identify the constraints to implement the guidelines and standards set based on dialogue with different stakeholders and surveying the local circumstances
8. Analyze the variations in guidelines and standards to meet the CSR in countries differing in biodiversity and cultural values
9. Identify the environmental indicators to formulate a monitoring and reporting system for CSR success
10. Evolve the appropriate communication style for different internal and external stakeholders
11. Field surveys and lab-based assays for monitoring the targeted ecosystem, biodiversity, environmental compartment, and socio-ecological systems for the impact of CSR

#### **Essential/recommended readings**

- Bachnik, K., Kaźmierczak, M., Rojek-Nowosielska, M., Stefańska, M. and Szumniak-Samolej, J. (eds.), 2022. *Corporate Social Responsibility and Sustainability: From Values to Impact*. Routledge.
- Camilleri, M.A., 2017. *Corporate Sustainability, Social Responsibility and Environmental Management*. Cham, Switzerland: Springer International Publishing.
- Geoffrey H., 2010. *When Principles Pay: Corporate Social Responsibility and the Bottom Line*, Columbia University Press.
- McKenna, K., 2015. *Corporate Social Responsibility and Natural Resource Conflict*. Routledge.

#### **Suggested readings**

- Roberts, L., Georgiou, N. and Hassan, A.M., 2022. Investigating biodiversity and circular economy disclosure practices: Insights from global firms. *Corporate Social Responsibility and Environmental Management*. DOI: 10.1002/csr.2402
- Ringham, K., 2017. *CSR and Sustainability: From the Margins to the Mainstream: A Textbook*, Routledge
- Rendtorff, J.D., 2019. *Philosophy of Management and Sustainability: Rethinking Business Ethics and Social Responsibility in Sustainable development*. Emerald Group Publishing.

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



**GENERIC ELECTIVES (GE-EVS-8): E-WASTES: LEGISLATION, TRADE AND 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
		Lecture	Tutorial	Practical/ Practice		
<b>E-WASTES: LEGISLATION, TRADE AND MANAGEMENT</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass</b>	<b>NIL</b>

**Learning objectives**

The Learning Objectives of this course are as follows:

- Define and explain e-waste and its category
- Learn effective mechanisms to regulate the generation, collection, storage, transport, import, and export,
- Empower with methods of recycling, treatment, and disposal of e-waste
- Current legislative rules for managing e-waste in the environment

**Learning outcomes:**

After the course, students will be able to

- Apply various concepts for e-waste management hierarchy with a holistic understanding of the environmental impacts of e-waste
- Decipher the roles of the various national and internal acts and laws applicable for e-waste management
- Evolve plans for handling e-waste to comply with its management proposed under national and global legislation
- Develop a holistic understanding of environmental impacts of e-waste, application of

**SYLLABUS OF GE-EVS-8**

**Theory (02 Credits: 30 lectures)**

**UNIT – I E-waste Composition, Generation and Management (8 Hours)**

Definition, Composition and generation, Global and national perspective, Co-pollutants, Hazardous properties, Effects on human health and environment, Domestic e-waste disposal, E-waste Management: Basic principles, Components, Resource recovery potential, Technologies for recovery of resources, Steps in recycling and recovery of materials-mechanical processing, Occupational and environmental health effects (8 Lectures)

**UNIT – II Global trade of E-waste (7 Hours)**

Factors in global waste trade economy, Waste trading and electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on

liberalizing import rules, E-waste economy in the organized and unorganized sector, Production and recycling of e-wastes in Indian metro cities.

### **UNIT – III Control measures (7 Hours)**

Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source.

### **UNIT – IV Relevant legislation (8 Hours)**

Hazardous Waste Rules, 2008, E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs. The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive. (8 Lectures)

### **Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)**

1. Prepare inventory and estimate the magnitude of electrical and electronic waste from the home, college, or the selected site (hospitals/company/manufacturing facilities) (example, air conditioners, heaters, microwaves, batteries, digital cameras, calculators, circuit boards, monitors, VCRs/DVD players, telephone equipment, etc.)
2. Categorize e-waste into different types as per international and national guidelines
3. Prepare a list of certified electronics recyclers in your city and transport e-waste to it, and have an interactive session to learn from the processes being followed.
4. Find out the composition of e-waste and segregate it from the given materials. Recommend the internationally acceptable shredding processes for each type of e-waste.
5. Prepare a poster showing salient features of the e-waste management act of India
6. Sort electronics and prepare a list of valuables that can be extracted from electronics, such as fluorescent light and toner cartridges (metals, plastics, glass, compounds, and other elements). Identify and remove e-waste that may carry hazardous materials (like cathode ray tubes) before sending the objects for recycling.
7. Visit a nearby e-waste handling facility and learn about the dismantling of e-waste and the handling process
8. Discuss with students in groups the plausible ways and implementation of e-waste reduction at the source and how regulatory mechanisms can be utilized in the management of e-waste in educational institutions.
9. Evaluate the status of e-waste handling at your institution. Suggest potential solutions as per the existing norms of E-Waste (Management) Rules, 2016 and beyond.
10. Decipher the methods of dust extractions, magnetic and water separation, purification, and preparation for sale. Identify the material that can be repurposed.
11. Study the evolutionary history of e-waste management rules and their implementation- Hazardous Waste Rules, 2008; E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016
12. Compare and analyze international laws on e-waste management- the international legislations: The Basel Convention; The Bamako Convention; The Rotterdam

- Convention; Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union; Restrictions of Hazardous Substances (RoHS) Directive
13. Develop an understanding and itinerary of the process for procuring e-waste import permissions and inventory of the e-waste disposal mechanisms.

**Essential/recommended readings**

- Hester, R.E. and Harrison, R.M., 2009. *Electronic Waste Management: Design, Analysis and Application*. Royal Society of Chemistry Publishing, Cambridge, UK.
- Fowler, B.A., 2017. *Electronic Waste: Toxicology and Public Health Issues*. Academic Press.
- Eduljee, G.H. and Harrison, R.M. eds., 2019. *Electronic Waste Management*. Royal Society of Chemistry.

**Suggested readings**

- Janyasuthiwong, S., 2020. *Metal Removal and Recovery from Mining Wastewater and E-waste Leachate*. CRC Press.
- Gaidajis, G., Angelakoglou, K. and Aktsoglou, D., 2010. E-waste: environmental problems and current management. *Journal of Engineering Science and Technology Review*, 3(1), pp.193-199.

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

## DEPARTMENT OF HOME SCIENCE

### Category I

#### B.Sc. (Hons.) Home Science

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE

#### DISCIPLINE SPECIFIC CORE COURSE – 4 (DSC HS 204): FASHION STUDIES

#### COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
FASHION STUDIES DSC HS 204	4	3	0	1	12 <sup>th</sup> Pass	NIL

#### Learning Objectives

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 student will be able to:

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 centres.
4. Apply the knowledge of elements and principles in design interpretation.

#### SYLLABUS OF DSC-4

##### 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  
Hours)**

**(12**

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 favoring 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****(09 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.

- Structural and Decorative Design
- Elements of Design
- Principles of 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 Centers
- Careers in Fashion

**ESSENTIAL READINGS**

- Brown, Patty, Rice J., 1998, *Ready to Wear Apparel Analysis*. Prentice Hall.
- Marshall S G, Jackson H O, Stanley MS, Kefgen M & Specht T, 2009, *Individuality in Clothing & Personal Appearance, 6<sup>th</sup> Edition*, Pearson Education, USA.
- Tate S.L., Edwards M.S., 1982, *The Complete Book of Fashion Design*, Harper and Row Publications, New York.
- Fringes G.S., 1994, *Fashion From Concept to Consumer, 6<sup>th</sup> edition*, Prentice Hall, New Jersey.

**SUGGESTED READINGS:**

- R. Andrew, 2018, *Key Concepts for Fashion Industry*, Bloomsbury Publishing, India

## **PRACTICAL** **(30 Hours)**

### **Unit I: Hand stitches**

**(14 Hours)**

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**

**( 16 Hours)**

This unit will train the students to identify the various elements of a design that a garment uses and the principles that are creating 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**

- Fringes G.S., 1994, *Fashion From Concept to Consumer*, 6<sup>th</sup> edition, Prentice Hall, New Jersey.
- Marshall S G, Jackson H O, Stanley MS, Kefgen M & Specht T, 2009, *Individuality in Clothing & Personal Appearance*, 6<sup>th</sup> Edition, Pearson Education, USA.

### **Suggested Readings:**

- Reader's Digest (Eds.). 2002, *New Complete Guide to Sewing*, (Canada) Ltd. Montreal.

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

**DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC HS 205): FUNDAMENTALS OF 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		
<b>FUNDAMENTALS OF RESOURCE MANAGEMENT DSC HS 205</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>12<sup>th</sup> Pass</b>	<b>NIL</b>

**Learning Objectives**

1. To enable students to understand the fundamentals of resource management in changing scenario and available resources, their uses and conservation.
2. To understand the processes of management in a scientific manner for the judicious use of resources.

**Learning Outcomes**

Students will be able to:

1. Comprehend the fundamentals of resource management in the changing scenario.
2. Familiarize with the available resources, their uses and conservation.
3. Utilize resources optimally in a prudent manner.
4. Understand the processes of management in a scientific manner for the use of resources.

**THEORY**

**Unit I: Introduction to management**

**(12 Hours)**

Unit Description: The focus of this unit would be on understanding the concept of management, scope and approaches of management in context to changing scenario.

Subtopics:

- Concept, nature, universality and scope of management
- Theories and Approaches to management.
- Ethics in management
- Motivation in management



**UNIT II: Understanding resources****(09 Hours)**

Unit Description: This unit attempts to acquaint the students with the available resources, their uses and conservation approaches.

Subtopics:

- Meaning, classification and characteristics of resources.
- Resource conservation- maximizing use of resources, factors affecting utilization of resources.
- Family life cycle in context to resource use: Time, energy, money.

**Unit III: Functions of management: An overview****(12 Hours)**

Unit Description: This unit will orient the students in understanding the functions and processes of management in a scientific manner for the optimization of resources.

- 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 IV: Management of time and energy resources****(12 Hours)**

This unit will familiarize students with effective management of time and energy resources and their functional use in day-to-day life.

- 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.

**PRACTICAL -30 Hours****Unit I: Identification and Development of managerial competencies****(14 Hours)**

Activities:

- Micro Lab and Who am I
- SWOC analysis
  - Self
  - Case studies: Individuals
  - Case studies: Organizations
- Building Decision making abilities
- Team building management games
- Decision Making: Case Analysis

**Unit II: Management of Time and Energy****(16 Hours)**

Activities:

- Time Management:
  - Evaluation of time plans through case analysis:
    - Case Study-1
    - 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

- Combe, C. (2014). *Introduction to management*. Oxford University Press.
- Drucker, P. F. (2007). *Management: Tasks, responsibilities, practices*. Transaction Pub, ISBN-13: 978-0750643894.
- Goel, S. Ed. (2016). *Management of resources for sustainable development*. New Delhi: Orient Blackswan Pvt. Ltd, ISBN: 9788125063490, 9788125063490.
- Griffin, R. W. (2013). *Management: Principles and practices (11th ed.)*. South-Western Cengage Learning, ISBN: 9788131530917, 8131530914.
- Hill, C. W., & Stevenane. (2006). *Principles of management (1st ed.)*. McGraw-Hill/Irwin. ISBN: 9780073530123.
- Koontz, H., & O' Donnel, C. (2005). *Management: A systems and contingency analysis of managerial functions*. New York: McGraw-Hill Book Company, ISBN-13: 978-0070853775.
- Moore, T. J. (2021). *Family resource management (4th ed.)*. ISBN-13: 978-1544370620.
- Rao, V.S.P. (2008). *Principles & practice of management*. Konark Publishers Pvt. Ltd, ISBN-13: 978-8122000283.

#### For Practicals

- Goel, S. Ed. (2016). *Management of resources for sustainable development*. New Delhi: Orient Blackswan Pvt. Ltd, ISBN: 9788125063490, 9788125063490.
- Arora, R., Magu, P., Singh, P., Meghna, Gupta, S. (2013). *Resource Management: An Introductory Manual*. R. Gangadharan of Elite Publishing House Pvt. Ltd., Daryaganj, ISBN No: 978-81-88-901-50-0.
- Drucker, P. F. (2007). *Management: Tasks, responsibilities, practices*. Transaction Pub, ISBN-13: 978-0750643894

### Suggested Readings:

- Jyoti, A. (2009). *Principles of management*. Gennext Publication. ISBN-13: 9789380222127.
- Kreitner, R. (2009). *Management*. Canada: Houghton Mifflin Harcourt Publishing Company.
- Nickel, D. (2002). *Management in family living*, 4e (4th ed.), ISBN-13: 978-8123908519.
- Robbin, S.P. (2009). *Fundamentals of management*, 11th edition, Pearson Education.
- Steidl, R. & Bratton, E. (1968). *Work in the Home*. USA: John Wiley & Sons, Inc, ISBN-13: 9780471820857.

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

**DISCIPLINE SPECIFIC CORE COURSE – 6 (DSC HS 206): LIFE SCIENCE FOR HOME 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		
<b>LIFE SCIENCE FOR HOME SCIENCE DSC HS 206</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>12<sup>th</sup> Pass</b>	<b>NIL</b>

**Learning Objectives**

- To impart the basic knowledge of animal diversity, plant diversity and its significance for human life.
- To make students aware of the fundamental process of plant growth and its regulation.
- To enable students to learn about methods of sustainable agriculture, plant conservation and propagation.
- To make students aware of immunology, genetics and biotechnology.

**Learning Outcomes**

- The students would be able to identify and appreciate some common plant and animal diversity in their vicinity.
- The students would understand the fundamentals of genetics and its significance in human life.
- The students would gain hands-on experience and training on gardening and plant propagation techniques along with the artificial methods of vegetative propagation.
- The students would acquire the basic knowledge of biotechnology along with recent trends and its applications in agriculture, animal husbandry and human welfare and associated ethical and social issues.
- The students would acquire knowledge about various zoonotic diseases, pandemics and learn about its control and management.
- The students would understand the importance prenatal screening and natal health.

## THEORY

### Section A – Botany

#### Unit I: Introduction to Plant Kingdom

(08 Hours)

Plant kingdom, plant growth and regulation, Economically Important Plants

- Introduction to Plant Diversity
- Economic importance of Microbes (Industrial & Household Products, Sewage treatment, Biogas production, Biocontrol agents, Bio-fertilizers)
- Angiosperm plants: Morphology (Parts of plants with modifications and Life cycle)
- Plant Nutrition and Soil: Essential Elements and Functions, Nutrient cycles, Human Impact on nutrient cycles and effects of pollution
- Plant growth and Development- Regulation and control (Hormones)
- Enzymes: principles and biotechnological applications
- Introduction to Economically important plants: Food Crops, Fibre Crops, Medicinal Plants, Oil Crops, Timber Plants

#### Unit II: Propagation, Gardening and Conservation of Plants

(06 Hours)

Plant propagation methods, Sustainable Agriculture, Biotechnology in Agriculture

- Seed Propagation
- Vegetative Propagation: Cuttings – stem leaf and root, Layering, Grafting, Tissue Culture
- Gardening: Concept and Types with example of Kitchen Garden, Green Roofs, Maintenance of plants
- Sustainable Agriculture: Concept of Organic farming, IPM, Biopesticides, Climate smart agriculture, Seed bank, Urban Agriculture
- Concept of Sustainable development with Sustainability Indicators
- Role of Plants in Air Pollution Control
- Principles and Applications of biotechnology in agricultural crops

### Section B – Zoology

#### Unit III: Animal Diversity and Human Needs

(08 Hours)

Animal diversity and its importance to humans

- Types, Structure and Function of Animal Cell and its components (Chromosomes and Nucleus)
- Animal diversity and its distribution
- Animals and their ecosystem services: role of animals in soil health, pollination, biological control of pests, food security
- Threatened species of animals and their conservation
- Zoonotic and Parasitic diseases- Life cycle, pathogenesis and control. (*Plasmodium*, *Giardia*, *Entamoeba*, *Taenia*, *Ascaris*, *Covid-19*, *malaria*, *tuberculosis*)
- Animals as economic resources: sericulture, apiculture, aquaponics (concept and applications)

#### Unit IV: Immunity, Genetics and Biotechnology

(08 Hours)

Basics of human immunity, Pandemics, genetic diseases, application of biotechnology, developmental biology

- Basics of Human Immunity: introduction to humoral and cell mediated immunity; Vaccination
- Introduction to Pandemics and its management
- Genetic diseases and importance of Genetic counselling
- Birth defects and its causes (genetic and environmental factors)
- Application of biotechnology: Stem cells, cloning and animal improvements

### **PRACTICAL – 60 Hours**

#### **SECTION A- BOTANY**

1. Preparation of soil mixture, potting and re-potting
2. Raising of healthy seedlings in a nursery bed
3. Assessment of soil quality: determination of soil pH, test for nitrates, nitrites
4. Propagation of plants through stem cutting, air layering and underground layering
5. Propagation of plants by approach grafting and veneer grafting
6. Identification and classification of economically important Food crops, Medicinal plants
7. Identification and classification of economically important plants: Fibre crops, Timber plants and Oil crops
8. Identification, Care and maintenance of important plants in controlling air pollution
9. A visit to Home Garden/ Organic farm/ Tissue culture Lab
10. Demonstration of Urban Home Gardens/ Kitchen Garden / Nutrition Garden
11. Study of techniques of biotechnology through audio visual aids

#### **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 animals 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. Soil biomonitoring using Burlese-Tullgren method: concept and importance of micro and macrofauna in soil health
9. Detection of chromosomal abnormalities: concepts and interpretation of diagnostic tests: Karyotyping
10. Detection of chromosomal abnormalities: concepts and interpretation of diagnostic tests: Dual marker test
11. Visit to any one of the following: Aquaponic facility/organic farm/ bee farm
12. Case study of a zoonotic/ parasitic disease: COVID-19 pandemics/ bird flu

### **Essential Readings**

- Jordan E. L. and Verma P. S., 2009. Invertebrate Zoology, S. Chand and Co. Ltd, New Delhi.
- Park K., 2016. Textbook of preventive and social medicine. Banarsidas Bhanot Publishers.
- Raven P. and Johnson G., 2010. Biology. Tata McGraw Hill Publication, New Delhi.
- Singh J. S, Singh S. P. and Gupta S. R., 2017. Ecology, Environment Science and Resource Conservation. S. Chand (G/L) & Company Ltd, India.
- Soni N. K. and Soni V., 2010. Fundamentals of Botany. Tata McGraw Hill Publication, New Delhi.

### **Suggested Readings**

- Chadha K. L. 2012. Handbook of Horticulture. ICAR Publication, New Delhi.
  - Gopaldaswamianger K.S. 1991. Complete gardening in India, Messers Nagaraj and Co., Madras.
  - Gupta R. 2015. Fundamentals of Zoology: Theory and Practice. Elite Publishing House Pvt. Ltd., New Delhi.
  - Hartman H.T and Kester D. 1986. Plant Propagation: Principles and Practices Prentice Hall of India Pvt. Ltd., New Delhi.
  - Kotpal R. L. 2000. Modern Textbook of Zoology, Rastogi Publications, Meerut.
  - Magurran, A. E. 1988. Ecological Diversity and Measurement. Croom Helm Limited, Australia.
  - Upadhyay R. 2017. Elements of Plant Science, Elite Publishing House, New Delhi.
- Vij, U. and Gupta, R. 2011. Applied Zoology Phoenix Publishing House, New Delhi

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

**Category-II**  
**B.Sc (Prog.) Home Science**

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC HP 204 ) –: Lifespan Development I: Prenatal and 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		
Lifespan Development I: Prenatal and Early Years	4	3	0	1	12 <sup>th</sup> Pass	NIL

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To acquire an understanding of lifespan development as a discipline
- To appreciate the role of heredity, context, family and community in Lifespan development
- To understand developmental progression across stages and domains of the lifespan

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- The student will develop an understanding about the discipline of Lifespan development
- The student will appreciate principles of growth and development
- The student will understand the concept of stages and domains in lifespan development
- The student will become aware of optimal practices in child rearing and child stimulation



## SYLLABUS OF DSC HP 204

### **Unit I: Understanding Lifespan Approaches and Perspectives – 09 Hours**

The unit provides a foundational view on Life Span development.

Subtopics:

- Definitions, nature, scope and multidisciplinary nature of Lifespan Development
- Developmental stages and domains
- Principles of growth and development
- Optimizing development in early years

### **Unit II: Pregnancy, Birth and the Neonate – 12 Hours**

The unit focuses on pregnancy and safe motherhood, understanding prenatal development and birthing techniques and the newborn.

Subtopics:

- Stages of prenatal development
- Influences on prenatal development and safe motherhood
- Birthing process and the high-risk newborns
- Newborn capacities and care

### **Unit III: Development during Infancy – 12 Hours**

Understanding the period of infancy through the framework of developmental domains

Subtopics:

- Developmental Norms and Milestones
- Physical- motor development
- Sensory Perceptual development
- Cognitive development
- Language development
- Social development

### **Unit IV: Development during Preschool – 12 Hours**

Understanding the domains of language, cognitive and socio-emotional development preschool period. Interlinkages between developmental domains for strong foundations.

Subtopics:

- Developmental Norms and Milestones during preschool
- Physical and motor development
- Language development
- Cognitive development
- Social and emotional development: Family, Play and Learning

## PRACTICAL -30 Hours

- Introduction to research methods in Lifespan development
- Documentation of methods: Interview, Observation and Narrative
- Prepare interviews to explore cultural practices and conceptions related to pregnancy, infancy and early childhood
- Conduct early childhood observations using specimen description and checklist in *any two* domains of development
- Using audio and video resources to study prenatal development, infancy and early childhood
- Preparation of activities and learning aids for parents using locally available materials
- Mapping resources in children's ecology by community survey
- Psychological tests- Developmental assessment of Indian children, WPPSI

### Essential Readings

- Berk, L. (2013). Child development. 9th ed. Boston: Pearson.
- Rice, F. P. (1998). Human Development: A Life-span Approach. New Jersey: Prentice Hall.
- Santrock, J. W. (2011). Life-span development. New York: McGraw-Hill.
- Singh, A. (Ed.) 2015. Foundations of Human Development. New Delhi: Tata McGraw-Hill.
- Snow, C. W., & McGaha, C. G. (2003). Infant development (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

### Suggested Readings

- Childhood in south Asia: A critical look at issues, policies and programmes. Conn.USA:Information Age.
- Hospital walls. In T.S. Saraswathi (Ed.). Culture, socialization and human development. New Delhi: Sage.
- Singhi, P. (1999). Child health & well-being: Psychological care within & beyond
- Sriram, R. (2004). Ensuring infant and maternal health in India. In J. Pattnaik (Ed.).
- Verma, P, Srivastava, D.N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Chapter 3: Indian women: Traditional and modern: pages 52-70.

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

**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		
Foundation of Food Science and Nutrition	4	3	0	1	12 <sup>th</sup> Pass	NIL

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To understand functions of food and the relationship between food, nutrition and health.
- To describe the functions of various nutrients, their sources and clinical manifestations of excess/ deficiency of nutrients.
- To learn about various methods of cooking and to understand the selection, nutritional contribution of and effect of cooking on different food groups.
- To describe ways of reducing nutrient losses during cooking.
- To be able to prepare dishes using principles of food science.

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- Comprehend the relationship between food, nutrition and health.
- Understand the selection, nutritional contribution and changes during cooking of the commonly consumed foods.
- Understand the importance of various nutrients and their dietary sources.
- Develop understanding about the methods of preparing food with better nutrient retention and improving quality of diets.

**SYLLABUS OF DSC HP 205****Unit I: Basic Concepts in Food and Nutrition -12 Hours**

Basic terminology used in the sciences of food and nutrition and understanding the relationship between what we eat and health.

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 -12 Hours**

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 – 12 Hours**

Selection, nutritional contribution 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

### **Unit IV: Methods of Cooking and Preventing Nutrient Losses- 09 Hours**

Different methods of cooking and how nutrients can be retained

Subtopics

- Dry, moist, frying and microwave cooking
- Advantages, disadvantages and the effect of various methods of cooking on nutrients
- Minimize nutrient losses

### **Practical -30 Hours**

- Weights and measures; preparing market order and table setting
  - 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. 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.
3. 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.
4. Rekhi T and Yadav H (2014). Fundamentals of Food and Nutrition. New Delhi: Elite Publishing House Pvt Ltd.
5. Srilakshmi B (2014). Food Science, 6th Edition. Delhi: New Age International Ltd.

### **Suggested Readings**

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2016). Textbook of Human Nutrition, 4<sup>th</sup> 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.

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

**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 Communication	4	3	0	1	12 <sup>th</sup> Pass	NIL

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To learn about the concept, nature, and scope of communication.
- To understand the process of communication with the help of theories, models, and elements of communication.
- To recognize and appreciate the role of Perception, Empathy, Persuasion, Culture and listening in communication.
- To be able to comprehend the various communication transactions and their role in day-to-day life with special reference to public communication.
- To understand the relationship between culture and communication and its applications in real life settings.

**Learning outcomes**

The Learning Outcomes of this course are as follows:

**The students would be able to:**

- Develop a clear understanding of the concepts of human communication.
- Comprehend the elements and models governing the process of effective communication.
- Gain understanding about the related concepts of communication such as Perception, Empathy, Persuasion and Listening
- Understand the various communication transactions as well as the qualities and skills required of an effective public speaker.
- Appreciate the role and application of factors for effective communication.

## **SYLLABUS OF DSC HP 206**

### **Unit I: Communication: Core Concepts-12 Hours**

The Unit 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- 09 Hours**

The Unit 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 – 12 Hours**

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**

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 – 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).

### **SUGGESTED 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.

### **PRACTICAL WORK:**

- Punhani & Aggarwal (2014). *Media for Effective Communication*. Elite Publishers, New Delhi.

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



## **BSC. (HONS.) 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		
PRINCIPLES OF FOOD PROCESSING	4	3	0	1	XII with PCM/PCB	NIL

### **Learning Objectives**

The Learning Objectives of this course are as follows:

- To understand freezer, dryer types and functioning
- To understand the material handling, separation processes and thermal processing

### **Learning outcomes**

The Learning Outcomes of this course are as follows:

- Understand cold preservation, Freezer types and functioning
- Understand Dehydration, Dryer types and functioning
- Understand the material handling in food industry, conveyer types, separation processes by distillation, extraction, filtration
- Understand thermal processing and fundamentals of thermal process calculations

### **SYLLABUS OF DSC-04**

#### **Unit1: Cold Preservation and Freezers (12 Hours)**

- Refrigeration and Freezing: requirements of refrigerated storage - controlled low temperature, air circulation and humidity, modified gas atmosphere. Changes in food during refrigerated and frozen storage, Refrigeration load, factors determining freezing rate: food composition and non-compositional.
- Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

**Unit2: Dehydration****(12 Hours)**

Changes in food during drying, drying methods and equipments air convection dryer, tray dryer, tunnel dryer, continuous belt dryer , fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying ,foam mat drying.

**Unit3: Thermal processing****(9 Hours)**

Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data, Thermal process Calculations, Aseptic processing of food

**Unit4: Material handling and Separation processes (12 Hours)**

Elementary concept of material handling in food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

Distillation principles and methods: steam, batch, continuous distillation with rectification and stripping.

Extraction : Hildebrandt, Bollman, SCF extraction Filtration : Plate and frame , pressure leaf, continuous rotary vacuum ,batch and continuous filtration

**Practical Exercises: 30 Hours**

The learners are required to:

- Preservation of food by freezing
- Drying of food using Tray dryer/other dryers
- Preservation of food by canning (Fruit/Vegetable/meat)
- Cut-out analysis of canned food
- Osmotic dehydration
- Minimal Processing
- Perform distillation of any food sample/by product
- Processing of ready to eat frozen products
- Study of Thawing Characteristics of frozen food

**Essential/recommended readings**

- Potter,N.N.and Hotchkiss,J.H.(2007). Food Science 5th Ed. New York: Chapman & Hall
- Ramaswamy, H. and Marcott, M. (2006). Food Processing Principles and Applications. CRC Press.
- Rao, P.G. (2010). Fundamentals of Food Engineering. New Delhi: PHI Learning Pvt Ltd .
- Desrosier, N.W. and Desrosier, J.N. (1998). The Technology of Food Preservation. New Delhi: CBS Publication.
- Toledo, Romeo T. (2007). Fundamentals of Food Process Engineering. Aspen Publishers.

- **Note: Learners are advised to use the latest edition of readings.**

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

## DSC 05 : TECHNOLOGY OF FOOD PRESERVATION

### 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		
TECHNOLOGY OF FOOD PRESERVATION	4	3	0	1	XII with PCM/PCB	NIL

#### Learning Objectives

The Learning Objectives of this course are as follows:

- To learn science behind various preservation/processing technologies.
- Technological application of concepts on conventional Indian foods.

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- Understanding of the concept of different processing and preservation technologies
- Appreciate significance of various preservation methods used in food industries.

### SYLLABUS OF DSC-05

#### Unit1: Introduction to Technology of Food Preservation (6 Hours)

Introduction to historical evolution to food preservation techniques- Conventional to recent technologies Classification of foods based on pH, concept of shelf life, perishable foods, semi perishable foods, shelf stable foods.

#### Unit2: Food Preservation by Low temperature (14 Hours)

Introduction to refrigeration, chilling, freezing as a means of preservation, cold storage Principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, Introduction to thawing, changes during thawing and its effect on food

#### Unit3: Food Preservation by Thermal Processing and Irradiation (10 Hours)

Introduction to Thermal Processing- Blanching, pasteurization, sterilization, commercial sterilization. Introduction, units of radiation, concept of cold sterilization, kinds of ionizing radiations, application in food industry.

#### Unit4: Food Preservation by Moisture control (15 Hours)

Introduction to Drying and Dehydration -Drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), normal drying curve, heat and mass transfer, factors affecting rate of drying and its application in food industry.

Introduction to Evaporation as a means of preservation – Definition, factors affecting evaporation, and its application in food industry.

#### Practical Exercises: 30 Hours

The learners are required to:

- To study methods of sampling.
- To study the concept of shelf life of different foods.
- To perform blanching of plant foods.
- To study the concept of sterilization
- To perform pasteurization of fluids- juices/ milk/ squashes etc using different methods.
- To determine the pH of different foods.
- To evaluate the quality characteristics of foods preserved by solar drying/ dehydration/ freezing.

**Essential/recommended readings**

- Potter, N. N., & Hotchkiss, J. H. (2012). Food Science. Springer Science & Business Media.
- Fellows, P. J. (2009). Food Processing Technology: Principles and Practice. Elsevier.
- Bawa. A.S., Chauhan, O.P, Raju. P.S. (2013) ed. Food Science. New India Publishing agency.
- Stewart, G.F., & Amerine, M.A. (2012). Introduction to Food Science and Technology. Elsevier, 2nd Edition.
- Rao, E.S. (2019) Fundamentals of Food Technology and Preservation, Variety Books, New Delhi.
- Frazier, W.C. & West Hoff, D.C. 2004. Food Microbiology. TMH Publication, New Delhi,.
- Rao, D.G. 2010. Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi,

- **Note: Learners are advised to use the latest edition of readings.**

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

**DSC 06 : FRUITS, VEGETABLES & PLANTATION CROPS PROCESSING TECHNOLOGY**  
**DSC 04 PRINCIPLES OF FOOD PROCESSING**

**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		
FRUITS, VEGETABLES & PLANTATION CROPS PROCESSING TECHNOLOGY	4	3	0	1	XII with PCM/PCB	NIL

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To impart knowledge of different methods of fruits and vegetables processing.
- To learn about processing of various spices, tea, coffee and cocoa.

**Learning outcomes**

The Learning Outcomes of this course are as follows:

- Understand the concept of quality of fruits and vegetables for developing good quality end products.
- Understand the processing and preservation of fruits and vegetables using various techniques.
- Understand processing of plantation crops.

**SYLLABUS OF DSC-06**

**Unit1: Introduction to Fruits and Vegetables (6 Hours)**

Importance of Fruits & Vegetables

History & need of preservation

Reasons of spoilage, method of preservation (Short & Long Term)

Post harvest physiological & biochemical changes in fruits & vegetables

**Unit2: Canning & Dehydration**

**(11 Hours)**

Process of canning, factors affecting the process- time and temperature

Containers of packing, lacquering, syrups and brines for canning.

Spoilage in canned foods.

Sun drying & mechanical dehydration

Process variation for fruits and vegetables packing and storage. Case hardening

**Unit3: Fruits Beverages & Tomato Products**

**(13 Hours)**

Introduction & Processing of fruit juices (selection, juice extraction, deaeration, straining, filtration and clarification)

Preservation of fruit juices (pasteurization, preservation with chemical, sugar & salt, freezing, drying, tetra-packing, carbonation)

Processing of squashes, cordials, nectars, concentrates and powder

Tomato Products : processing of tomato juice, tomato puree, paste, ketchup, sauce and soup

#### **Unit4: Products preserved with class I & class II preservatives (7 Hours)**

Processing & Technology of Jam, Jelly, Marmalade & Pickles (Essential constituents, Role of pectin), Theory of jelly formation, defects in jelly,

Marmalade - Types, defects.

Pickles-- Processing , Types, Causes of spoilage in pickling

#### **Unit5: Technology of Plantation Crops (8 Hours)**

Spices

Processing and properties of major and minor spices

Essential oils & oleoresins, adulteration Tea, Coffee and Cocoa

Processing, Variety and Products

#### **Practical Exercises: 30 Hours**

The learners are required to:

- Estimation of total soluble solids (TSS), pH, acidity of various products.
- Estimation of brix: acidity ratio of various products.
- Estimation of ascorbic acid and effect of heat treatment on it.
- To study the steps of can making process.
- Preparation & evaluation of pectin based product. (Jam)
- Preparation & evaluation of tomato puree.
- Dehydration of fruits and vegetables
- Rehydration of fruits and vegetables
- Extraction & estimation of polyphenols from fruit & Vegetable wastes.

#### **Essential/recommended readings**

- Girdharilal., Siddappaa, G.S and Tandon, G.L.(2009). Preservation of fruits & vegetables. ICAR, New Delhi.
- Thompson, A.K., (2003). Fruits and vegetables; Harvesting, handling and storage. Blackwell Publishing.
- Verma L.R. & Joshi VK. 2000. Post Harvest Technology of Fruits & Vegetables. Indus Publication.
- Crusess, W.B. (2004). Commercial Unit and Vegetable Products. W.V. Special Indian Edition. Agrobios India.
- Manay, S. and Shadaksharaswami, M. (2004). Foods: Facts and Principles. New Age Publishers.
- Ranganna S.(2007). Handbook of analysis and quality control for fruits and vegetable products. Tata Mc Graw-Hill publishing company limited, Second edition.
- Srivastava, R.P. and Kumar, S. (2006). Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.
- Somogyi, L.P., Ramaswamy, H.S. and Hui, Y.H. (1996). Biology, Principles and Applications. Volume 1. Technomic Publishing Company, Inc.

• **Note: Learners are advised to use the latest edition of readings.**

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

## GE 02: CHEMISTRY OF FOOD

### 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		
CHEMISTRY OF FOOD	4	3	0	1	XII with PCM/PCB	NIL

#### Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the chemistry of foods - composition of food, role of each component
- To understand the different macromolecules and micro molecules in food
- To understand how food components contribute to overall quality of foods

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- To understand the chemistry of foods - composition of food
- To understand the role of each component, their properties and reactions in food
- To comprehend how dietary components influence total food quality

### SYLLABUS OF GE 02

#### **Unit1: Introduction to chemistry of Food (5 Hours)**

Introduction to Food Chemistry

Brief composition of food (Carbohydrates, fats, proteins, vitamins, minerals and pigments)

#### **Unit2: Chemistry of Macromolecules (20 Hours)**

Water: Definition of water in food, Structure of water and ice, Types of water, Role of water activity in shelf life and packaging Carbohydrates: Introduction, Classification, and Chemical reactions of carbohydrates Protein: Introduction, classification and structure, types of food protein (meat, egg, milk and wheat)

Lipids: Introduction, classification and structure of triglycerides, types of fatty acid, deterioration of fats and oils. (Autooxidation and lipolysis)

#### **Unit3: Chemistry of Micro molecules (10 Hours)**

Vitamins: Introduction, types (water soluble and fat soluble vitamins)

Minerals: Introduction, major and minor minerals, Toxic minerals in food

#### **Unit4: Flavors and Pigments (10 Hours)**

Definition and basic tastes

Description of some common food flavors

Introduction and classification of pigments

### **Practical Exercises: 30 Hours**

The learners are required to:

- Preparation of primary and secondary solutions
- Estimation of moisture content
- Determination of gelatinization temperature range (GTR) of different starches
- Determination of effect of additives on GTR of starches
- Estimation of total nitrogen content by Kjeldahl method
- Estimation of fat
- Estimation of total ash and acid insoluble ash
- Estimation of reducing sugar

### **Essential/recommended readings**

- DeMan, John M. (1995). Principles of Food Chemistry. 3rd Ed., Springer.
- Fennema, Owen R. (2008). Fennema's Food Chemistry-CRC Press (2008) - 4th Edition.
- Potter, N.N. and Hotchkiss, J.H. (2007). Food Science 5th Ed. New York: Chapman & Hall.
- Richard Owusu-Apenten. (2002) Introduction to Food Chemistry. CRC press
- Hans-Dieter Belitz, Werner Grosch, Peter Schieberle. (2009) Food Chemistry. Springer link

- **Note: Learners are advised to use the latest edition of readings.**

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



**B.A (Prog.) with Nutrition and Health Education (NHE) as Major**

**Category-II**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-3-NHE: DIET PLANNING THROUGH THE LIFE SPAN**

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
<b>Diet Planning Through the Life Span</b>	4	3	0	1	Class XII Pass	DSC-1-NHE and DSC-2-NHE

**Learning Objectives:**

1. To introduce students to the basic concepts of meal planning.
2. To equip them with knowledge of physiological changes, nutritional requirements, nutritional concerns and healthy food choices during the life cycle.

**Learning Outcomes:**

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

1. Describe physiological changes and nutritional requirements across the lifespan.
2. Understand the factors affecting meal planning.
3. Understand the importance of food exchange list and use them for meal planning.
4. Plan and prepare balanced meals and nutritious snacks for various age groups.

**SYLLABUS OF DSC-3**

**Theory:**

**Unit 1: Nutrient Requirements and Recommendations (5 Hours)**

- *Unit Description:* This unit will introduce the concept of dietary reference intake.
- *Subtopics:*
  - Nutrient requirement - concept and background
  - Dietary reference intake
  - EAR and RDA
  - Reference man and reference woman

**Unit 2: Fundamentals of Menu Planning (6 Hours)**

- *Unit Description:* This unit will introduce essential requirements for planning of

meals.

- *Subtopics:*
  - Introduction and use of food exchange list
  - Concept and importance of meal planning
  - Factors affecting meal planning

**Unit 3: Nutrition during Childhood (16 Hours)**

- *Unit Description:* This unit will introduce nutritional requirement, physiological changes, nutritional concerns and healthy eating practices during childhood.
- *Subtopics:*
  - Infancy
  - Preschoolers
  - School- going children
  - Adolescents

**Unit 4: Nutrition during Adulthood and Old Age (18 Hours)**

- *Unit Description:* This unit will introduce nutritional requirement, physiological changes, nutritional concerns and healthy food choices during adulthood and old age.
- *Subtopics:*
  - Adulthood
  - Pregnancy
  - Lactation
  - Old age

**Practical: 30 Hours**

**Unit 1: Introduction to Meal Planning (10 Hours)**

- *Subtopics:*
  - Use of comprehensive food exchange list in meal planning
  - Meal distribution and menu planning
  - Nutrient calculations

**Unit 2: Planning and Preparation of Diets/Dishes/Snacks (20 Hours)**

- *Subtopics:*
  - Infant- complementary feeding
  - Preschooler child

- School aged child
- Adolescent
- Adult
- Pregnant and lactating woman
- Elderly

**Essential/recommended readings:**

1. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient Blackswan.
2. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.
3. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy* (6<sup>th</sup> ed.). Delhi: New Age International (P) Ltd.
4. Siddhu, A., Bhatia, N., Singh, K., Gupta, S. (Eds.). (2017). *Lady Irwin College Technical series 6: Compilation of food exchange list*. Delhi: Global books organisation.
5. Puri, S. et al (2020). *Food exchange list- A tool for meal planning*. New Delhi: Elite publishing house.
6. Longvah, T. et al (2017). *Indian food composition tables*. Hyderabad, Telangana: National Institute of Nutrition.

**Suggested readings:**

1. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition*. (11<sup>th</sup> ed.). New York, NY: McGraw Hill.
2. Khanna, K. et al. (2013). *Textbook of nutrition and dietetics*. Delhi: Elite Publishing house (P) Ltd.
3. Shubhangini, A., & Joshi, S. (2021). *Nutrition and Dietetics* (5<sup>th</sup> ed.). McGraw Hill Education (India) Private Limited. ISBN: 978-93-90727-82-7.
4. Edelstein, S., & Sharlin, J. (Eds). (2009). *Life cycle nutrition – an evidence based approach* Burlington, MA: Jones and Barlett Publishers.

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

## DISCIPLINE SPECIFIC CORE COURSE – DSC-4-NHE: DIETARY GOALS AND GUIDELINES FOR INDIANS

### 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		
<b>Dietary Goals and Guidelines for Indians</b>	4	3	1	0	Class XII Pass	NIL

### Learning Objectives:

1. To introduce the concept of nutritionally adequate diets and healthy lifestyles from conception till old age.
2. To equip the students with the knowledge of dietary goals and guidelines for Indians relating to nutritional requirements, deficiency diseases and chronic diet-related disorders.

### Learning Outcomes:

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

1. Describe food groups, food pyramid and the concept of a balanced diet.
2. Understand the physiological changes throughout the lifespan.
3. Acquaint themselves with the dietary goals and dietary guidelines for Indians across the life cycle.

### SYLLABUS OF DSC-4

#### Theory:

#### Unit 1: Basic Concepts of Food (Hours)

(9

- *Unit Description:* This unit will introduce various food groups, concept of balanced diet, food pyramid and other aspects regarding diet.
- *Subtopics:*
  - Food groups: basic classification and nutritional contribution
  - Food pyramid
  - Balanced diet and My food plate
  - Food facts, fads and fallacies

**Unit 2: Dietary Guidelines I  
Hours)**

**(15**

- *Unit Description:* This unit will introduce basic dietary goals for healthy living and dietary guidelines.
- *Subtopics:*
  - Dietary goals
  - Guidelines to ensure nutritional adequacy and prevent deficiency diseases
  - Guidelines related to various stages of life

**Unit 3: Dietary Guidelines II  
Hours)**

**(13**

- *Unit Description:* This unit will introduce dietary guidelines to deal with health concerns and healthy food practices.
- *Subtopics:*
  - Guidelines to maintain an ideal body weight and prevent chronic diet-related disorders
  - Guidelines regarding food-related practices

**Unit 4: Practical Application of Dietary Guidelines  
Hours)**

**(8**

- *Unit Description:* This unit will introduce practical aspects with suitable examples to attain all dietary guidelines for Indians.
- *Subtopics:*

Sample eating patterns/ menus for the following meals/ snacks:

  - Breakfast
  - Lunch/packed lunch
  - Dinner
  - Snacks

**Essential/recommended readings:**

1. Damyanthi, K. et al. (2011). *Dietary guidelines for Indians- A manual*. (2<sup>nd</sup> ed.) Hyderabad. National Institute of Nutrition.
2. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient Blackswan.
3. Agarwal, A., & Udipi. S. (2014). *Textbook of human nutrition*, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
4. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.

**Suggested readings:**

1. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy* (6<sup>th</sup> ed.). Delhi: New Age International (P) Ltd.
2. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition*. (11<sup>th</sup> ed.). New York, NY: McGraw Hill.
3. Shubhangini, A., & Joshi, S. (2021). *Nutrition and Dietetics* (5th ed.). McGraw Hill Education (India) Private Limited. ISBN: 978-93-90727-82-7.
4. Khanna, K. et al. (2013). *Textbook of nutrition and dietetics*. Delhi: Elite Publishing house (P) Ltd.

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**B.A (Prog.) with Nutrition and Health Education (NHE) as Non-Major**  
**Category-III**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-4-NHE: DIETARY GOALS AND GUIDELINES FOR INDIANS**

**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		
<b>Dietary Goals and Guidelines for Indians</b>	4	3	1	0	Class XII Pass	NIL

**Learning Objectives:**

1. To introduce the concept of nutritionally adequate diets and healthy lifestyles from conception till old age.
2. To equip the students with the knowledge of dietary goals and guidelines for Indians relating to nutritional requirements, deficiency diseases and chronic diet-related disorders.

**Learning Outcomes:**

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

1. Describe food groups, food pyramid and the concept of a balanced diet.
2. Understand the physiological changes throughout the lifespan.
3. Acquaint themselves with the dietary goals and dietary guidelines for Indians across the life cycle.

**SYLLABUS OF DSC-2**

**Theory:**

**Unit 1: Basic Concepts of Food  
Hours)**

**(9**

- *Unit Description:* This unit will introduce various food groups, concept of balanced diet, food pyramid and other aspects regarding diet.
- *Subtopics:*
  - Food groups: basic classification and nutritional contribution

- Food pyramid
- Balanced diet and My food plate
- Food facts, fads and fallacies

**Unit 2: Dietary Guidelines I (15 Hours)**

- *Unit Description:* This unit will introduce basic dietary goals for healthy living and dietary guidelines.
- *Subtopics:*
  - Dietary goals
  - Guidelines to ensure nutritional adequacy and prevent deficiency diseases
  - Guidelines related to various stages of life

**Unit 3: Dietary Guidelines II (13 Hours)**

- *Unit Description:* This unit will introduce dietary guidelines to deal with health concerns and healthy food practices.
- *Subtopics:*
  - Guidelines to maintain an ideal body weight and prevent chronic diet-related disorders
  - Guidelines regarding food-related practices

**Unit 4: Practical Application of Dietary Guidelines (8 Hours)**

- *Unit Description:* This unit will introduce practical aspects with suitable examples to attain all dietary guidelines for Indians.
- *Subtopics:*  
Sample eating patterns/ menus for the following meals/ snacks:
  - Breakfast
  - Lunch/packed lunch
  - Dinner
  - Snacks

**Essential/recommended readings:**

1. Damyanthi, K. et al. (2011). *Dietary guidelines for Indians- A manual*. (2<sup>nd</sup> ed.) Hyderabad. National Institute of Nutrition.
2. Chadha, R., & Mathur, P. (2015). *Nutrition: A life cycle approach*. Delhi: Orient Blackswan.
3. Agarwal, A., & Udipi. S. (2014). *Textbook of human nutrition*, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.



4. Sethi, P., & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt. Ltd.

**Suggested readings:**

1. Mudambi, S. R., & Rajagopal M. V. (2012). *Fundamentals of food, nutrition and diet therapy* (6<sup>th</sup> ed.). Delhi: New Age International (P) Ltd.
2. Wardlow, G. M., & Hampl, J. S. (2019). *Perspectives in nutrition*. (11<sup>th</sup> ed.). New York, NY: McGraw Hill.
3. Shubhangini, A., & Joshi, S. (2021). *Nutrition and Dietetics* (5th ed.). McGraw Hill Education (India) Private Limited. ISBN: 978-93-90727-82-7.
4. Khanna, K. et al. (2013). *Textbook of nutrition and dietetics*. Delhi: Elite Publishing house (P) Ltd.

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**CATEGORY-II**  
**B.A (Prog.) with Human Development and Family**  
**Empowerment (HDFE) as Major**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-3-HDFE: ADULTHOOD AND AGEING THROUGH A LIFE SPAN PERSPECTIVE**

**Credit distribution, Eligibility and Pre-requisite 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		
<b>Adulthood and Ageing through a Lifespan perspective</b>	4	2	0	2	Class XII Pass	DSC-1-HDFE and DSC-2-HDFE (both as Major)

**Learning Objectives:**

1. To understand the developmental patterns in early, middle and late adulthood.
2. To understand the needs and challenges of the older adults.
3. To use research tools to investigate the ageing process and develop critical thinking skills, necessary to do research in the field of ageing.

**Learning Outcomes:**

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

1. Understand the characteristics of Adulthood and old age.
2. Understand the challenges of adulthood and ageing and the coping strategies.
3. Students will develop awareness about the developmental patterns in adulthood.
4. Sensitizing students towards the concerns of adulthood and ageing.

**THEORY**  
**(Credits:2, Periods: 30)**

**Unit 1: Adulthood and Ageing**  
**hours)**

**(10**

- *Unit Description:* This unit will introduce the concept of adulthood and ageing
- *Subtopics:*
  - Understand definition
  - Concept and scope of ageing as a field of study

- Theoretical perspectives on ageing
- Developmental Tasks of Adulthood

**Unit 2: Early & Middle Adulthood (10 hours)**

- *Unit Description:* This unit will introduce the concept of early and middle adulthood.
- *Subtopics:*
  - Characteristics
  - Developmental milestones - Physical, cognitive, social and emotional development

**Unit 3: Late Adulthood (10 hours)**

- *Unit Description:* This unit will introduce the concept of Late adulthood.
- *Subtopics:*
  - Definition
  - Characteristics
  - Developmental milestones
  - Physical changes in males and females
  - Psychological implications of physical changes. Social – Emotional Development. Cognitive Development

**PRACTICAL  
(Credits: 2, Periods: 60)**

- **Unit 1: Conduct Case profile of a senior citizen (30 hours)**
- **Unit 2: Visit to a senior citizen home and /or Movie review (30 hours)**

**Essential / recommended readings:**

1. Berk, L. E. (2017). *Development through the lifespan* (7rd edition). US: Pearson Education.
2. Rice, F.P. (1998). *Human Development: A Life-span Approach* (3rd edition). US: Prentice Hall.
3. Santrock, J. W. (2011). *Life-span development* (13th ed.). McGraw-Hill Education.
4. Verma, P., Srivastava D. N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Agrawal Publication

**Suggested Readings:**

1. Patrick, J.H., Hayslip Jr. B., Sawyer, L.H. (2000). *Adult Development and aging: Growth, longevity and challenges* (1st edition). Sage Publications
2. Singh, A. (2015). *Foundation of Human development: A lifespan approach*. Hyderabad: Orient Blackswan Pvt.
3. Singh, V. (2007). *Bal vikas avam bal manovigyan*. Jaipur: Panchsheel Prakashan

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

**DISCIPLINE SPECIFIC CORE COURSE – DSC-4-HDFE: INTRODUCTION TO HUMAN DEVELOPMENT**

**Credit distribution, Eligibility and Pre-requisite 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		
<b>Introduction to Human Development</b>	4	2	0	2	Class XII Pass	DSC-1-HDFE and DSC-2-HDFE (both as Major)

**Learning Objectives:**

1. To create an understanding of various stages of lifespan development.
2. To understand developmental changes occurring during infancy, childhood, adolescence.
3. To understand the conflicts during various stages of lifespan development and ways to deal with it.

**Learning Outcomes:**

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

1. Understand developmental changes occurring during the lifespan with respect to infancy, childhood, adolescence
2. Understand various stages of lifespan development with respect to conflicts and ways to deal with it.
3. Learn the basic skills of research and documentation and apply the knowledge of methods of data collection in real life situations.

**THEORY**

**(Credits: 2; Periods: 30)**

**Unit 1: Development in early years: The new-born and stage of infancy (10 Hours)**

- *Unit Description:* This unit will discuss about the development in early years
- *Subtopics:*
  - New-born: Characteristics.
  - Reflexes
  - Infant developmental milestones

**Unit 2: Childhood- Early & Middle Hours) (10**

- *Unit Description:* This unit will introduce all domains of development with regard to early and middle childhood period.
- *Subtopics:*
  - Physical Development.
  - Socio-emotional Development.
  - Cognitive and Language Development

**Unit 3: Adolescence Hours) (10**

- *Unit Description:* This unit will introduce regarding adolescent age group
- *Subtopics:*
  - Definition.
  - Characteristics.
  - Developmental milestones.
  - Physical changes in males and females.
  - Psychological implications of physical changes.
  - Social – Emotional Development.
  - Cognitive Development.

**PRACTICAL  
(Credit: 2, Periods: 60)**

**Unit 1: Understand Methods and techniques of child study. (15 hours)**

**Unit 2: Conduct any 2 interviews. (30 hours)**

**Unit 3: Conduct any 1 observation. (15 hours)**

**Essential / recommended readings:**

1. Bee, H. L (2011). *The developing child*. London: Pearson.
2. Berk, L. E. (2017). *Development through the lifespan* (7rd edition). US: Pearson Education.
3. Santrock, J. W. (1996). *Child development*. New York: Tata McGraw Hill
4. Verma, P., Srivastava D. N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Agrawal Publication.

**Suuggested readings:**

1. Papilla, D.E., Olds, S. W. and Feldman, R. D (2004). *Human development*. New York: Mcgraw Hill.
2. Singh, A. (2015). *Foundation of Human development: A lifespan approach*. London: Orient Longman.

3. Singh, V. (2007). *Bal vikas avam bal manovigyan*. Jaipur: Panchsheel Prakashan.
4. Sapra, R. (2007). *Manav vikas: Ek parichaya*. New Delhi: Vishwa Bharti Publications.  
Chapter 1, pg 1-6

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

### CATEGORY-III

#### B.A (Prog.) with Human Development and Family Empowerment (HDFE) as Non-Major

#### DISCIPLINE SPECIFIC CORE COURSE – DSC-4-HDFE: INTRODUCTION TO HUMAN DEVELOPMENT

#### Credit distribution, Eligibility and Pre-requisite 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 Human Development	4	2	0	2	Class XII Pass	DSC-2-HDFE (Non-Major)

#### Learning Objectives:

1. To create an understanding of various stages of lifespan development.
2. To understand developmental changes occurring during infancy, childhood, adolescence.
3. To understand the conflicts during various stages of lifespan development and ways to deal with it.

#### Learning Outcomes:

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

1. Understand developmental changes occurring during the lifespan with respect to infancy, childhood, adolescence
2. Understand various stages of lifespan development with respect to conflicts and ways to deal with it.
3. Learn the basic skills of research and documentation and apply the knowledge of methods of data collection in real life situations.

#### THEORY

(Credits: 2; Periods: 30)

#### Unit 1: Development in early years: The new-born and stage of infancy (10 Hours)

- *Unit Description:* This unit will discuss about the development in early years
- *Subtopics:*
  - New-born: Characteristics.
  - Reflexes
  - Infant developmental milestones



**Unit 2: Childhood- Early & Middle Hours) (10**

- *Unit Description:* This unit will introduce all domains of development with regard to early and middle childhood period.
- *Subtopics:*
  - Physical Development.
  - Socio-emotional Development.
  - Cognitive and Language Development

**Unit 3: Adolescence Hours) (10**

- *Unit Description:* This unit will introduce regarding adolescent age group
- *Subtopics:*
  - Definition.
  - Characteristics.
  - Developmental milestones.
  - Physical changes in males and females.
  - Psychological implications of physical changes.
  - Social – Emotional Development.
  - Cognitive Development.

**PRACTICAL  
(Credit: 2, Periods:60)**

**Unit 1: Understand Methods and techniques of child study. (15 hours)**

**Unit 2: Conduct any 2 interviews. (30 hours)**

**Unit 3: Conduct any 1 observation. (15 hours)**

**Essential / recommended readings:**

1. Bee, H. L (2011). *The developing child*. London: Pearson.
2. Berk, L. E. (2017). *Development through the lifespan* (7rd edition). US: Pearson Education.
3. Santrock, J. W. (1996). *Child development*. New York: Tata McGraw Hill
4. Verma, P., Srivastava D. N. and Singh, A. (1996). *Bal manovigyan and bal vikas*. Agra: Agrawal Publication.

**Suugested readings:**

1. Papilla, D.E., Olds, S. W. and Feldman, R. D (2004). *Human development*. New York: Mcgraw Hill.
2. Singh, A. (2015). *Foundation of Human development: A lifespan approach*. London: Orient Longman.
3. Singh, V. (2007). *Bal vikas avam bal manovigyan*. Jaipur: Panchsheel Prakashan.

4. Sapra, R. (2007). *Manav vikas: Ek parichaya*. New Delhi: Vishwa Bharti Publications. Chapter 1, pg 1-6

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

*Category-II*

**B.A (Prog.) with Apparel Design and Construction (ADC) as Major**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-3-ADC:  
GARMENT DETAILING**

**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		
Garment Detailing	4	2	0	2	Class XII Pass	DSC-1-ADC and DSC-2-ADC

**Learning Objectives:**

1. To impart basic knowledge required for layout planning on fabrics requiring special attention
2. To familiarise the students about the concepts related to the handling of special fabrics
3. To create an understanding of designing clothes for people with special needs.
4. To develop pattern making and construction skills for various garments and their components
5. To impart skills for developing design variations through dart manipulations

**Learning Outcomes:**

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

1. Plan pattern layout on fabrics with special requirements
2. Calculate the fabric requirement per garment
3. Make use of different marker making methods
4. Use design variations of garment components in garment construction
5. Carry out dart manipulation according to design variations
6. Handle special fabrics during pattern layout and sewing
7. Design clothes for people with special needs

**SYLLABUS OF DSC-3**

**Theory:**

**Unit 1: Layout planning**

**(8 Hours)**

- *Unit Description:* This unit deals with planning on special fabrics, assessing fabric requirement per garment and marker making.
- *Sub Topics:*
  - Pattern Layouts on special fabrics- unidirectional, bold and large prints, stripes and checks, border design, irregular design fabric, napped fabric
  - Calculation of material requirement for garment construction
  - Marker Making – Factors influencing marker making, Methods of marker making.

## **Unit 2: Design variations in Garment Components (12 Hours)**

- *Unit Description:* This unit focuses on the study of garment components and their design variations. It also covers dart manipulation and creating design variations.
- *Sub Topics:*
  - Study of Garment components – terms, types and Styles, evaluation criteria – Necklines, Collars, Sleeves, Cuff, Yokes, Pockets, Plackets
  - Design variations in bodice, skirts, silhouettes, trousers
  - Dart manipulation: Definition, Principles, Methods, dart equivalents

## **Unit 3: Handling of Special Fabrics (10 Hours)**

- *Unit Description:* This unit provides the basic knowledge relating to special fabrics and their handling. It also deals with the concepts and requirements of self-help garments and maternity wear.
- *Sub Topics:*
  - Definition and features of Special fabrics
  - Handling of fabrics with reference to designing, layout, marking, cutting, stitching, needle sizes, stitch sizes, threads used, seams and other special considerations – Sheer and slippery fabrics, napped and pile fabrics, lace, silk & crepe, velvet, wool, knits, plaids and stripes. Preparation of a sample file.
  - Garment designing for special needs: basic principles and design requirements – Self-help, maternity wear

### **Practical:**

## **Unit 1: Basic Blocks and Dart Manipulation (20 Hours)**

- *Sub Topics:*
  - Dart manipulation techniques - Single and double dart series, style lines, Yokes, adding fullness
  - Hip length/ Torso Draft
  - Trousers Block
  - Men's Bodice Block

## **Unit 2: Construction of Garments and their Components (40 Hours)**

- *Sub Topics:*

- Preparation of Samples of any three styles of Sleeves
- Preparation of Samples of any three styles of Collars
- Preparation of Samples of any three styles of pockets
- Preparation of Samples of Plackets - continuous bound, even hem, zipper, tailored placket
- Designing and stitching of one upper and one lower garment

**Essential/ Recommended Readings:**

1. Armstrong, H.J., (2009), Pattern Making for Fashion Design, Harper Collins Publishers Inc., New York.
2. Liechty, E.G., Potterberg, D.N., Rasband, J.A., (2010), Fitting and Pattern Alteration: A Multimethod Approach, Fairchild Publications, New York
3. Macdonald Nora M., (2009), Principles of Flat-Pattern Design, Fairchild Books, New York.
4. Shaeffer Claire, (2003), Sew any Fabric, Krause Publications

**Suggested Readings:**

1. Brown, P. and Rice, J., (1998), Ready-to-wear Apparel Analysis, Prentice Hall
2. Kallal, M. J., (1985), Clothing Construction, Macmillan Publishing Company, New York
3. Mansfield, E. A. & Lucas, E. L., (1974), Clothing Construction, Houghton Mifflin
4. Stamper, A.A., S. H. Sharp and L.B. Donnell, (1986), Evaluating Apparel Quality, Fairchild Publications, US

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

**DISCIPLINE SPECIFIC CORE COURSE – DSC-4-ADC:  
BASIC PATTERN MAKING AND CLOTHING 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		
Basic Pattern Making and Clothing Construction	4	2	0	2	Class XII Pass	Nil

**Learning Objectives:**

1. To introduce students to basic concepts of Body measurements and pattern making
2. To equip the students with the knowledge of pattern layout, fabric cutting, garment sewing and assessing fit in a garment.

**Learning Outcomes:**

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

1. Take measurements from body and garments accurately.
2. Create patterns of simple women's clothes and apply the pattern information correctly.
3. Operate a sewing machine for simple sewing tasks using the correct thread, needle and stitch length for various fabrics.
4. Use various types of seams and seam techniques during garment construction
5. Apply concept of fit, evaluate garment fit and do pattern alterations as necessary.

**SYLLABUS OF DSC-4**

**Theory:**

**Unit 1: Body Measurements and Pattern Making (10 Hours)**

- *Unit Description:* This unit introduces the students to the process of taking measurements from body or garment and developing basic blocks for creating garment patterns. It also provides an understanding of the different types of patterns as well as using the symbols and markings mentioned on a pattern correctly.
- *Sub Topics:*
  - Importance of Body measurements, Body Landmarks, Correct procedure of taking body measurements, size charts, Taking measurements from Garments
  - Garment Ease - type and amount in different garments

- Basic Blocks and their importance
- Methods of pattern development: Drafting, Flat pattern making, Draping
- Types of paper pattern - Commercial pattern, Graded pattern, Production pattern
- Pattern information and marking symbols and their importance

## **Unit 2: Sewing Machines**

**(8 Hours)**

- *Unit Description:* This unit provides the essential knowledge required for operating and maintaining a sewing machine for garment construction.
- *Sub Topics:*
  - Classification of Sewing machines
  - Components of a Basic Sewing machine and their functions
  - Introduction to Industrial sewing machines- single needle lock stitch, overlock, blind stitching, button hole and button stitching, bartacking
  - Sewing defects and remedies
  - Care and maintenance of a sewing machine, precautions while working on a sewing machine
  - Selection of threads, needles and stitch length for various fabrics

## **Unit 3: Sewing Techniques and Garment Fit**

**(12 Hours)**

- *Unit Description:* This unit imparts knowledge of seam categories and seam techniques. It also deals with the concept of garment fit and correcting fitting problems through pattern alteration.
- *Sub Topics:*
  - Garment Support Fabrics (Lining, Underlining, Interlining, Interfacing) – their use and selection
  - Basic seam categories- super imposed seam, lapped seam, bound seam, flat seam, decorative seam, ridge seam
  - Additional seam techniques: clipping, notching, grading, trimming, easing, under stitching, stay stitching, trimming a corner
  - Finishing of straight & curved edges- self finish, crossway strips, bias facing, bias binding, shaped facing, self-finishing, casings and finishing with trims
  - Elements of Fit: line, ease, grain, set and balance
  - Fit evaluation, Common fitting problems and pattern correction

## **Practical: 60 Hours**

### **Unit 1: Development of Basic Blocks and design variations**

**(20 Hours)**

- *Subtopics:*
  - Adult women's bodice block, sleeve block, skirt block
  - Developing design variations in adult skirt- A-line, flared, wrap-around, pleated, skirt with yoke

### **Unit 2: Seams and Garment Construction**

**(40 Hours)**

- *Subtopics:*

- Samples of Seams – Plain Seam, French seam, Run-n-fell seam, Lapped seam, Top stitching, Bound/Piped seam, Slot seam, Curved and Corner seam
- Necklines and their finishing: bias facing, bias binding, shaped facing
- Adaptation of basic blocks to construct Saree blouse, Kurti/Kameez, Skirt
- Construction of lower garments: Salwar/ Churidar, Palazzo

**Essential Readings:**

1. Armstrong, H.J., (2009), Pattern Making for Fashion Design, Harper Collins Publishers Inc., New York.
2. Brown, P. and Rice, J., (1998), Ready-to-wear Apparel Analysis, Prentice Hall
3. Colton V. (1995). Reader's Digest- Complete Guide to Sewing. New York: The Reader's Digest Association, Inc.
4. Knowles A. (2006). Patternmaking for Fashion Designers. New York: Fairchild Publications Inc.
5. Liechty, E.G., Potterberg, D.N., Rasband, J.A., (2010), Fitting and Pattern Alteration: A Multimethod Approach, Fairchild Publications, New York

**Suggested Readings:**

1. Kallal, M. J., (1985), Clothing Construction, Macmillan Publishing Company, New York
2. Kindersley D. (1996). The Complete Book of Sewing. London: Dorling Kindersley Limited.
3. MacDonald M. (2009). Principles of Flat Pattern Design (4th Edition). New York: Fairchild Publications Inc
4. Stamper, A.A., S. H. Sharp and L.B. Donnell, (1986), Evaluating Apparel Quality, Fairchild Publications, America

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



### Category-III

#### B.A (Prog.) with Apparel Design and Construction (ADC) as Non-Major

### DISCIPLINE SPECIFIC CORE COURSE – DSC-4-ADC: BASIC PATTERN MAKING AND CLOTHING 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		
Basic Pattern Making and Clothing Construction	4	2	0	2	Class XII Pass	NIL

#### Learning Objectives:

1. To introduce students to basic concepts of Body measurements and pattern making
2. To equip the students with the knowledge of pattern layout, fabric cutting, garment sewing and assessing fit in a garment.

#### Learning Outcomes:

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

1. Take measurements from body and garments accurately.
2. Create patterns of simple women's clothes and apply the pattern information correctly.
3. Operate a sewing machine for simple sewing tasks using the correct thread, needle and stitch length for various fabrics.
4. Use various types of seams and seam techniques during garment construction
5. Apply concept of fit, evaluate garment fit and do pattern alterations as necessary.

#### SYLLABUS OF DSC-2

##### Theory:

##### Unit 1: Body Measurements and Pattern Making

(10 Hours)

- *Unit Description:* This unit introduces the students to the process of taking measurements from body or garment and developing basic blocks for creating garment patterns. It also provides an

understanding of the different types of patterns as well as using the symbols and markings mentioned on a pattern correctly.

- *Sub Topics:*
  - Importance of Body measurements, Body Landmarks, Correct procedure of taking body measurements, size charts, Taking measurements from Garments
  - Garment Ease - type and amount in different garments
  - Basic Blocks and their importance
  - Methods of pattern development: Drafting, Flat pattern making, Draping
  - Types of paper pattern - Commercial pattern, Graded pattern, Production pattern
  - Pattern information and marking symbols and their importance

## **Unit 2: Sewing Machines**

**(8 Hours)**

- *Unit Description:* This unit provides the essential knowledge required for operating and maintaining a sewing machine for garment construction.
- *Sub Topics:*
  - Classification of Sewing machines
  - Components of a Basic Sewing machine and their functions
  - Introduction to Industrial sewing machines- single needle lock stitch, overlock, blind stitching, button hole and button stitching, bartacking
  - Sewing defects and remedies
  - Care and maintenance of a sewing machine, precautions while working on a sewing machine
  - Selection of threads, needles and stitch length for various fabrics

## **Unit 3: Sewing Techniques and Garment Fit**

**(12 Hours)**

- *Unit Description:* This unit imparts knowledge of seam categories and seam techniques. It also deals with the concept of garment fit and correcting fitting problems through pattern alteration.
- *Sub Topics:*
  - Garment Support Fabrics (Lining, Underlining, Interlining, Interfacing) – their use and selection
  - Basic seam categories- super imposed seam, lapped seam, bound seam, flat seam, decorative seam, ridge seam
  - Additional seam techniques: clipping, notching, grading, trimming, easing, under stitching, stay stitching, trimming a corner
  - Finishing of straight & curved edges- self finish, crossway strips, bias facing, bias binding, shaped facing, self-finishing, casings and finishing with trims
  - Elements of Fit: line, ease, grain, set and balance
  - Fit evaluation, Common fitting problems and pattern correction

## **Practical: 60 Hours**

### **Unit 1: Development of Basic Blocks and design variations**

**(20 Hours)**

- *Subtopics:*
  - Adult women's bodice block, sleeve block, skirt block

- Developing design variations in adult skirt- A-line, flared, wrap-around, pleated, skirt with yoke

## **Unit 2: Seams and Garment Construction**

**(40 Hours)**

- *Subtopics:*

- Samples of Seams – Plain Seam, French seam, Run-n-fell seam, Lapped seam, Top stitching, Bound/Piped seam, Slot seam, Curved and Corner seam
- Necklines and their finishing: bias facing, bias binding, shaped facing
- Adaptation of basic blocks to construct Saree blouse, Kurti/Kameez, Skirt
- Construction of lower garments: Salwar/ Churidar, Palazzo

### **Essential Readings:**

1. Armstrong, H.J., (2009), Pattern Making for Fashion Design, Harper Collins Publishers Inc., New York.
2. Brown, P. and Rice, J., (1998), Ready-to-wear Apparel Analysis, Prentice Hall
3. Colton V. (1995). Reader's Digest- Complete Guide to Sewing. New York: The Reader's Digest Association, Inc.
4. Knowles A. (2006). Patternmaking for Fashion Designers. New York: Fairchild Publications Inc.
5. Liechty, E.G., Potterberg, D.N., Rasband, J.A., (2010), Fitting and Pattern Alteration: A Multimethod Approach, Fairchild Publications, New York

### **Suggested Readings:**

1. Kallal, M. J., (1985), Clothing Construction, Macmillan Publishing Company, New York
2. Kindersley D. (1996). The Complete Book of Sewing. London: Dorling Kindersley Limited.
3. MacDonald M. (2009). Principles of Flat Pattern Design (4th Edition). New York: Fairchild Publications Inc
4. Stamper, A.A., S. H. Sharp and L.B. Donnell, (1986), Evaluating Apparel Quality, Fairchild Publications, America

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**Category-II**  
**B.A. (Prog.) with Food Technology (FT) as Major**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-3-FT:  
NUTRITION AND WELL BEING FOR LIFESPAN**

**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		
Nutrition and Well Being for Lifespan	4	3	0	1	Class XII Pass	DSC-1-FT

**LEARNING OBJECTIVES:**

1. To make students understand the concept of wellbeing, good health, dietary guidelines and lifestyle management.
2. To familiarize students with the salient physiological changes and nutrition related health concerns during various stages of lifespan.
3. To familiarize students with the dietary guidelines and lifestyle practices which would support overall wellbeing and good health
4. Make students plan and prepare nutritious meals for self, family and the community.

**LEARNING OUTCOMES:**

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

1. Appreciate the role of dietary guidelines and lifestyle management in promoting health and well being
2. Adopt a healthy and active lifestyle suitable to each physiological stage in lifespan
3. Enhance ability to make healthy food choices for self, family and the community
4. Develop educational aids to impart nutrition knowledge.

**SYLLABUS OF DSC-3-FT**

**THEORY:**

**UNIT I: Maternal and Infant Nutrition**

**(12 Hours)**

- *Unit Description:* This unit will focus on basic concepts of wellbeing,

dietary guidelines as well as maternal and infant nutrition.

- *Subtopics:*
  - Basic concepts: well-being, nutritional status, dietary guidelines and lifestyle management
  - Pregnancy - physiological changes during pregnancy, dietary guidelines, the role of nutrition in the developmental origins of disease
  - Lactation - factors affecting nutritional requirements, dietary guidelines, breast feeding practices
  - Infancy - growth and development, growth monitoring, dietary guidelines (advantages of mother's milk, complimentary feeding)

## **UNIT II: Child and Adolescent Nutrition**

**(12 Hours)**

- *Unit Description:* This unit will focus on dietary guidelines and lifestyle management of children and adolescents.
- *Subtopics:*
  - Childhood Years: growth and development, dietary guidelines during early, middle and late childhood years, common nutrition concerns.
  - Adolescence: growth and development, eating behaviour, dietary guidelines, common health problems during adolescence, eating disorders, lifestyle management.

## **UNIT III: Nutrition during Adulthood**

**(12 Hours)**

- *Unit Description:* This unit will focus and reference man as well as woman and nutritional needs of adults.
- *Subtopics:*
  - Reference Man and Reference Woman, dietary guidelines, role of nutrition in adulthood in the prevention and development of chronic diseases
  - Lifestyle management: healthy eating behaviour, physical activity, stress management, sleep pattern.

## **Unit IV: Nutrition for the Elderly**

**(9 Hours)**

- *Unit Description:* This unit will focus on nutritional needs, lifestyle management, longevity and care for elderly.
- *Subtopics:*
  - Introduction to Geriatrics, physiological changes, nutrition and longevity, nutritional concerns, dietary guidelines, Nutrition and chronic Degenerative Diseases, Nutrient-Drug Interactions (basic concept).

**PRACTICAL: 30 Hours**

*No. of Students per Practical Class Group: 10-15*

1. Develop a poster/chart on dietary guidelines or lifestyle management for adults (sedentary, moderate, heavy workers) or pregnant woman. (4 Hours)
2. Develop a digital educational aid on importance of colostrum/mother's milk/food behaviour/lifestyle management (2 Hours)
3. Develop a questionnaire on common nutrition/health concerns (2 Hours)
4. Learn to fill growth chart for under five years children (case study) (2 Hours)
5. Plan and prepare nutritious snack for Pregnant women (iron and folic acid rich) (2 Hours)
6. Plan and prepare nutritious snack Lactating mother (protein and calcium rich) (2 Hours)
7. Plan and prepare nutritious snack Pre-schooler (Vitamin A rich) (2 Hours)
8. Plan and prepare nutritious tiffin for School going child (energy and protein rich) (2 Hours)
9. Plan and prepare nutritious snack for adolescents (energy and protein rich) (2 Hours)
10. Plan and prepare nutritious snack for Elderly (easy to prepare, protein and micro-nutrient rich) (2 Hours)
11. Plan and prepare premix or complimentary food for infants (2 Hours)
12. Plan and organize a health awareness activity in college for college students (exhibition of model snacks/tiffins/one dish 2meals) OR Plan and play a skit on the concept of longevity for elderly in a nearby slum or community center or college event (Group activity) (6 Hours)

**ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):**

1. Chadha, R., & Mathur, P. (Eds.). (2015). Textbook Nutrition: A Lifecycle Approach. Orient Blackswan. ISBN978-8125059301
2. Khanna, K., Gupta, S., Passi, S. J., Seth, R., Mahna, R., & Puri, S. (2013). Textbook of Nutrition and -Dietetics (2nd ed.). Elite Publishing House Pvt. Ltd. ISBN: 978-81- 88901-53-1
3. Srilakshmi, B. (2006). Dietetics. New Age International (P) Limited Publishers. ISBN 81-224-1611-X
4. Wardlaw, G. M., & Smith, A. M. (2015). Contemporary Nutrition (9th ed.). McGraw Hill Education (India) Private Limited.

**SUGGESTED READINGS:**

1. Evans, S. (2009). Nutrition: A Lifespan Approach, Wiley-Blackwell. ISBN:978-1-405- 17878-5.
2. Shubhangini A Joshi, S. (2021). Nutrition and Dietetics (5th ed.). McGraw Hill Education (India) Private Limited. ISBN:978-93-90727-82-7.
3. Bernstein, M. & McMahon, K. (2018). Nutrition Across Life Stages, Jones & Bartlett Publishers. ISBN: 9781284102161
4. Katz, D., Yeh, M. and Levitt, J. (2022). Wolters Kluwer Publishers. ISBN: 9781975161491

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**DISCIPLINE SPECIFIC CORE COURSE – DSC-4-FT: FOOD SCIENCE PART-II**

**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-II	4	3	0	1	Class XII Pass	DSC-2-FT

**LEARNING OBJECTIVES:**

1. To familiarize the students with the composition and processing of milk, egg, sugars, fats and miscellaneous food.
2. To impart concept of properties of fats and oil, sugar, egg foam stages and emulsions.

**LEARNING OUTCOMES:**

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

1. Describe the composition and nutritive value of milk, egg, sugar and fats and their role in food processing.
2. Develop understanding about basic processing of milk and eggs.
3. Illustrate the behaviour of sugar at various temperatures.
4. Describe spoilage of fat scientifically, determine the smoke point of different fats and illustrate the ways to prevent rancidity of fats.

**THEORY:**

**UNIT I: MILK**

**(9 Hours)**

- *Unit Description:* This unit is about milk, its nutritive value, processing, types and effect of processing on milk quality.
- *Subtopics:*
  - Nutritive value
  - Introduction to liquid milk technology (clarification, pasteurization, homogenization, fortification, sterilization)
  - Types of milk
  - Effect of processing on milk

**UNIT II: EGGS**

**(12 Hours)**



- *Unit Description:* This unit is about eggs its composition and nutritive value, structure, quality, foam formation and effect of heat on egg proteins.
- *Subtopics:*
  - Composition and nutritive value
  - Structure of an egg
  - Egg quality and deterioration
  - Effect of heat on egg proteins: Green ring formation in boiled egg
  - Storage and preservation of eggs
  - Egg foams – stages of preparation and factors affecting them

**UNIT III: FATS AND OILS (12 Hours)**

- *Unit Description:* This unit is about types of fats and oils, their functions, spoilage, precautions to be taken while using, emulsions and RUCO.
- *Subtopics:*
  - Definitions, types of fats and oils and their functions
  - Rancidity in fat and its prevention
  - Care of fat used for frying (smoke, flash and fire points)
  - Emulsions
  - Repurpose used cooking oil (RUCO).

**UNIT IV: MISCELLANEOUS FOOD PRODUCTS (12 Hours)**

- *Unit Description:* This unit is about miscellaneous food items like sugar and its properties and behaviour during cooking, tea and coffee processing and flavouring compounds in spices
- *Subtopics:*
  - Sugar: Properties, sugar behaviour during cooking.
  - Tea and Coffee: Types of tea and coffee, basic processing of tea and coffee.
  - Spices and Herbs: Types and flavouring components

**PRACTICAL:30 Hours**

*No. of Students per Practical Class Group: 10-15*

1. Determination of pH of different foods. (2 Hours)
2. Selection and purchase criteria of raw materials (cereal, pulses, vegetables, fruits and eggs) (2 Hours)
3. Effect of heat on milk processing. (2 Hours)
4. Effect of acid and alkali on milk processing. (2 Hours)

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|--|-----------|
| 5. Egg white foam formation                                | (2 Hours) |
| 6. Factors affecting egg white foam stability              | (4 Hours) |
| 7. Green ring formation in boiled eggs and its prevention  | (2 Hours) |
| 8. Determination of the quality of an egg                  | (2 Hours) |
| 9. Behaviour of sugar at various temperatures              | (4 Hours) |
| 10. Preparation of crystalline candies                     | (2 Hours) |
| 11. Preparation of non-crystalline candies                 | (2 Hours) |
| 12. Determination of smoke point of different fats and oil | (2 Hours) |
| 13. Preparation of emulsions – mayonnaise                  | (2 Hours) |

### **ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):**

1. 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/](https://wps.pearsoned.co.in/suri_fsns_1/)
  - ii. Online Instructor Resources: [www.pearsoned.co.in/sukhneetsuri](http://www.pearsoned.co.in/sukhneetsuri)
2. Sethi, P. & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt.Ltd.
3. Srilakshmi, B. (2018). *Food Science*. Delhi: New Age International Pvt.Ltd.
4. Potter, N. & Hotchkiss, J.H. (2007). *Food Science*. 5th Edition. Delhi: CBS Publishers.
5. Rekhi, T. & Yadav, H. (2014). *Fundamentals of Food and Nutrition*. Delhi: Elite Publishing House Pvt.Ltd.
6. Sharma, A. (2010). *Textbook of Food Science and Technology*. 2<sup>nd</sup> Edition. Delhi: IBDC Publishers

### **SUGGESTED READINGS:**

1. Manay, N. S. & Shadakshraswamy. (2020). *Foods: Facts and Principles*. 3rd Edition. New Age International Pvt Ltd.
2. McWilliams, M. (2016). *Foods: Experimental Perspectives*. USA: Pearson.
3. Roday, S. (2018). *Food Science and Nutrition*. 3rd Edition. Delhi: Oxford University Press.
4. Vaclavik, V.A. & Elizabeth, C. (2014). *Essentials of Food Science*. 4th Edition. New York: Springer

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**B.A. (Prog.) with Food Technology (FT) as Non-Major  
Category-III**

**DISCIPLINE SPECIFIC CORE COURSE – DSC-2A-FT: FOOD SCIENCE PART-II**

**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-II	4	3	0	1	Class XII Pass	DSC-1A-FT

**LEARNING OBJECTIVES:**

1. To familiarize the students with the composition and processing of milk, egg, sugars, fats and miscellaneous food.
2. To impart concept of properties of fats and oil, sugar, egg foam stages and emulsions.

**LEARNING OUTCOMES:**

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

1. Describe the composition and nutritive value of milk, egg, sugar and fats and their role in food processing.
2. Develop understanding about basic processing of milk and eggs.
3. Illustrate the behaviour of sugar at various temperatures.
4. Describe spoilage of fat scientifically, determine the smoke point of different fats and illustrate the ways to prevent rancidity of fats.

**THEORY:**

**UNIT I: MILK**

**(9 Hours)**

- *Unit Description:* This unit is about milk, its nutritive value, processing, types and effect of processing on milk quality.
- *Subtopics:*
  - Nutritive value
  - Introduction to liquid milk technology (clarification, pasteurization, homogenization, fortification, sterilization)
  - Types of milk
  - Effect of processing on milk

## UNIT II: EGGS

(12 Hours)

- *Unit Description:* This unit is about eggs its composition and nutritive value, structure, quality, foam formation and effect of heat on egg proteins.
- *Subtopics:*
  - Composition and nutritive value
  - Structure of an egg
  - Egg quality and deterioration
  - Effect of heat on egg proteins: Green ring formation in boiled egg
  - Storage and preservation of eggs
  - Egg foams – stages of preparation and factors affecting them

## UNIT III: FATS AND OILS

(12 Hours)

- *Unit Description:* This unit is about types of fats and oils, their functions, spoilage, precautions to be taken while using, emulsions and RUCO.
- *Subtopics:*
  - Definitions, types of fats and oils and their functions
  - Rancidity in fat and its prevention
  - Care of fat used for frying (smoke, flash and fire points)
  - Emulsions
  - Repurpose used cooking oil (RUCO).

## UNIT IV: MISCELLANEOUS FOOD PRODUCTS

(12 Hours)

- *Unit Description:* This unit is about miscellaneous food items like sugar and its properties and behaviour during cooking, tea and coffee processing and flavouring compounds in spices
- *Subtopics:*
  - Sugar: Properties, sugar behaviour during cooking.
  - Tea and Coffee: Types of tea and coffee, basic processing of tea and coffee.
  - Spices and Herbs: Types and flavouring components

### PRACTICAL: 30 Hours

*No. of Students per Practical Class Group: 10-15*

1. Determination of pH of different foods. (2 Hours)
2. Selection and purchase criteria of raw materials (cereal, pulses, vegetables, fruits and eggs) (2 Hours)
3. Effect of heat on milk processing. (2 Hours)

- |  |           |
|--|-----------|
| 4. Effect of acid and alkali on milk processing.           | (2 Hours) |
| 5. Egg white foam formation                                | (2 Hours) |
| 6. Factors affecting egg white foam stability              | (4 Hours) |
| 7. Green ring formation in boiled eggs and its prevention  | (2 Hours) |
| 8. Determination of the quality of an egg                  | (2 Hours) |
| 9. Behaviour of sugar at various temperatures              | (4 Hours) |
| 10. Preparation of crystalline candies                     | (2 Hours) |
| 11. Preparation of non-crystalline candies                 | (2 Hours) |
| 12. Determination of smoke point of different fats and oil | (2 Hours) |
| 13. Preparation of emulsions – mayonnaise                  | (2 Hours) |

#### **ESSENTIAL/ RECOMMENDED READINGS (Theory and Practical):**

1. Suri, S. & Malhotra, A. (2014). *Food Science Nutrition and Safety*. Delhi: Pearson India Ltd.
  - a. Online Question Bank and student E  
Resources: [https://wps.pearsoned.co.in/suri\\_fsns\\_1/](https://wps.pearsoned.co.in/suri_fsns_1/)
  - b. Online Instructor Resources: [www.pearsoned.co.in/sukhneetsuri](http://www.pearsoned.co.in/sukhneetsuri)
2. Sethi, P. & Lakra, P. (2015). *Aahar Vigyan, Poshan Evam Suraksha*. Delhi: Elite Publishing House Pvt.Ltd.
3. Srilakshmi, B. (2018). *Food Science*. Delhi: New Age International Pvt.Ltd.
4. Potter, N. & Hotchkiss, J.H. (2007). *Food Science*. 5th Edition. Delhi: CBS Publishers.
5. Rekhi, T. & Yadav, H. (2014). *Fundamentals of Food and Nutrition*. Delhi: Elite Publishing House Pvt.Ltd.
6. Sharma, A. (2010). *Textbook of Food Science and Technology*. 2<sup>nd</sup> Edition. Delhi: IBDC Publishers

#### **SUGGESTED READINGS:**

1. Manay, N. S. & Shadakshraswamy. (2020). *Foods: Facts and Principles*. 3rd Edition. New Age International Pvt Ltd.
2. McWilliams, M. (2016). *Foods: Experimental Perspectives*. USA: Pearson.
3. Roday, S. (2018). *Food Science and Nutrition*. 3rd Edition. Delhi: Oxford University Press.
4. Vaclavik, V.A. & Elizabeth, C. (2014). *Essentials of Food Science*. 4th Edition. New York: Springer

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## Category-IV

### COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY DEPARTMENT OF HOME SCIENCE

### GENERIC ELECTIVES (GE HS 002): SELF DEVELOPMENT AND WELLBEING

#### 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		
Self Development and Wellbeing	4	3	0	1	12 <sup>th</sup> Pass	NIL

#### Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the concepts of self-development and wellbeing
- To study theoretical perspectives and stages of self-development
- To understand framework and dimensions of wellbeing
- To understand the context and significance of managing emotions and wellbeing
- To study and understand activities for enhancing self-development and wellbeing

#### Learning outcomes

The Learning Outcomes of this course are as follows:

- The student will be able to understand the concept of self-development and parameters of wellbeing
- The student will be able to understand the theoretical perspectives on self-development and wellbeing
- The students will be able to demonstrate skills in developing and using contextually appropriate methods to promote well-being
- The student will be able to enhance their self-development and wellbeing through reflection and introspection

## **SYLLABUS OF GE HS 002**

### **Unit I: Understanding the self (12 Hours)**

To introduce various approaches and theories of self.

Subtopics:

- Definitions and concepts of self
- Perspectives on self
- Phases of self-development
- Theories of self-development

### **Unit II: Components of self-development (09 Hours)**

To understand various aspects of self-development.

Subtopics:

- Components of Self- An integrated approach
- Self-concept and self esteem
- Social self and development
- Factors influencing self

### **Unit III: Concept, approaches and importance of wellbeing (12 Hours)**

To understand basic definitions and concepts of wellbeing and interlink these with self-development.

Subtopics:

- Definitions and concept of Wellbeing
- Frameworks and dimensions of wellbeing
- Health and Wellbeing
- Happiness and Wellbeing

### **Unit IV: Promoting self-development and wellbeing (12 Hours)**

To understand significance of activities related to wellbeing.

Subtopics:

- Managing relationships and emotions
- Happiness and emotional wellbeing
- Mindfulness and decision making
- Academics and Work-life balance
- 

### **Practical component (if any)**

#### **PRACTICAL: 30 Hours**

- An activity on self-reflection from early childhood to adolescence.
- Focused group discussion on self and wellbeing.
- Narrative analysis/: biographies and autobiographies/ Diagrammatic representation of the self)

- Selected exercises to promote wellbeing: Music, dance, literature, poetry, art, yoga, meditation, play, and theatre
- Psychometric tests- on self and wellbeing
- Session on basics of counselling
- Profile an organisation work in sector of counselling

### Essential Readings

1. Burkitt, I. (2008). *Social selves: Theories of self and society*. Sage
2. Emmons, R. A., & Shelton, C. M. (2002). Gratitude and the science of positive psychology. *Handbook of positive psychology*, 18, 459-471.
3. Kakar, S. (1978). *The inner world*. Delhi: Oxford University Press.
4. Kakar, S. and Kakar, K. (2007). *The Indian: The portraits of a people*. London: Penguin/Viking.
5. Mathews, G., & Izquierdo, C. (Eds.). (2008). *Pursuits of happiness: Well-being in anthropological perspective*. Berghahn books.
6. Rice, F. P. (2007). *Adolescent: Development, Relationship and Culture*.
7. Sabharwal, N., Ranganathan, N., Singh, I. V., & Basu, S. (2017). *Unit-1 Dimensions of Self: An Integrated Approach*.
8. Santrock, J. (2010). *LifeSpan Development: A Topical Approach*, New Delhi: Tata McGraw Hill.
9. Snyder, C. R., Lopez, S. J., Edwards, L. M., & Marques, S. C. (Eds.). (2020). *The Oxford handbook of positive psychology*. Oxford university press.
10. Snyder, C.R., & Lopez, S.J. (2007). *Positive psychology: The scientific and practical explorations of human strengths*. Thousand Oaks, CA: Sage.
11. Winnicott, D. W. (2012). *The family and individual development*. Routledge.
12. Gough, I., & McGregor, J. A. (Eds.). (2007). *Wellbeing in developing countries: from theory to research*. Cambridge University Press.

### Suggested Readings

1. Snyder, C.R., Lopez, S.J., Pedrotti, J.T. (2011). *Positive psychology: The scientific and*
2. *Practical explorations of human strengths*. New Delhi: Sage.
3. Seligman, M. (2011). *Flourish: A Visionary New Understanding of Happiness and Well-being*, Atria Books. Peterson, C. A. (2006). *A Primer in Positive Psychology*, Oxford University Press.
4. Nettle, D.S. (2006). *Happiness: The Science Behind Your Smile*, Oxford University Press.
5. Lyubomirsky, S. (2013). *The Myths of Happiness: What Should Make You Happy, but Doesn't, What Shouldn't Make You Happy, but Does*, Penguin.

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



## GENERIC ELECTIVES (GE HS 006): NUTRITION FOR THE FAMILY

### 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		
Nutrition for the Family	4	3	0	1	12 <sup>th</sup> Pass	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To enable students in understanding the principles of planning nutritionally adequate diets.
- To acquire knowledge about the nutritional needs and concerns of an individual throughout the life cycle.
- To make them exercise food choices consonant with good health based on sound knowledge of principles of nutrition.

### Learning outcomes

The Learning Outcomes of this course are as follows:

The students will be able:

- The student will be able to comprehend the principles of planning nutritionally adequate diets.
- The student will be able to acquire knowledge about the nutritional needs and concerns of an individual throughout the life cycle.
- The student will be able to exercise food choices consonant with good health based on sound knowledge of principles of nutrition.

## **SYLLABUS OF GE HS 006**

### **Unit I: Basics of nutrients requirements (06 Hours)**

Concepts of estimated average requirements, recommended allowances and methods of assessing nutrient requirements in general for Indians

Subtopics:

- Concept of EAR, RDA and TUL
- Methods of assessment of nutrient requirements

### **Unit II: Principles of Meal Planning (06 Hours)**

Concepts of food groups and food exchange lists for meal planning, factors affecting meal planning will be dealt with. Students will also be introduced to dietary guidelines for Indians.

Subtopics:

- Food groups
- Food exchange list
- Factors affecting meal planning and food related behaviour
- Dietary guidelines for Indians

### **Unit III: Nutrition during adulthood (18 Hours)**

Physiological influence on nutrient requirements during adulthood (EAR/RDA), energy balance in adulthood, nutritional concerns and changes in requirements during pregnancy, lactation, and old age will be dealt with.

Subtopics:

- Adult men and women
- Pregnant women
- Lactating mothers
- Elderly

### **Unit IV: Nutrition during childhood (15 Hours)**

Physiological changes during infancy, childhood and adolescence – growth and development; and their influence on nutrient requirements (EAR/RDA), concepts of nutrient requirements during these ages and nutrition concerns keeping in mind the changing food habits and importance of physical activity will be dealt with.

Subtopics:

- Infants
- Preschool children
- School children
- Adolescents

**Practical component (if any)**

## **PRACTICAL: 30 Hours**

Introduction to meal planning:

- Rich sources of nutrients
- Use of food exchange lists

Planning nutritious diets for:

- Adult (Male and Female)
- Pregnant and Lactating woman
- Pre-schooler
- Adolescent
- Elderly

Planning and cooking of nutrient rich snacks/dishes for:

- Infants (Freshly prepared complementary foods)
- Packed tiffin
- Pregnancy/Lactation

### **Essential Readings**

1. Chadha R and Mathur P eds. (2015). Nutrition: A Lifecycle Approach. New Delhi: Orient Blackswan
2. ICMR-NIN (2020). Expert Group on Nutrient Requirements for Indians, Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR)-2020
3. Khanna K, Gupta S, Seth R, Passi SJ, Mahna R, Puri S (2013). Textbook of Nutrition and Dietetics. Delhi: Elite Publishing House Pvt. Ltd.
4. Longvah T, Ananthan R, Bhaskarachary K and Venkaiah K (2017). Indian Food 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. Puri S, Bhagat A, Aeri, BT, Sharma A (2019). Food Exchange List: A Tool for Meal Planning. New Delhi: Elite Publishing House.
7. Seth V, Singh K, Mathur P (2018). Diet Planning Through the Lifecycle Part I: Normal Nutrition- A Practical Manual. 6th Edition. New Delhi: Elite Publishing House.
8. Siddhu, A, Bhatia, N, Singh, K, Gupta, S (2017). Compilation of Food Exchange List, Technical Series 6, Lady Irwin College, University of Delhi Publ. Global Books Organisation, Delhi.

### **Suggested Readings**

1. Byrd-Bredbenner C, Moe G, Beshgetoor D, Berning J (2013). Wardlaw's Perspectives in Nutrition, McGraw- Hill International Edition, 9th edition
2. B Srilakshmi Eighth Edition (2019). Nutrition Science. New Age International Publishers.
3. Punita Sethi, Poonam Lakra (2015). Aahar Vigyan Suraksha evam Poshan. Delhi: Elite Publishing House Pvt.Ltd

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**GENERIC ELECTIVES (GE HS 009): GENDER AND MEDIA 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			
Gender and Media Studies	4	3	0	1	12 <sup>th</sup> Pass	NIL	Home Science

**Learning Objectives**

The Learning Objectives of this course are as follows:

- To introduce the concepts relating to gender and to sensitize the students to the construction of gender.
- To highlight the various aspects in gender and development, and its dimensions, theories and approaches.
- To understand the gender-based issues of equality and equity through a study of development indices and feminist theories and perspectives.
- To learn about the inter-relationships between portrayal of women in media and the status of women as well as the role media can play in empowerment of women.

**Learning outcomes**

The Learning Outcomes of this course are as follows:

After studying, students will be able to:

- The student will be able to understand the concept of gender and socio-cultural practices impacting the construction of gender.
- The student will be able to understand the theories and approaches of feminism.
- The student will be able to comprehend the various aspects in gender and development, and its dimensions, theories
  - and approaches.
- The student will be able to critique the role of the media in promoting gender equity and empowerment.

**SYLLABUS OF GE HS 009**

## **Unit I: Social Construction of Gender (12 Hours)**

The Unit aims to critically understand the concept of gender and socio-cultural practices impacting the social construction of gender.

Subtopics:

- Concept of gender and sex
- Socialization and construction of gender
- Patriarchal social order and status of women
- Shifts in Status of women – historical and contemporary perspectives on status of women

## **Unit II: Gender and Development (12 Hours)**

The Unit highlights the various aspects in gender and development and focuses on its dimensions, theories and approaches.

Subtopics:

- Concept of Gender, Development and Indicators
- Approaches to women's participation in development
- Invisibility of women's work and economic participation
- Gender differentials in various sectors of development
- Life Cycle Approach to gender studies (violence against women)

## **Unit III: Feminism, Gender and Media (12 Hours)**

This Unit focuses on historical evolution of feminism and perspectives on gender and media.

Subtopics:

- Feminist theories; A short introduction
- Gender and Media; Theoretical perspectives - portrayal and representation
- Theory of Visual Pleasure - Male Gaze (Laura Mulvey);
- Queer Theory (Judith Butler)
- Masculine Hegemony (R.W. Connell)
- Framework for gender responsive media and gender mainstreaming

## **Unit IV: Gender and Empowerment (09 Hours)**

This Unit provides an insight on the concept of empowerment and gender equality.

Subtopics:

- Advocacy of women's rights through media
- Women's Empowerment; Historical and Contemporary Perspectives
- Women's Legal Rights and Redressal System
- Media laws related to women

## Practical component (if any)

### PRACTICAL: 30 Hours

- Exercises on sex and gender
- Data interpretation on gender-related indicators
- Review and content analysis of various Media: print, films/documentaries on gender issues and their critical analysis.
- Case studies on representation of gender in mainstream media from a gender perspective (print, broadcast and new media)
- Critical analysis of Laura Mulvey's notion of Male Gaze

## Essential Readings

- Bhasin, Kamla (2000). *Understanding Gender*. New Delhi. Kaali for Women.
- Butler, J. (1999). *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.
- Connell, R. W., & Messerschmidt, J. W. (2005). Hegemonic Masculinity: Rethinking the Concept. *Gender & Society*, 19(6), 829–859.
- Human Development Reports. (n.d.). Hdr.undp.org. <https://hdr.undp.org/en/towards-hdr-2022>
- Mulvey, L. (1989). Visual Pleasure and Narrative Cinema. In *Visual and other pleasures* (pp. 14-26). Palgrave Macmillan, London.

## Suggested Readings

- Beauvoir, S. (2015). *The Second Sex*. London: Vintage Books.
- Chattopadhyay, S (2018). *Gender Socialization and the Making of Gender in the Indian Context*. New Delhi: Sage Publications.
- Dube, L. (2001). *Anthropological Explorations in Gender-Intersecting Fields*. New Delhi: Sage Publications.
- Ghadially, R (2007). *Urban Women in Contemporary India*. New Delhi: sage Publications.
- Goel, A. (2004). *Education & Socio-Economic Perspectives of Women Development and Empowerment*. New Delhi: Deep & Deep.
- Goel, A. (2004). *Organisation & Structure of Women Development and Empowerment*. New Delhi: Deep & Deep.
- Goel, A, Kaur, A and Sultana, A (2006). *Violence against women: Issues and Perspectives*. New Delhi, Deep & Deep Publishers.
- Khanna, S. (2009). *Violence against Women and Human Rights*. Delhi: Swastik
- Krishna, S. (Ed) (2003) *Livelihood and Gender Equality in Community Resource Management*. New Delhi: Sage Publications.
- Madhi, V. J et al (2014) *Women's Studies in India*. New Delhi: Rawat.
- Sohoni, K Neeraja, (1994), *Status of Girls in Development Strategies*, New Delhi, Har-Anand Publications.

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## GENERIC ELECTIVES (GE HS 014): FABRIC STUDY

### 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			
Fabric Study	4	3	0	1	12 <sup>th</sup> Pass	NIL	Home Science

### Learning Objectives

The Learning Objectives of this course are as follows:

- To briefly study the fabric components.
- To enhance awareness of various commercially available fabrics.
- To understand the properties and end uses of the various types of fabrics.

### Learning outcomes

The Learning Outcomes of this course are as follows:

After studying, students will be able to:

- The student will be able to understand the components of a textile fabric.
- The student will be able to identify the various commercially available fabrics.
- The student will be able to appropriately select fabrics based on their properties, cost and recommended end-use.

## SYLLABUS OF GE HS 014

### UNIT I: Fabric components

(09 Hours)

In this unit, students will be able to understand the basics of fibres, yarns and fabric.

Subtopics:

- Fibres and yarns
- Methods of fabric construction

Fabric finishing- dyeing, printing, aesthetic and functional finishes

**Unit II: Commercially important woven fabrics: Identification, properties and end use (21 Hours)**

In this unit, students will gain an understanding of various types of woven fabrics

Subtopics:

- **Cotton and other Cellulosic Fabrics**
  - Lightweight fabrics- Mulmul, Voile, Organdy, etc.
  - Medium weight fabrics- Cambric, Poplin, Cotton, Rubia, Denim, Chambray, Seer-sucker, Eyelash dobby, Schiffli, Jute, Linen, etc.
  - Heavy weight fabrics- Canvas, Casement, Gabardine, Damask, Corduroy, Velvet, Terry, etc.
- **Silk and Wool fabrics**
  - Lightweight fabrics- Silk Crepe, De Chine, Georgette, Chiffon, Organza, etc.
  - Medium/Heavy weight fabrics- Flat silk, Satin, Taffeta, Dupion, Shantung, Raw silk, Tussar silk, Habutai silk, Tweed
- **Man-made fibre and blended fabrics**

Art silk, Lizzy-Bizzy, Terivoile, Semi-crepe, Moss crepe, Artificial chiffon, Artificial georgette, Terrycot, Poly-satin, Lycra, Modal, Viscose

**Unit III: Commercially Important Knitted and Non-woven fabrics: Identification, properties and end use (09 Hours)**

In this unit, students will learn about various types of knitted and non-woven and other types of fabrics

Subtopics:

- Knitted Fabrics- Knitted Terry, Jersey, Rib Knit, Interlock knit, Pique, Velour, Scuba, Fleece, etc.
- Non-wovens- Different types and weights
- Others- Leatherette, Suede, Nets and Laces

**Unit IV: Traditional Indian Fabrics: Identification, properties and end use (06 Hours)**

In this unit, students will be learn to identify various types of traditional Indian fabrics

Subtopics:

Selected woven, embroidered, painted, printed and dyed traditional Indian textiles.

**Practical component (if any)**

**PRACTICAL: 30 Hours**



### **Unit I: Identification of various types of fibres, yarns, fabrics and weaves**

- Learn to identify the different components of a fabric, its construction and other essential properties

Subtopics:

- Identification of common textile fibres
- Identification of textile yarns
- Identification of fabric types: Woven, Knitted, Non-Wovens and others
- Identification of fabric weave
- Identification of various types of woven fabrics in terms of Weight
- Thread Count

### **Unit II: Collection of swatches for portfolio preparation of woven, knitted, non-woven and traditional Indian fabrics**

Learn to recognise various types of commercially available fabrics

Subtopics:

- Preparation of portfolio of commonly available fabrics
- Commercially important Woven Fabrics

Commercially important Knitted, Non-Woven and other fabrics o Traditional Indian Fabrics

### **Essential Readings**

- Corbman P. B., (1989), Textiles- Fibre to Fabric, 6th edition, McGraw Hill, New York.
- Hollen N., Saddler J., Langford A.L., Kadolph S.J., (1988), Textiles, 6 th Edition, Macmillan Publishing Company New York, USA
- Joseph, M.L., (1988) Essentials of Textiles (6th Edition), Holt, Rinehart and Winston Inc., Florida.
- Rastogi, D. (Ed.) and Chopra, S. (Ed.), (2017), Textile Science, Orient Black Swan.
- Sekhri S., (2011) Textbook of Fabric Science: Fundamentals to Finishing, PHI Learning, Delhi.
- Chattopadhyay, K.D., 1995, Handicrafts of India, Wiley Eastern Limited, N Delhi.

### **Suggested Readings: (Practical)**

- Corbman P. B., (1989), Textiles- Fibre to Fabric, 6th edition, McGraw Hill, New York.
- Chelna Desai, 1988, Ikats Textiles of India, Chronicle Books, India.
- Pizzuto's J.J. "Fabric Science", Fairchild Publication, New York.
- Hollen N., Saddler J., Langford A.L., Kadolph S.J., (1988), Textiles, 6<sup>th</sup> Edition, Macmillan Publishing Company New York, USA
- Das, Shukla, 1992, Fabric Art- Heritage of India, Abhinav Publications, N Delhi.
- Chelna Desai, 1988, Ikats Textiles of India, Chronicle Books, India
- Tholia A., (2013) Understanding Fabrics- A practical Approach, 2nd edition, Sarv

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## Credit distribution, Eligibility and Pre-requisites of the Course

GENERIC ELECTIVES (GE HS 018): INNOVATIVE DESIGN PRACTICES							
Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Innovative Design Practices	4	3	0	1	12 <sup>th</sup> Pass	NIL	Home Science

### Learning Objectives

The Learning Objectives of this course are as follows:

- To sensitize students towards innovation in design to improve the quality of life of users as well as comply with environment protection.
- To stimulate the students to engage in creativity and integrate sustainability in their design endeavours.

### Learning outcomes

The Learning Outcomes of this course are as follows:

After studying, students will be able to:

- The student will be able to get sensitized towards innovation and creativity through innovative and sustainable design practices and techniques.
- The student will be able to carry out development of product and prototyping from a sustainability perspective.
- The student will be able to brainstorm new product ideas in a systematic manner.

### Unit I: Introduction to Innovation in Design

**(09 Hours)**

The focus of this unit would be on understanding the theoretical concepts related to innovation, design and creativity.

Subtopics:

- Concept of Design, Innovation, and Creativity
- Theories and principles of design and innovation
- Challenges to innovation

### Unit II: Methods and techniques for Innovation in Design

**(12 Hours)**

This unit focuses on studying the various methods and techniques used for design innovation

Subtopics:

- Understanding disruptions in innovation approaches, case analysis
- Process of creativity and design
- Methods of ideating, creating and implementing innovative design ideas

### Unit III: Approaches for Sustainability in Design

**(12 Hours)**

This unit attempts to acquaint the students with contemporary techniques and approaches for integrating concepts of sustainability in design.

Subtopics:

- Role of sustainability in design practice
- Emerging trends and sustainable methods and techniques of design
- Sustainable Materials: reclaimed and eco-friendly composite materials
- Contemporizing traditional designs
- Circular Economy as a pathway to sustainability in design

#### **Unit IV: Design Development and Presentation**

**(12 Hours)**

This unit will develop competence amongst students towards creating and executing their innovative design ideas.

Subtopics:

- Critical evaluation of existing designs:
  - Products
  - Interiors and Space
- Case study of Innovative design practices related to:
  - Interiors and Space

Product

### **SYLLABUS OF GE HS 018**

**Practical component (if any)**

**PRACTICAL: 30 Hours**

#### **Unit I: Brainstorming Methods**

Activities:

- Sessions on Tinkering Lab
- Engaging students in a practical setup for brainstorming
- Narration / Documentation of brainstorming sessions
- Workshop/ Field Visits- Contemporary discussion with the artists and designers

#### **Unit II: Project on Innovative Design Idea**

Activities:

- Case study on Reuse/ Recycle/ Reclaim products
- Minor project on sustainable materials
- Portfolio on Innovative Design Idea
- Description
- Relevance of the idea in present context Digital Presentation / Prototype of Innovative Design Idea

### Essential Readings

- Brown, T. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. ISBN-13: 9780062856623
- Soni, P. (2020) Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving.
- Jones, J. C. Design Methods. ISBN-13: 978-0471284963
- Ashby, M.F, Johnson, K. Materials and Design: The Art and Science of Material Selection in Product Design.
- Allwood, J, Cullen, J. (2011). Sustainable Materials.
- Desai, A, Mital, A. Sustainable Product Design and Development. ISBN: 9780367343217
- William McDonough and Michael Braungart (2002). “Cradle-to-Cradle: Remaking the Way We Make Things”, North Point Press, New York.
- Lance Hosey, (2012). “The Shape of Green: Aesthetics, Ecology, and Design”, Island Press, Washington, D.C.

### Suggested Readings

- Norman, A.D. The Design of Everyday Things: Revised and Expanded Edition.
- Kaptelinin, V. Affordances and Design.
- Pivot. From Concept to Product Launch: A guide to Product Development.
- Monto Mani and Prabhu Kandachar (Eds) (2015), “Design for sustainable well-being and empowerment: Selected Papers”, IISc, Bangalore and TU Delft, The Netherlands.
- Papanek, V. (1984), “Design for the Real World”, 2nd Edition, London: Thames & Hudson.
- White Lemon, “365 Days of DIY”, Create Space Independent Publishing Platform, 2016.
- Jaffe, S.B et.al. (2020). Sustainable Design Basics.



**REGISTRAR**