

Appendix-46
Resolution No. 14-1 (14-1-6)

INDEX
BSc (H) Biological Sciences

Sl.No.	Content	Page No.
1	<p style="text-align: center;">SEMESTER-IV</p> <p>BSc (Hons.) Biological Science</p> <ol style="list-style-type: none">1. DSC – 10: Metabolism and Integration2. DSC – 11: Animal Physiology3. DSC -12: Plant Physiology <p>Pool of DSE</p> <ol style="list-style-type: none">1. Natural Resources and their Sustainable Utilization (Botany)2. Human Nutrition and Biochemistry (Biochemistry)3. Conservation and Management of Wildlife (Zoology) <p>Pool of GE</p> <ol style="list-style-type: none">1. Light and Life2. Wellness and health	2-23
2	<p style="text-align: center;">SEMESTER-V</p> <p>BSc (Hons.) Biological Science – DSC</p> <ol style="list-style-type: none">1. DSC – 13: Molecular Biology I2. DSC – 14: Transmission and Molecular Genetics3. DSC -15: Growth and Reproduction <p>Pool of DSE</p> <ol style="list-style-type: none">1. Plant Resource Management (Botany)2. Membrane Biology (Biochemistry)3. Ethology (Zoology) <p>Pool of GE</p> <ol style="list-style-type: none">1. Bioremediation and sustainability2. Epidemiology and Biostatistics	24-44

SEMESTER-IV

Category I

(BSc Honors in Biological Science in three years)

DISCIPLINE SPECIFIC CORE COURSE – 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 (if any)
		Lecture	Tutorial	Practical/ Practice		
Metabolism and Integration (BS-DSC-401)	4	2		2	Class XII Pass with Biology and chemistry	Should have a background in chemistry of biomolecules and enzymes

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce the students to the basic concepts of metabolism occurring within a living organism.
- to provide the students an understanding of the major metabolic pathway and their regulation.
- To provide knowledge about the possible integration between various metabolic pathways.
- To enable them to correlate adaptations in metabolic pathways and physiological as well as pathophysiological states.

Learning outcomes

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

- Outline the pathways involved in catabolism and biosynthesis of glucose.
- Understand the biosynthesis and degradation of glycogen
- Comprehend the catabolism and biosynthesis of fatty acids
- Understand the biosynthesis and degradation of amino acids and nucleotides
- Understand the integration of metabolism

SYLLABUS FOR DSC-10

CREDITS:2

TOTAL HOURS: 30 hrs

UNIT I: Carbohydrate metabolism

No. of hours: 14

Principles of metabolism, anabolism, catabolism, standard free energy change, metabolic roles of ATP, phosphoryl group transfer, nucleotidyl group transfer. Glycolysis as a universal pathway, anaerobic glycolysis, fermentation, gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis, Glycogenesis and glycogenolysis and overview of regulation, Pentose phosphate pathway, Pyruvate dehydrogenase complex, oxidation of acetyl CoA. TCA cycle, amphibolic role, ATP calculation, Glycerol-3-phosphate and malate-aspartate shuttle.

UNIT II: Lipid metabolism**No. of hours: 8**

Lipid metabolism - Mobilization of triglycerides, metabolism of glycerol, β -oxidation of saturated, monounsaturated and poly-unsaturated fatty acids, even and odd chain fatty acids. Ketogenesis and significance, Biosynthesis of C-16 palmitic acid, brief overview of cholesterol metabolism and lipoprotein cycle.

UNIT III: Amino acid and nucleotide metabolism**No. of hours: 5**

Transamination and deamination, Urea cycle, glucogenic and ketogenic amino acids, secondary metabolites from amino acids. Nucleotide Metabolism- De novo and Salvage pathways and degradation. Inborn errors of metabolism - Phenylketonuria, Alkaptonuria, Maple syrup, Lesch Nyhan syndrome.

UNIT IV: Integration of metabolism**No. of hours: 3**

Starve feed cycle: Metabolic shifts in absorptive, post absorptive, fasting and starvation states

PRACTICALS**CREDITS: 2****TOTAL HOURS: 60**

1. Estimation of Random Blood Glucose – Glucose Oxidase- Peroxidase method
2. Estimation of Oral Glucose tolerance test (O-GTT).
3. Determination of Lipid Profile: Total Cholesterol (TC), High Density Lipoproteins (HDL) and Triglycerides (TAG).
4. Estimation of SGPT and SGOT in serum/plasma sample.
5. Estimation of creatinine in serum/plasma sample.
6. Estimation of Blood Urea.
7. Estimation of serum uric acid

Essential Readings

1. Nelson, D.L. and Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). W.H. Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10-1464126119.
2. Berg, J.M., Tymoczko, J.L., Stryer L., (2012) Biochemistry 7th ed., W.H. Freeman and Company (New York); ISBN:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4.
3. Campbell, M.K., Farrel, S.O. (2012) Biochemistry 7th ed, S.O. Brooks/Cole, Cengage Learning (Boston); ISBN: 13:978-1-111-42564-7 ISBN:10:1-4292-2936-5.
4. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10:0-07-099487-0

Suggested Readings

1. Principles of Biochemistry (2013) 4th ed., Voet, Donald, Voet, Judith & Pratt, charlotte. Wiley & Sons, Inc. (New Jersey), ISBN:978-1-11809244-6.

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

DISCIPLINE SPECIFIC CORE COURSE – 11

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		
Animal Physiology (BS-DSC-402)	4	2		2	Class XII pass with Biology and chemistry	None

Learning Objectives

The Learning Objectives of this course are as follows:

- Seeks to understand what the physiological adaptations are that enable animals to thrive across virtually any environment on earth, and
- How some of these adaptations can reveal the general principles that govern life functions
- Provides an understanding of fundamental principles of animal physiology and how these principles are incorporated into adaptations of different animal groups.
- Emphasizes on integrating the knowledge of how systems within diverse organisms' function and respond to changes in their environment
- Serves as a comprehensive guide to understand the complexity of an organ system and to cover the comparative aspects of system in different animal groups.
- The course is based on the “Krogh's principle”, which proposes the use of specific organisms convenient to study specific questions and to address the central concept based on evolutionary adaptations.

Learning outcomes

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

- Students will know how animals obtain energy from their environment.
- Students will understand the unique role of various organs and organ systems in performing various vital functions.
- Students will understand the role of physiology in adapting to various environments.
- Students will appreciate the importance of homeostasis in different animals.
- Students will learn to apply critical thinking and integrate scientific knowledge to understand the basic physiological principles which led to diverse evolutionary adaptations.

SYLLABUS OF DSC- 11

Theory

TOTAL HOURS: 30

CREDITS: 2

Unit 1: Production of Energy

No. of hours: 4

Feeding patterns found in different animals; Intracellular and extracellular digestion, cellulose digestion in animals: invertebrates, ruminants, non-ruminants and coprophagy.

Unit 2: Gas Exchange in Organisms

No. of hours: 5

Physiology of aquatic and terrestrial breathing; Respiratory organs in aquatic and terrestrial organisms: respiration in insects: terrestrial, aquatic and cyclic respiration, respiration in fishes: ventilation, water pumping and counter current flow, respiration in birds: air sacs, lung function and crosscurrent flow

Unit 3: Bulk Transport

No. of hours: 6

General plan of circulatory system in invertebrates and vertebrates: closed and open system of circulation, single circulation and double circulation: circulation patterns of cockroach, bony fishes and amphibians. Physiology of vertebrate heart: cardiac output, regulation of heartbeat- Starling's law of the heart.

Unit 4: Regulatory Physiology

No. of hours: 10

Homeostasis in animals: regulation of water and solutes in aquatic and terrestrial animals; osmoconformers and osmoregulators; physiology of osmoregulation in marine invertebrates, elasmobranchs and bony fishes (freshwater and marine); water balance in terrestrial animals: kangaroo rat.

Patterns of thermoregulation: heat exchange with the environment. Ectotherms: tolerance to high temperature (lethal temperature), tolerance to cold and freezing temperature (freeze tolerant and intolerant animals). Endotherms: thermogenesis and regulation of body temperature. Structural and functional adaptations to temperature stress (taking examples of arctic fox, penguins, and camels)

Unit 5: Integrative Physiology

No. of hours: 5

An overview of neuronal structure and function; general principles of sensory physiology-chemoreceptors (gustatory and olfactory); mechanoreceptors (statocyst in invertebrates and lateral line system of fishes); sonar system in bats; electroreceptors (electric organs in fishes); thermoreceptors.

PRACTICALS

TOTAL HOURS: 60

CREDITS: 2

1. Effect of isotonic, hypotonic and hypertonic saline solutions on erythrocytes
2. Study of mouth parts and digestive system of *Paramecium**
3. Preparation of temporary mounts: nerve cells and blood smear
4. Enumeration of Differential Leucocyte Count (D.L.C)
5. Effect of temperature on action of salivary amylase.

6. Study of permanent slides of nephridia of earthworm and mammalian oesophagus, stomach, ileum, rectum, liver, trachea, lung, kidney, spinal cord
(*Subject to UGC guidelines)

Essential Readings

1. Moyes, C. D., & Schulte, P. M. (2008). Principles of Animal Physiology. San Francisco, CA: Pearson/Benjamin Cummings.
2. Randall, D. C., Burggren, W. W., & French, K. (2002). Eckert Animal Physiology. New York: W. H. Freeman.
3. Schmidt-Nielsen, K. (2010). Animal Physiology: Adaptation and Environment. Cambridge: Cambridge University Press.

Suggested readings.

2. Prakash, G. (2012). Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand andCo. Ltd.
3. Reece, J. B., & Campbell, N. A. (2011). Campbell Biology. Boston: Benjamin Cummings /Pearson.

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

DISCIPLINE SPECIFIC CORE COURSE –12 :

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 Physiology (BS-DSC-403)	4	2		2	Class XII pass with Biology and chemistry,	None

Learning Objectives

The Learning Objectives of this course are as follows:

- Gives the students an insight into the structure-function integration in plants.
- To appreciate the complex interactions of the plant with the environmental and edaphic factors that forms a major portion of plant physiology
- To provide students with comprehensive exposure to the subject of plant physiology.
- Aims to familiarize the students with the role of various functional processes of plants in their growth and development;
- To understand transport mechanisms and translocation in the phloem,
- Appreciate the commercial applications of plant physiology.

Learning outcomes

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

- Comprehend the fundamental concepts of plant physiology
- Understand the physiological mechanisms of plant growth, function, and development.
- Understand the integration of soil, atmosphere, and plant in carrying out the life processes by plants.
- Understand the complex regulation of phenomena of growth and flowering.
- Be able to use the knowledge gained to help crop growers, fruit farmers, floriculturists and others in the related area.

SYLLABUS OF DSC-12

Theory

Credits: 2

Total Hours: 30

Unit 1: Water relations

No. of hours: 9

Water potential and its components (solute potential, pressure potential, gravimetric potential and matric potential); inter cellular water transport (diffusion, mass flow and osmosis), short- distance transport (water absorption by roots), aquaporins, pathway of water movement (apoplast and symplast), water and ion uptake from soil into roots, root pressure, guttation, ascent of sap, cohesion-tension theory; Transpiration and its significance, factors affecting transpiration, anti- transpirants; Mechanism of stomatal movement (starch-sugar hypothesis, proton transport theory).

Unit 2: Plant Nutrition: uptake and distribution

No. of hours: 10

Essential elements (macronutrients and micronutrients, criteria of essentiality, roles and deficiency symptoms), methods of study and use of nutrient solutions (ash analysis, hydroponics and aeroponics), Soil cation exchange capacity, transport of ions across cell membrane-passive transport and active transport, experimental evidence in support of phloem as the site of sugar translocation, Source-sink relationship, pressure flow model, phloem loading and unloading.

Unit 3: Regulation of plant growth

No. of hours: 5

Discovery, basic structure, bioassays, physiological roles and commercial applications of auxins, gibberellins, cytokinins, abscisic acid and ethylene, general mechanism of mode of action of hormones. Brassinosteroids and Jasmonic acid (brief)

Unit 4. Physiology of Flowering

No. of hours: 6

Photoperiodism: SDPs, LDPs, DNPs, photoinductive cycle(perception of photoperiodic signal), physiology of flowering (florigen concept), phytochrome (discovery, structure and responses on photomorphogenesis) vernalization, seed dormancy and germination (causes and methods to overcome dormancy).

2.1 Practical

Credit:2

Total Hours: 60

1. To determine the osmotic potential of plant cell sap by incipient plasmolytic method.
2. To determine the water potential by weight method.
3. To study the effect of two environmental factors on transpiration of an excised twig.
4. To calculate stomatal index and stomatal frequency of two surfaces of leaves of a mesophyte and a xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and a xerophyte (any one surface)
6. To demonstrate suction due to transpiration
7. To demonstrate the role of auxins in rooting of the cuttings
8. To study the phenomenon of Bolting
9. To study the role of Ethylene in fruit ripening
10. To study the effect of pH on anthocyanin pigments

Essential readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Kochhar, S.L. and Gujral, S.K. (2011). Comprehensive Practical Plant Physiology, Macmillan India Ltd, New Delhi.
3. Noggle, G.R. and Fritz, G.J. (1986). Introduction to Plant Physiology, 2nd Ed. Prentice Hall of India Ltd., New Delhi.
4. Salisbury, F.B. and Ross, C.W. (2005). Plant Physiology, Thomson Wadsworth, 4th edition.
5. Taiz, L., Zeiger, E. Moller, I.M. and Murphy, A. (2015). Plant Physiology and Development, Sinauer Associates Inc. U.S.A 6th edition.

Suggested readings:

1. Bhatla, S.C. and Lal M.A. (2018). Plant Physiology, Development and Metabolism, Springer Nature, 1st edition.
2. Nobel, P.S. (2009). Physicochemical and Environmental Plant Physiology, Academic Press, 4th edition.

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

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-4 :

Course title& Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Natural resources and their Sustainable Utilization(BS-DSE-4)	4	2		2	Class XII pass with Biology and chemistry	NA

Learning Objectives:

Natural Resource Management (NRM) is an integrated and multidisciplinary approach combining Earth- Science, Life-Science, Environmental Science and Social Science to manage and restore natural resources and ecosystems. This paper takes an objective view of the nature of Earth's resources, how and where they are generated, how they are extracted and used, and how these activities impact Earth's environment. It also addresses sustainability by looking into different ways of conservation of the natural resources and their management. Natural Resource Management helps to balance the needs of people and the economy with protecting the ability of ecosystems to support soil, water, forests, biodiversity, recreation and other resources

Learning Outcomes:

On successful completion of the course, a student will:

- Define and differentiate between biological and physical natural resources
- Appreciate the role of natural resources in ecological, economic and socio-cultural activities
- Understand the effect of anthropogenic interference on natural resources
- Understand the laws and policies associated with resource management and conservation

SYLLABUS for DSE-4

Course Contents – Theory

Unit 1: Natural Resources and Sustainable Utilization

No. of hours: 3

Definition and types of Natural resources. Concept of sustainable utilization and approaches (economic, ecological and socio-cultural), ecotourism

Unit 2: Land and Water**No. of hours: 6**

Land resources and land use patterns and changes: Land as a resource, land degradation, landslides (natural & man-induced), soil types of India, soil erosion and desertification. Water resources (Fresh water (rivers, freshwater lakes, salt lakes, groundwater, aquifers, watershed); Marine; Estuarine), Use and over-exploitation of surface and ground water, floods, drought. Effects of climate change on water and land.

Unit 3: Biological Resources**No. of hours: 5**

Importance of Biological Resources in Human welfare. Threats; Management strategies; Bioprospecting; IPR (Intellectual Property Rights); CBD (Convention on Biological Diversity); National Biodiversity Action Plan, National Green Tribunal (NGT) and its role.

Unit 4: Forests and Energy**No. of hours: 8**

Forests & forest resources of India: Use and over-exploitation, Major and minor Forest products. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, impact of growing energy needs and energy crisis- remedial measures.

Unit 5: Contemporary practices in Resource Management**No. of hours: 8**

Environment Impact Assessment (EIA), Geographical Information System (GIS), Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Types of waste and their management. National and international efforts in resource management and conservation

PRACTICALS**CREDITS: 2****TOTAL HOURS: 60**

1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation.
2. Collection of data on vegetation/ forest cover of specific city/state (any two) and correlate with conservation and socio economic practices.
3. Measurement of dominance of woody species by DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Estimation of soil organic carbon by Walkley and Black's method.
6. Ecological modeling.
7. Estimation of dissolved carbon-dioxide in different water samples.
8. Soil Analysis for water holding capacity, pore-space, cation-exchange capacity
9. Visit to landfill sites/ mining area/ sewage treatment plant.

Essential Readings:

1. Craig, J.R., Vaughan, D.J. Skinner, B.J. (1996). Resources of the Earth: Origin, Use, and Environmental Impact (2nd ed). Prentice Hall, New Jersey.
2. Klee, G.A. (1991). Conservation of Natural Resources. Prentice Hall Publ. Co., New Jersey
3. Owen, O.S, Chiras, D.D. and Reganold, J.P. (1998). Natural Resource Conservation – Management for Sustainable future, (7th Edn.), Prentice Hall.
4. N. Vasudevan, Essentials of Environmental Science, Narosa Publishing House, (New Delhi), 2006
5. Vasudevan, N. (2006). Essentials of Environmental Science. New Delhi: Narosa Publishing House.
6. Sharma, P. D. (2017). Ecology and Environment. Meerut: Rastogi Publications

Additional Resources

1. J. S. Singh, S.P Singh and S. Gupta, Ecology, Environment and Resource Conservation, Anamaya Publications, (New Delhi), 2006
2. An P.P Rogers, K.F Jalal and J.A Boyd, Introduction to Sustainable Development, Prentice Hall of India Private Limited (New Delhi), 2008

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-5 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Human Nutrition and Biochemistry (BS-DSE-5)	4	2		2	Class XII pass with Biology and chemistry	NA

Learning Objectives:

This course provides students with knowledge and understanding of the characteristics, function, metabolism and deficiency of macro and micronutrients in the human body. It involves integrated learning between the areas of Biochemistry and Nutrition.

Learning Outcomes:

On successful completion of the course, a student will:

- Critically analyze and evaluate concepts in nutritional biochemistry that are important for an understanding of human nutrition.
 - Appreciate the biochemical underpinning of human nutrition in maintaining health.
 - Demonstrate understanding of the biochemical basis of essentiality of macro and micronutrients and their nutritional deficiencies.
 - Be aware of techniques used in the assessment of nutritional status and nutritional disorders.
- Understand drug nutrient interactions

SYLLABUS FOR DSE-5

Course Contents -Theory

UNIT 1: Introduction to Nutrition and Energy Metabolism

No. of hours: 4

Defining nutrition, role of nutrients. Unit of energy, Food energy, Specific Dynamic Action. Energy expenditure and its components, Energy Balance, Recommended Nutrient Intakes (RNI) and Daily Recommended Intakes for different age groups.

UNIT 2: Macronutrients

No. of hours: 10

Food sources of carbohydrates, functions of carbohydrates, RDA, Factors affecting bioavailability, Glycemic index and glycemic load. Dietary fiber and the role of fiber in health. Role of Gut microbiome in maintaining health. Role of prebiotics and probiotics in nutritive health.

Essential Fatty Acids; Functions of EFA, AI, excess and deficiency of EFA, factors affecting bioavailability. Dietary implications of ratios of n6 and n3, MUFA, PUFA, SFA and Cholesterol in the body.

Functions of proteins in the body. RDA for different age groups. Essential and Nonessential amino acids. Complete and incomplete protein, Amino Acid Interactions: Antagonism, Toxicity, Imbalance, Amino acid complementation and Supplementation in foods. Protein quality determinants: Net protein utilization (NPU), Biological Value, Protein digestibility-corrected amino acid score (PDCAAS), Nitrogen balance. PEM: Marasmus and Kwashiorkor.

UNIT 3: Fat- and water-soluble Vitamins

No. of hours: 9

Vitamin A, D, E, K and their dietary sources, RDA, Role of Vitamin A in Visual cycle and overview of other functions. Role of Vitamin K in Gamma carboxylation (blood clotting). Role of Vitamin E as an antioxidant. Role of Vitamin D in maintenance of bone physiology and overview of other functions. Vitamin C- Dietary sources, RDA, role in collagen synthesis. The B Complex vitamins- Dietary sources, RDA. Functions and role in metabolism, Role of Vitamin B12 and Folate in Hematopoiesis and Neurology Biochemical basis for deficiency symptoms, Hypervitaminosis.

UNIT 3: Minerals

No. of hours: 7

Minerals: Dietary Sources, RDA. Sodium, Potassium, Calcium, Iron, Chloride, Copper and Phosphorus-Function, metabolism, Excretion, Deficiency and Toxicity.

Function, Metabolism, deficiency, Toxicity and Sources of Trace Elements: Iodine, Fluoride, Mg, Zn, Se, Chromium, Molybdenum.

PRACTICAL

CREDITS: 2

TOTAL HOURS: 60

1. Anthropometric identifications for nutrition related diseases –Body mass index (BMI), percentage body fat
2. Calculation of Basal Metabolic Rate (BMR) and Total daily Energy Expenditure (TDEE)
3. Determination of oxidative stress: Thiobarbituric acid reactive substances (TBARS) in serum.
4. Assay of antioxidant enzymes in hemolysate/plant sources.
5. Estimation of vitamin A/E in serum.
6. Estimation of minerals in drugs/food/serum.
7. Determination of nutritive value of foods through Kjeldal's method, Soxhlet method
8. Understanding fortification and supplementation
9. Presentation and discussion on Food as medicine.
10. Group discussion on Nutrient-nutrient and drug-nutrient interactions
11. Case studies on nutritional disorders.

Essential Readings

1. Coombs Jr. G. F., (2008). *The vitamins, Fundamental aspects in Nutrition and Health*. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
2. Mahan, L.K., Strings, S. E., Raymond, J. (2012) *Krause's Food and Nutrition Care process*. Elsevier's Publications. ISBN: 978-1-4377-2233-8.
3. Rosalind Gibson (2005). *Principles of Nutritional Assessment*. Oxford University Press. ISBN: 9780195171693
4. Tom Brody (1999). *Nutritional Biochemistry* (2nd Ed). Harcourt Braces. ISBN:9814033251, 978981403325
5. Malik, D., Narayanasamy, N., Vavilala, P., Takur, J., Sinha, N., (2022). *Textbook of Nutritional Biochemistry*. Springer Singapore, ISBN978-981-19-4149-8.

Suggested Reading

1. Devlin, T. M., (2011). *Textbook of Biochemistry with Clinical Correlations*. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-6 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Conservation and Management of Wildlife (BS-DSE- 6)	4	2		2	Class XII pass with Biology and chemistry,	NA

Learning Objectives:

The Discipline Specific Paper on Wildlife Conservation and Management is designed to acquaint students with varied aspects of wildlife conservation, including its importance, major threats, management of their habitats and populations. The emphasis will be on developing interest and invoking a sense of responsibility among students towards wildlife conservation. The course also explores different techniques, perspectives, and approaches to both identify and achieve wildlife management goals. This course will motivate students to pursue career in the field of wildlife conservation and management.

Learning Outcomes:

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

- Understand the importance of wildlife in general, and its conservation and management in particular.
- Comprehend the application of the principles of ecology and animal behaviour to formulate strategies for the management of wildlife populations and their habitats.
- Understand the management practices required to achieve a healthy ecosystem for wildlife population along with emphasis on conservation and restoration.
- Know the key factors for loss of wildlife and important strategies for their in situ and ex situ conservation.
- Recognize the techniques for estimation, remote sensing and Global Position Tracking for wildlife.
- Gain knowledge about the wildlife diseases and the quarantine policies.
- Know about the Protected Area Networks in India, Ecotourism, Ecology of perturbation and Climax persistence.
- Perform critical thinking, literature review; scientific writing as well as presentations; and participation in citizen science initiatives with reference to wildlife.

SYLLABUS for DSE-6
Course Contents- Theory

Unit 1: Introduction to Wildlife

No. of hours: 6

Values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion

Unit 2: Management of Habitats

No. of hours:4

Setting back succession: Grazing logging; Mechanical treatment; Advancing the successional process:
Cover Construction

Unit 3: Wildlife identification and estimation

No. of hours: 8

Fecal analysis of ungulates and carnivores: Faecal samples, slide preparation, and Hair identification; Pugmarks and Census methods

Unit 4: Wildlife Health Management

No. of hours: 6

Common diseases of wild animals: Zoonosis (Ebola and Salmonellosis), Rabies, Foot and Mouth Disease, Mycobacterium TB, Bovine and Avian Flu

Unit 5: Protected Areas and Management

No. of hours: 6

National parks and sanctuaries; Biosphere reserves; Conservation and Community reserve; Important

features of protected areas in India; Tiger conservation - Tiger reserves in India and management

challenges in Tiger reserves. Human-wildlife conflict; Ecotourism / wild life tourism in forests

PRACTICAL

Credits: 2

Total Hours: 60

1. Identification of mammalian fauna, avian fauna, herpeto-fauna through direct and indirect evidences seen on a field trip to a wildlife conservation site.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field: Identification of animals through Pug marks, Scats & Nests.
4. Identification of big cats: Lion, Tiger, Cheetah, Leopard and Jaguar.
5. To Study the various Animal tracking systems: VHF, UHF, GPS and GIS
6. Trail / transect monitoring for abundance and diversity estimation of wildlife (direct and indirect wildlife evidences).

7. A report based on a visit to National Park/Wildlife Sanctuary or any other wildlife conservation site.

Essential Readings

1. Saha, G.K. and Mazumdar, S. (2017) Wildlife Biology: An Indian Perspective. PHI learning Pvt. Ltd. ISBN: 8120353137, 978-812035313
2. Sinclair, A.R.E., Fryxell, J.M. and Caughley, G. (2006) Wildlife Ecology, Conservation and Management. Wiley-Blackwell, Oxford, UK.
3. Singh, S.K. (2005) Text Book of Wildlife Management. IBDC, Lucknow.
4. Hossetti, B. B. (1997). Concepts in Wildlife Management. Daya Publishing House, Delhi.

Suggested Readings:

1. Hudson, P.J., Rizzoli, A., Grenfell, B.T. Heesterbeek, H. and Dobson, A.P. (2002) The Ecology of Wildlife Diseases. Oxford University Press, Oxford.
2. Banerjee, K. (2002) Biodiversity Conservation in Managed and Protected Areas. Agrobios, India. • Sharma, B.D. (1999) Indian Wildlife Resources Ecology and Development. Daya Publishing House, Delhi.
3. Primack, R.B. (1998). Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, MA.

Online Tools and Web Resources:

- <https://swayam.gov.in/courses/4687-july-2018-wildlife-conservation>
- <https://swayam.gov.in/courses/5364-jan-2019-wild-life-ecology>
- <https://papaco.org/mooc-on-species-conservation/>
- <https://www.iucn.org/theme/protected-areas/our-work/capacity-development/moocs>
- <https://www.zsl.org/united-for-wildlife-free-conservation-courses>
- <https://wildlife.org/next-generation/career-development/online-courses/>
- <https://www.openlearning.com/umtmooc/courses/wildlife-management>

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

GRNERIC ELECTIVE COURSE –GE-1 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Light and Life (BS-GE- 1)	4	2		2	Class XII pass with Biology and chemistry,	NA

Course Objective:

The course explores the physical properties of light and its interplay with living organisms. Light as a source of energy and information has shaped life on earth over the last 3.6 billion years. We see the world around us because the light reflected to the retina is processed to our brain (Photoreception), we breathe in oxygen because it has been evolved by the plants around us due to the light dependent Photosynthesis. Where there is no natural light organisms produce their own (Bioluminescence). Maintaining coordination with the surrounding light regime is fundamentally important to the inherent biological clock in organisms which needs re-calibration almost every 24 hours (Circadian Rhythms); whereas a disruption may lead to adverse effects. Every part of the spectrum is used in one way or the other by different life forms. In this paper students will be able to appreciate the delicate processes of life that are dependent on light.

Course Learning Outcomes:

- Students will understand and appreciate the dual nature of light.
- Students will comprehend the impact of light on biodiversity from pole to pole.
- Students will gain knowledge about the various photoreceptors in plants and animals and will appreciate and understand the mechanism of photosynthesis.
- Students will understand bioluminescence, photoperiodism and biological rhythms.
- Students will gain knowledge about the ecological and physiological responses to light.

Syllabus for GE-1

THEORY

TOTAL HOURS: 30

CREDITS: 2

Unit I: Introduction to Light and Life**No. of Hours: 4**

Nature of light (Wave and Particle), spectrum of light. Measurement of light (Lux, Candela, Foot Candle). Polarized light, light attenuation in water. Light as an ecological factor affecting distribution of plants and animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems. Latitudinal Diversity gradient.

Unit II: Photoreception**No. of Hours: 4**

Comparative account of chemistry and functional roles of pigments associated with harvesting light energy: photoreceptors in plants: chlorophylls, carotenoids, phycobilinoproteins, bacteriochlorophylls etc. Photoreception in animals, color vision and visual processing in human eye.

Unit III: Photosynthesis**No. of Hours:6**

History, Structure of chloroplast, Photosynthetic equation, Photosynthetic electron transport (cyclic and non-cyclic), photolysis of water, , concept of Reaction centers, , Dark Reactions in Photosynthesis, C3, C4, CAM cycle, Regulation of PCR cycle, photorespiration (C2 cycle), photoautotroph vs. photoheterotrophs; Photoautotroph vs. chemoautotroph, Anoxygenic and oxygenic photosynthesis.

Unit IV: Bioluminescence**No. of Hours: 6**

Definition, discovery, diversity of organisms, Functions and mechanism of Bioluminescence (*Photinus pyralis*, *Aequorea victoria*).

Unit V: Photoperiodism**No. of Hours: 10**

Photoperiodism: phytochromes, LDP, SDP, DNP plants, vernalization, vernalin, etiolation and de-etiolation. Animal responses to changing photoperiodism. Physiological and Behavioural adaptations to extreme light conditions in plants and animals. Three rhythm domains, Biological clock and Circadian rhythms. Sleep disorders, Shift work disorder, Jetlag.

Unit VI: Ecological and physiological responses to Light**No. of Hours: 6**

Color in animals: chromatophores and colour changes in animals, morphological and physiological colour change. Role of Light as an inducer for biosynthesis of Vitamin D and Melatonin along with significance .Thymine dimer formation, skin cancer and cataract in response to UV exposure. Light pollution and its impacts on environment, ecosystems and wildlife.

PRACTICALS

TOTAL HOURS: 60

CREDITS: 2

1. To study light penetration in water using Secchi disc.
2. To demonstrate the effect of light on soil fauna using Berlese funnel setup.
3. To study the effect of light and darkness on the chromatophores of fish.
4. To test / survey for color blindness using Ishihara charts.
5. To study oxygen liberation during photosynthesis using Hydrilla. Measurement of light using Luxmeter.
6. Separation of Chloroplast pigments by Paper Chromatography.
7. Demonstration of Hill's Reaction and study the effect of Light intensity (any 2 light conditions).
8. To study the effect of Light intensity and CO₂ concentration on the rate of photosynthesis

Essential Readings:

1. Björn, L. O. (2015) 3rd Ed. *Photobiology: Science of Light and Life*, L.O. Björn., Springer
2. Buchanan, B. B., Gruissem, W., and Jones, R. L. (2000). *Biochemistry and molecular biology of plants*. Rockville, Md.: American Society of Plant Physiologists.
3. Huner, N. and Hopkins, W. (2013). *Introduction to Plant Physiology*. In: 4th ed. John Wiley & Sons, Inc.
4. Kohen E., Santus R., Hirschberg J.G. (1995) 1st Ed., *Photobiology* Academic Press
5. Randall D., Burggren W., & French k. (2001) 5th Ed. *Eckert, Animal Physiology Mechanisms and Adaptations*. W.H. Freeman and Co.

Suggested Readings:

1. Gross M. (2003). *Light and Life*. Oxford University Press
2. Shimomura O., (2012) *Bioluminescence: Chemical Principles and Methods*, World Scientific,
3. Taiz, L., & Zeiger, E. (1991). *Plant physiology*. Redwood City, Calif: Benjamin/Cummings Pub. Co.

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

GRNERIC ELECTIVE COURSE –GE-2 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Wellness and health (BS-GE- 2)	4	2		2	Class XII pass	NA

Learning Objectives

This course aims at creating consciousness among the students towards health, fitness and wellness and in developing and maintaining a healthy life style. The course provides an introduction to basic personal health issues and concerns in today's society. The course will lay emphasis on current health issues such as malnutrition, mental health, sleep hygiene, substance abuse and stress. Upon completion, students should be able to demonstrate an understanding of the factors necessary to lead

a stress free and healthy life.

Learning Outcome

Upon successful completion of this course, the student will be able to:

1. Define Health and Wellness and understand the importance of a healthy lifestyle
2. Be familiar with factors contributing to physiological and mental health
3. Discuss misconceptions about nutrition and weight management; appreciate factors that contribute to malnutrition.
4. To create awareness of various life style related diseases and maintain a reasonable and cardiac-respiratory fitness and health.
5. Understand factors that contribute to stress, identify stressors commonly reported by different groups and appreciate ways to manage stress.
6. Identify the characteristics of emotionally and mentally healthy individuals
7. Identify the characteristics and risk factors of sexually transmitted infections and disease

GE-2 Syllabus

THEORY

Credits:2

Total hours: 30

UNIT I: Understanding Wellness and Health

2 hrs.

Defining health, Factors that contribute to health and wellness: Genetic, Physiological, Physical, Psychological, Social and Geopolitical.

UNIT II: Nutrition and Health

6 hrs.

Definition of Nutrition, Understanding different body types in relation to appropriate diet, Concept of Balanced Diet, Diet Plans: Keto diet, Intermittent fasting, Paleo diet, Atkins diet; Malnutrition and its contribution to ill health. Current concerns in India regarding Nutrition and Health.

UNIT III: Sleep, Mental Health and Stress

6 hrs

Defining sleep, Sleep Physiology and sleep wake cycle, Stages of sleep, Sleep hygiene and its contribution to health, Basic physiology of stress and mental health, Psychosomatic illness, PTSD, Depression and Anxiety; Social, Psychological, Physiological and Environmental factors contributing to stress and its mental health

UNIT IV: Lifestyle Management and Fitness

6 hrs

Understanding Non-Communicable diseases (NCD), Cardiovascular and pulmonary health and disease, Diabetes Mellitus and Obesity. Management of Life Style disease: Diet, sleep, exercise and stress management. Cardiopulmonary fitness, Maintenance of Healthy lifestyle, Exercise: types, benefits; Yoga and Pranayama.

UNIT V: Addiction and Health Concerns

5 hrs

Definition of Addiction, Physiology and psychology of addictive behaviour, Addiction of alcohol,

drugs, nicotine and electronic devices and their effect on health, Deaddiction, Counselling and Rehabilitation

UNIT VI: Sexual Health and Disease

5 hrs

Overview of reproductive physiology, Contraception, sexually transmitted disease (HIV, Herpes, Cervical cancer), PCOS, Infertility and health

PRACTICALS

Credits: 2

Total hours: 60

1. Calculating BMI, BMR and Total daily energy expenditure
2. Calculating Nutrient Intake and Total Daily Energy Intake
3. Calculating Energy balance and obesity indices like percent body fat, Body Conicity Index and Body Adiposity Index, Waist to Hip ratio
4. Measuring Blood Pressure and Pulmonary function tests.
5. Determining Mental Health through established questionnaire.
6. Maintaining record and calculating sleep hours.
7. Case Studies: Life Style Disorders, Sexually Transmitted Diseases

ESSENTIAL READINGS:

1. Physical Activity and Health by Claude Bouchard, Steven N. Blair, William L. Haskell. ISBN-13: 978-0736095419
2. Mental Health Workbook by Emily Attached & Marzia Fernandez, 2021. ISBN-13:979-8640649550
3. Lifestyle Diseases: Lifestyle Disease Management, by C. Nyambichu & Jeff Lumiri, 2018.
4. An Invitation to Health 18th ed., by Dianne Hales ISBN: 1337392898
5. The Psychology of Addiction by Jenny Svanberg, 2018 ISBN-13: 978-1133104544
6. Introduction to Human Physiology by Lauralee Sherwood, ISBN-13:978-1133104544

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

SEMESTER-V

Category I

(BSc Honors in Biological Science in three years)

DISCIPLINE SPECIFIC CORE COURSE – 13:

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		
Molecular Biology I(BS-501)	4	2		2	Sem III Of a BSc course	Should have a background in chemistry of biomolecules and enzymes

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce to the students, the basic concepts of genome, DNA structure, genes, chromatin and chromosomes.
- Provide an understanding of mechanism of DNA replication, recombination, mutations and repair.
- To enable students to apply this knowledge in understanding the life processes and develop an interest to pursue high quality research.

Learning outcomes

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

- Explain the basic information about the structure of DNA and various forms of DNA, about organization of genome in various life forms, supercoiling of DNA and its significance
- Outline and elaborate the molecular basis of processes like DNA replication, recombination and transposition and explain the significance of these processes
- Discuss about the various ways in which the DNA can be damaged leading to mutations and lesions and the different ways that DNA damage can be repaired.

SYLLABUS FOR DSC-13

Credits: 2
30

Total hours:

UNIT 1: Structure of DNA and genomic organization

No. of hours: 8

Watson and Crick model of DNA, various forms of DNA, Supercoiling of DNA, linking number, Topoisomerases, Topoisomerase inhibitors and their clinical

importance, Definition of a gene, organization of genes in viruses, bacteria and eukaryotes, concept of split genes, introns, exons, satellite DNA, highly repetitive DNA.

UNIT 2: Replication of DNA

No. of hours: 10

The chemistry of DNA synthesis, DNA polymerase, the replication fork, enzymes and proteins in DNA replication, *E coli* DNA polymerases, stages of replication: initiation, elongation, origin of replication, relationship between replication and cell division, replication in eukaryotes, end replication problem, telomerases. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine.

UNIT 3: Recombination and transposition of DNA

No.

of hours: 6

Homologous recombination, enzymes in homologous recombination, site-specific recombination, recombinases. Transposition, DNA transposition by cut and paste and replicative mechanism.

UNIT 4: Mutations and DNA Repair

No. of hours: 6

Types of mutations, DNA damage by hydrolysis, alkylation, oxidation and radiation. Mutations caused by base analogs and intercalating agents. Ames test. Replication errors and their repair, mismatch repair system, repair of DNA damage-direct reversal of DNA damage, base excision repair, nucleotide excision repair, translesion DNA synthesis. DNA repair diseases.

PRACTICALS

CREDITS: 2

TOTAL HOURS : 60

1. DNA estimation by DPA
2. Separation of nitrogenous bases by paper chromatography
3. To plot the ultraviolet absorption spectrum of DNA
4. Isolation of chromosomal DNA from *E coli* cells
5. Determination of DNA concentration and purity by UV absorption.
6. Determination of the melting temperature of DNA
7. Demonstration of the mechanism of Transposition and Recombination (Dry Lab)

ESSENTIAL READINGS

1. Lehninger: Principles of Biochemistry (7th ed.) (2017) Nelson, D.L. and Cox, M.M W.H.Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10-1464126119.
2. Molecular biology of the gene: (7th ed), (2014) Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. International). Pearson.

SUGGESTED READINGS

1. Genetics - A Conceptual Approach,) (6th ed). (2012), Pierce, B.A. W.H. Freeman & Co.(New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-
2. Lewin's Gene X (10th edition) (2018). Lewin, B., Krebs, J.E., Kilpatrick, S.T., Goldstein,E.S., Bartlett Learning publishers, LLC, ISBN: 978-0-7637-6632-0.
3. The Cell: A Molecular Approach (7th ed.) (2009). Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland (Washington DC), Sinauer Associates, MA. ISBN:978-0- 87893-3030.
4. *Biochemistry* (6th ed.) (2016). Garrett, R. H., & Grisham, C. M. Brooks Cole. ISBN:9781305882409

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

DISCIPLINE SPECIFIC CORE COURSE – 14

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		
Transmission and Molecular Genetics (BS-DSC-502)	4	2		2	Class XII pass with Biology and chemistry.	

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide the students with an understanding of both classical and modern

concepts in genetics.

- To familiarize them with the principles and mechanisms of the inheritance of traits and genes, various modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation.
- To understand the areas of transmission genetics, different mapping techniques, chromosomal aberrations and molecular and developmental genetics.
- To correlate practical exercises with the theory and facilitate skill-oriented learning outcomes

Learning outcomes

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

- Understand the concept of genotype and phenotype, describe the basic principles of Mendelian genetics and appreciate the various factors that confer genotypic and phenotypic variability.
- Understand the inter relationship between environment (Nurture) versus inheritance (Nature) in determining the conversion of genotype to phenotype.
- Be able to use the concepts of bacterial and viral genetics to understand resistance patterns and to create linkage and genetic maps
- Be able to apply the principles of transmission and inheritance in real life situations.

SYLLABUS OF DSC- 14

Theory

TOTAL HOURS: 30

CREDITS: 2

Unit 1: Transmission Genetics

No. of hours: 8

Introduction to the basic principles of heredity. Mendelian Genetics and Extensions: Mendel's work on transmission of traits, genetic variation, molecular basis of Genetic Information.

Principles of Inheritance, Chromosome theory of inheritance, Laws of probability, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy Penetrance and expressivity, norm of reaction and phenocopy. Polygenic inheritance; continuous and discontinuous variation.

Unit 2: Organelle heredity and Chromosomal variations

No. of hours: 6

Chloroplast mutation/variegation in four 'o' clock plant, mitochondrial mutations in Neurospora, maternal effects, infective heredity- Kappa particles in Paramecium. Chromosomal aberrations: Variations in chromosome number and structure.

Unit 3: Linkage, crossing over and mapping techniques

No. of hours: 4

Linkage and Crossing over, cytological basis of crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and Coincidence

Unit 4: Molecular genetics

No. of hours: 6

Sex determination: Genetic basis of sex determination in Humans, *Drosophila melanogaster*, sex linked, sex influenced and sex limited traits. Mechanism of dosage compensation- X chromosome inactivation. Epigenetic mechanisms of transcriptional regulation, Genomic imprinting. Eukaryotic transposable elements- Ac-Ds system in maize and P-elements in drosophila.

Unit 5: Genetics of bacteria and virus**No. of hours: 6**

Complementation test, limitations of cis-trans test, intragenic complementation, rII locus of phage T4 and concept of cistron. Mechanism of genetic exchange - conjugation, transformation and transduction. Prokaryotic transposable elements- IS elements, Composite transposons, Tn-3 elements.

Practical

Credits: 2**Total Hours: 60**

1. To understand the genetic interaction involved using the seed mixture given (all six ratios)
2. Study of Linkage, recombination, gene mapping using marker-based data from *Drosophila*.
3. Preparation of karyotype and idiogram from the metaphasic plate of *Phlox/Allium sp*
4. Effect of colchicine and demonstration of polyploidy in *Allium sp*.
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype.
7. Study of pedigree conventions and pedigree analysis
8. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
9. Smear technique to demonstrate sex chromatin in buccal epithelial cells.

Essential readings:

1. Griffiths, A. J. F., Wessler, S. R, Carroll, S. B., Doebley, J. (2010). An Introduction to Genetic Analysis (10thed.). W.H. Freeman & Company (New York). ISBN:10: 1- 4292-2943-8
2. Pierce, B.A. (2012). Genetics - A Conceptual Approach (4thed.). W.H. Freeman & Co. (New York). ISBN:13: 978-1-4292-7606-1 / ISBN: 10:1-4292-7606-1
3. Snustad, D. P., Simmons, M. J. (2015). Principles of Genetics (7th ed.). ISBN: 978-1-119-14228-7.
4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings.

Additional Readings:

- a. Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Co. Additional Resources
- b. Hartl, D.L., Ruvolo, M. (2012). Genetics: Analysis of Genes and Genomes, 8th edition. New Delhi, Delhi: Jones and Bartlett Learning.

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

DISCIPLINE SPECIFIC CORE COURSE –15 :

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		
Growth and Reproduction (BS-DSC-503)	4	2		2	Class XII pass with Biology and chemistry	Understanding of animal and plant physiology

Learning Objectives

The Learning Objectives of this course are as follows:

- To allow students to explore the development of plants and animals from juvenile to mature phase.
- To enthuse students to explore the myriad ways in which plants produce fruits and seeds, and encourage them to pursue further studies in plant reproductive biology and its genetic regulation.
- To explore the fundamentals of reproduction and development in animals particularly vertebrates, from fertilization to organogenesis, primarily for understanding of tissue differentiation and molecular mechanisms fundamental to development of animals.

Learning outcomes

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

- Students will understand the development of plants from juvenile to senescent stage with the associated genetic, cellular, anatomical and morphological changes.
- Students will appreciate the role of pollinators and get hands-on experience of observing patterns on pollen grains, pollen germination, embryo and endosperm dissection, and collecting seeds with different dispersal mechanisms.
- Students will understand the reproductive system in animals and human beings so as to relate with the control of population and environmental threats in the current scenario.
- Students will be able to explain how errors in development can lead to congenital defects.
- Students will visualize and appreciate concepts learnt in theory and apply experimental approaches to understand these developmental events in the laboratory

SYLLABUS OF DSC-15

Theory

Credits: 2

Total

Hours: 30

Unit 1: Introduction to Growth and Reproduction

No. of hours: 5

Vegetative and Reproductive phases of growth in plants, senescence and abscission. Functional anatomy of male and female reproductive systems in humans.

Unit 2: Fertilization

No. of hours: 10

Sexual reproduction in angiosperms: Structure and organisation of flower, organization of typical tetrasporangiate anther and eight nucleate embryo sac (Polygonum type), pre-fertilization events in plants, microgametogenesis and megagametogenesis, anther dehiscence, pollination, pollen- pistil interaction, pollen germination, double fertilization.

Gametogenesis- Spermatogenesis and Oogenesis with reference to human, Estrus and menstrual cycle, Types of eggs in animals, capacitation, fertilization and development of an embryo from zygote, Causes of Infertility.

Unit 3: Embryogenesis in Plants and Animals

No. of hours: 10

Post fertilization events in plants: Types of embryogenesis (with special emphasis on dicot embryogenesis), endosperm development, types of endosperm, seed formation, seed dispersal: mechanisms and agents. Embryogenesis; Types of cleavages, Morphogenetic movements, Gastrulation in humans; Extra Embryonic membranes, Mechanism of Implantation, Placentation: Endocrine functions and types based on chorionic villi distribution and histology. feto-placental unit

Unit 4: Differentiation

No. of hours: 5

Post-embryonic meristem in plants with special reference to *Arabidopsis* embryogenesis. Role of meristem in differentiation, shoot and root apical meristems, lateral meristem (vascular and cork cambium), floral meristem, ABC model of flowering. senescence and abscission

Formation of organs Organogenesis during development, critical windows of development in humans during pregnancy. Teratogens and Ageing.

PRACTICALS

CREDITS: 2

TOTAL HOURS: 60

1. Luteinizing Hormone (LH) Levels and HCG based test.
2. Vaginal smear preparation to examine estrous cycle.
3. Preparation and histological study of mammalian testis and ovary or Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina; Study different types of mammalian placenta on the basis of histology and morphology.

4. Case studies on teratogens.
5. Study different stages of micro and mega-gametogenesis in angiosperms-through permanent slides.
6. To study percent pollen germination using different media.
7. To study embryo development in flowering plant /slides.
8. To dissect out endosperm and embryo from angiosperm seeds.
9. Study of apical and lateral meristem by permanent slides.
10. Survey of dispersal mechanisms of seeds/ pollination agents
11. To study Polyembryony/ Types of Embryo sacs through permanent slides/ photographs/temporary preparations/chart
12. Project report on visit to animal house facility/ IVF lab.

Essential Readings:

1. Bhatnagar, S. P., Dantu, P. K., & Bhojwani, S. S. (2018). *The Embryology of Angiosperms*, 6th Edition. Vikas
2. Raghavan, V. (2000). *Developmental Biology of Flowering Plants*. New York: Springer.
3. Tortora, G. J., & Derrickson, B. (2017). *Principles of anatomy & physiology*. Fifteenth edition; Wiley Loose-Leaf Print Companion. Hoboken, New Jersey: John Wiley & Sons, Inc.
4. Regulation of Implantation and Establishment of Pregnancy in Mammals, Editors: Rodney D Geisert, Fuller W. Bazer, ISBN 978-3-319-15856-3, Springer International Publishing, 2015.
5. Gilbert, S. F., & Barresi, M. J. F. (2016).

Developmental biology.

Additional readings:

1. Kalthoff, K. O. (2000). *Analysis of Biological Development* (2 edition). Boston: McGraw-Hill Science/Engineering/Math.
2. William. J. Larsen.(2001). *Human Embryology* (3 edition). New York: Churchill Livingstone.

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

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-7 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant resource Utilization (DSE-7)	4	2		2	Class XII pass with Biology and chemistry, as one of the papers in Class XII	NA

Learning Objectives:

- To make the students familiar with the economic importance of diverse plants that offer resources to human life.
- It emphasizes the plants used as- food for man, fodder for cattle, feed for poultry, plants having medicinal value and also plant source of huge economic value etc.
- After studying Economic Botany, students would have first-hand information of plants used as food and the various kinds of nutrients available in the plants. The dietary requirements of proteins, fats, amino-acids, vitamins etc that can be met by plants.
- They will also learn about the use of fibre plants, beverages, oil yielding and medicinal plants that are integral to day to day life .

Learning Outcomes:

On successful completion of the course, a student will:

- Know about the concept of origin of cultivated plants
- Gain an understanding of morphology, processing and economic value of plant sources of cereals, legumes, spices, oil, beverages, medicines etc.
- Gain an insight into the importance of medicinal plants and their therapeutic properties
- Understand the extraction of essential oils and their commercial applications.
- Learn to perform the micro-chemical tests to demonstrate various components present in economically important plants.

SYLLABUS FOR DSE-7

Course Contents - Theory

UNIT 1: Origin of Cultivated Plants **No. of hours: 3**

Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers). Major plant introductions.

UNIT 2: Cereals and Legumes **No. of hours: 6**

Cereals- General account and Importance of cereals with special reference to Wheat (origin, evolution, morphology & uses); Legumes- General account, Importance of legumes to man and ecosystem with special reference to Gram and Soybean (origin, morphology & uses).

UNIT 3: Spices and Beverages **No. of hours: 8**

Spices: General account with special reference to clove, turmeric and black pepper (Botanical name, family, part used, morphology and uses)
Beverages: General account with special reference to non-alcoholic beverages. Tea (morphology, processing, uses)

UNIT 4: Oils and Fats (Edible, Non-edible and Essential) **No. of hours: 6**

General description and classification; extraction of Edible and essential oils; uses and health implications; Groundnut, Mustard (Botanical name, family, morphology of the part used & uses). Adulteration of edible oils. Dropsy disease.

UNIT 5: Drug Yielding Plants **No. of hours: 4**

Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*.

UNIT 6: Fibres **No. of hours: 3**

Classification based on the origin of fibres; Cotton (origin of tetraploid cotton, morphology, processing and uses).

PRACTICAL

Credits: 2

Total Hours: 60

1. Cereals: Wheat (habit sketch, L.S./T.S. grain, micro-chemical tests)
2. Legumes: Soybean, Groundnut (habit sketch, fruit, seed structure, micro-chemical tests).
3. Spices: Black pepper, Fennel and Clove (habit sketch and sections L.S./T.S.).

4. Beverages: Tea (plant specimen, sectioning of tea leaves) Coffee(Plant specimen and fruits)
5. Oils and fats: Groundnut- plant specimen, habit sketch, micro-chemical tests
6. Drug-yielding plants: Specimens of *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*.
7. Fiber-yielding plants: Cotton (specimen, whole mount of fiber and micro-chemical test),jute (specimen, whole mount of fibre and micro-chemical test)
8. Essential oil-yielding plants: Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus* (specimens/photographs).
9. Dye yielding plants: Any two (*Indigofera*/*Henna*/*Bixa*/*Butea*)
10. Report on study of Industrially important plants (specimens/products)- morphology, botany and uses.

3.1 Essential readings:

1. Kochhar, S.L. (2012). *Economic Botany in Tropics*. New Delhi, India: MacMillan & Co.
2. Wickens, G.E. (2001). *Economic Botany: Principles & Practices*.The Netherlands: Kluwer AcademicPublishers.

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-8

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Membrane Biology (BS-DSE-8)	4	2		2	Class XII pass with Biology and chemistry	Basic cell biology

Learning Objectives:

The objective of the course is to provide students with

- The basic understanding of membrane composition, structure-function relationship, and properties of membranes.
- To provide an understanding of the various types of membrane transporters and their molecular mechanisms.
- Provides an understanding of molecular mechanisms involved in vesicular transport processes and membrane fusion.

Learning Outcomes:

On successful completion of the course, a student will:

- Understand the general composition and structure of biomembranes.
- Gain knowledge of the basic properties of membranes such as membrane fluidity.
- Have knowledge about the various types of membrane transport mechanisms.
- Have knowledge about the molecular mechanism of vesicular transport and membrane fusion.

SYLLABUS FOR DSE-8

Course Contents -Theory

UNIT 1: Membrane composition and structure

No. of hours: 8

Composition of membranes: Lipids (Phospholipids, Glycolipids, sterols), Proteins (Peripheral Proteins, Integral Membrane Proteins and Lipid-Anchored proteins) and carbohydrates. Historical background and various membrane models. Comparison of various cellular and subcellular membranes. Lateral and transverse asymmetry in membranes. Role of Flippase, Floppase and Scramblase. Model systems to study membranes- Lipid monolayers, Planar bilayer, Liposome and their applications. Polymorphic Lipid-Water Systems. Determinants of polymorphic phases: Critical Micellar Concentration (CMC), lipid shape, critical packing parameter.

UNIT 2: Membrane dynamics

No. of hours: 6

Membrane fluidity: lateral, transverse and rotational motion of lipids and proteins. Factors affecting membrane fluidity- composition, barriers (tight junctions), cytoskeleton interactions, Microdomains- rafts, caveolae. Study of RBC membrane architecture. Homeoviscous adaptation. Techniques to study membrane dynamics: FRAP, TNBS, SPT.

UNIT 3: Membrane transport

No. of hours: 10

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport glucose transporter and anion transporter. Primary active transporters- P-type ATPases, V-type ATPases, F-type ATPases. Secondary active transporters- Lactose permease, Na⁺-glucose symporter. ABC family of transporters- MDR and CFTR. Group translocation (PEP-PTS) and bacteriorhodopsin. Ion channels: voltage-gated ion channels (Na⁺ and K⁺ channel) and ligand-gated ion channels (Acetylcholine receptor) and aquaporins. Ionophores: valinomycin, gramicidin. Relationship between membrane transport and diseases.

UNIT 4: Vesicular transport and membrane fusion

No. of hours: 6

Vesicular transport. Vesicles, Clathrin-coated Vesicles and COP-Coated Vesicles (COPI and COPII).

Molecular mechanism of vesicular transport. Membrane fusion (dynamin protein, Rab proteins, NSF/ SNAP complex, SNARE proteins). Receptor Mediated Endocytosis: LDL and Transferrin.

PRACTICALS

CREDIT: 2

TOTAL HOURS: 60

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Isolation of membrane phospholipids and separation by TLC.
3. Effect of temperature, pH, detergents and ionic strength on Tonoplast membrane of beetroot.
4. Determination of CMC of Neutral and Ionic detergents.

5. Preparation of RBC ghost cell.
6. Separation of RBC membrane proteins by SDS-PAGE.
7. Demonstration of Histidine uptake from the intestinal membrane.

Essential readings:

1. Garret, R.H., Grisham, C.M. (2016). Biochemistry (6th ed.). Boston, Cengage Learning. ISBN-10: 1305577205, ISBN-13: 978-1305577205
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K.C., Yaffe, M., Amon, A. (2021). Molecular Cell Biology (9th ed.). New York, WH: Freeman & Company. ISBN-13:978-1319208523, ISBN-10:1319208525.
3. Nelson, D.L., Cox, M.M. (2021). Lehninger: Principles of Biochemistry (8th ed.). New York, WH: Freeman and Company. ISBN: 13: 978-1319381493 / ISBN-10:1319381499.
4. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd. ISBN: 978-1-11809244-6.
5. Wardhan, R., Mudgal, P. (2017). Textbook on Membrane Biology (1st ed.). Singapore, Springer. ISBN-10: 9811071004, ISBN-13: 978-9811071003

DISCIPLINE SPECIFIC ELECTIVE COURSE –DSE-9 :

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Ethology (BS-DSE-9)	4	2		2	Class XII pass with Biology and chemistry,	NA

Learning Objectives:

Ethology or Animal Behavior is the scientific study of the wild and wonderful ways in which animals interact with each other, with other living beings, and with the environment in which they live in. One important aspect pertaining to the studies on Animal Behavior is that it can be conducted anywhere and at any time, depending on the interest of the researcher. Moreover, it is not confined to the four walls of the classroom or the laboratory. The behavioral biology has high applied value and currently linked to conservation biology, molecular biology, behavioral ecology and integrated pest management. This course will help the learners to understand and appreciate different types of animal behaviors, their adaptive, evolutionary and practical significance.

Learning Outcomes:

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

- Understand types of animal behaviour and their importance to the organisms.
- enhance their observation, analysis, interpretation and documentation skills by taking short projects pertaining to Animal behaviour and emotions.
- Relate animal behaviour with other subjects such as Animal biodiversity, Evolutionary biology, Ecology, Conservation biology and Genetic basis of the behaviour.
- Realize, appreciate and develop passion to biodiversity; and will respect the nature
- Learn to evaluate and analyse human behaviour and emotions, and develop intuitive skills and empathy for better leadership qualities

SYLLABUS FOR DSE -9

Course Contents- Theory

Unit 1: Mechanisms of Behaviour

No. of hours: 6

Definition of Proximate and Ultimate causes of behaviour; Innate behaviour: Instinct, Fixed Action Pattern (FAP); Learning: Associative learning: Classical and Operant conditioning; Non-associative learning: Habituation, Imprinting; Code breakers.

Unit 2: Patterns of Behaviour

No. of hours: 7

Reflexes: Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behaviour. Orientation: Primary and Secondary orientation; Kinesis-orthokinesis, klinokinesis; Taxis-tropotaxis and klinotaxis; menotaxis (light compass orientation).

Unit 3: Social Behaviour and Sociobiology

No. of hours: 8

Concept of Society; Degree of sociality; Insect society-Honey bee as example; Society organization and caste system, Polyethism vs Polymorphism; Dance as means of communication; Altruism and Reciprocal altruism; Hamilton's rule and inclusive fitness with suitable examples.

Unit 4: Sexual Behaviour

hours: 6

No. of

Asymmetry of sex, Sexual dimorphism mate choice, Intra-sexual selection (male rivalry: competition, territoriality, infanticide), Inter-sexual selection (female choice), Consequences of mate choice for female fitness, Courtship Behaviour in stickleback fish.

Unit 5: Emotions

No. of hours: 3

Concept of emotions, Emotional intelligence, Emotional Quotient (EQ) vs Intelligence Quotient (IQ); Components and theories of emotions

**Practical
Credits: 2**

Total Hours: 60

1. To study the nests and nesting behavior of any 5 birds.
2. To study the nests and nesting behavior of social insects (Wasps, Honeybees, Termites and Ants).
3. To study the behavioral responses of wood lice to dry and humid conditions.
4. To study Geotaxis behavior in earthworm/ Phototaxis behavior in insect larvae.
5. Study of various behavioral concepts (courtship, nesting, infanticide, territoriality) through shortvideos/films.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Construct an ethogram using suitable data to study animal behavior
8. Prepare a project report on the survey based on questions to study Emotional Quotient (EQ)
9. Visit to a Zoological Park to study and record the behavioral activities of animals and prepare a short report.

Essential readings:

1. Alcock J. Animal Behaviour. Sinauer Associate Inc., USA.
2. McFarland D. Animal Behaviour. Pitman Publishing Limited, London, UK.
3. Vinod Kumar (2002) Biological Rhythms. Narosa Publishing House, Delhi/ Springer-Verlag, Germany
4. Manning, A., & Dawkins, M. S. (2012). An Introduction to Animal Behaviour. Cambridge: Cambridge University Press.
5. Goodenough, J., McGuire, B., and Jakob, E. 2010. Perspectives on Animal Behavior. 3rd Edition. John Wiley and Sons.
6. Passer, M.W. & Smith, R.E. (2010). Psychology: The science of mind and behaviour. New Delhi: Tata McGraw-Hill.

Suggested readings:

1. Mandal, F.B. (2015). Textbook of Animal Behaviour. Delhi: PHI Pvt. Ltd.
2. Sherman, P. W., & Alcock, J. (2013). Exploring Animal Behavior, Sinauer Associate Inc., Massachusetts.
3. Martin, P. and Bateson, P. 1986. Measuring Behaviour: An Introductory Guide. Cambridge University Press.
4. Dugatkin, L.A. 2013. Principles of Animal Behavior. 3rd Edition. WW Norton and Co

SEMESTER-V

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

GENERAL ELECTIVE COURSE –GE-3:

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Bioremediation and sustainability (BS-GE- 3)	4	2		2	Class XII pass	NA

Learning Objectives

This course will provide understanding of environment around and which pollutants are of concern to us . It will provide knowledge of sustainability and methods which can help to improve the sustainability. It will also make students understand how toxicity can be monitored in our body and how our body copes to detoxify its internal system. It will also introduce methods which can be used to monitor the pollutants in various samples.

Learning Outcomes:

Students will:

- Understand the various components of the environment.
- Understand and evaluate the local and global scale of environmental problem.
- Gain knowledge and skills necessary to understand multifaceted nature of environmental studies.
- Get informed perspective of biological, chemical and physical processes relevant to environmental problems.
- Get hands on experience of some quantitative and qualitative research tools to assess and analyse the environmental problems

Syllabus for GE-3

Theory

Credits: 2

Total Hours: 30

Unit 1: Introduction to Environment and the Pollutants

No. of hours: 8

Normal Chemistry of - Air, Water, Soil. Environmental Toxins-Physical Pollutants- Noise, Light and Radiation and Air Pollutants- Carbon Monoxide, Lead, Nitrogen Oxides, Ozone, Particulate Matter, Sulphur Dioxide, Methane Volatile Organic Chemicals (VOC); Water Pollutants - Volatile Organic Chemicals (VOC), Heavy Metals, Insecticides, Herbicides/ Endocrine Disruptors; Soil Pollutants- Heavy metals, Herbicides/pesticides, Polyaromatic Carbon (PAH), Microplastics; Source, Effect and Impact on Flora, Fauna including Human Beings. Definition of Terminologies: Air Quality Index (AQI) Suspended Particulate matter (SPM), Water Quality Index (WQI), Air Pollution Tolerance Index (APTI), Anticipated Performance Index (API).

Unit 2: Environment and Xenobiotics

No. of Hours: 8

Understanding the principle of Toxicity. Concept of Dose and Response (LD50). Process of Bioaccumulation, Bioaugmentation and Biotransformation. Impact of pollutants on human health Mammalian Detoxification by Liver to Organic Chemicals (Heavy Metals, Endocrine Disruptors, Microplastics).

Unit 3: Sustainability and its Enhancement

No. of Hours: 8

Concept of Sustainability and Enhancement of Sustainability, Waste Management (Refuse, Reduce, Reuse and Recycle), Bioremediation- Introduction and Types of Bioremediations- Phytoremediation, Microbial Bioremediation, In-situ Remediation, Ex-situ Remediation.

Unit 4: Techniques to Analyse Pollutants

No. of Hours: 6

Determination of pollutants in soil, water, air, blood by following Analytical Techniques: Flame Photometer; Atomic Absorption Spectroscopy (AAS); Inductive Coupled Plasma (ICP) & Mass spectroscopy MS; Gas Liquid Chromatography (GC-MS); Ion Chromatography; High Performance Liquid Chromatography (HPLC); UV spectrophotometer; Biosensors and its application in pollution detection;

Practical:

Credits: 2

Total Hours: 60

1. Evaluating APTI and API of Herbs/Shrubs/Trees
2. Evaluating seasonal variations of AQI and SPM
3. Evaluating C/N/P/K content of soil by Spectrophotometry/Titrimetric method
4. Detecting Microbial Contamination of water
5. Composting of waste (Leaf/Kitchen Waste/Cow dung) and Detecting Maturity by pH and Electric conductivity (EC) content changes
6. Studying Enzymatic Activity (amylase/urease) in the soil sample due to microbial activity
7. Student Environment Projects.

Essential readings:

- Basic Concepts on Environmental Chemistry by Des. W. Conwell (2005) 2nd edition, CRC press, ISBN 9781498770484
- Environmental Chemistry by Stanley E Manahan, 11th Edition, Taylor and Francis,2022, ISBN 9780367560546
- Biodegradation and Bioremediation by Alexander Martin, 2nd Edition, Academic Press, ISBN 978-0-12-049861-8
- Fundamentals of Ecology author Eugene Odum, Cary W. Barrett, ,5th edition Cengage learning India. ISBN 9788131500200

- Environment and Ecology author P.D. Sharma, 12th Edition, Rastogi Publication. ISBN 978-93-5078-068-8

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

GENERAL ELECTIVE COURSE –GE-4:

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Epidemiology and Biostatistics (BS-GE- 4)	4	2		2	Class XII pass	NA

Learning Objectives

Throughout the course, students will explore different units of study, including Introduction to Epidemiology, Infectious Disease Epidemiology, Chronic Disease Epidemiology, Screening and Diagnostic Tests, Data Collection and Management, and Public Health and Epidemiology. They will learn about key concepts, study designs, disease surveillance, global health initiatives, and statistical analysis techniques relevant to each unit.

Practical exercises will further enhance students' skills and understanding. They will engage in case-control studies, outbreak investigations, estimation of sensitivity and specificity, analysis of vaccination coverage rates, hypothesis testing, and field visits to healthcare centers to gather data on disease rates. These practical experiences will provide hands-on application of epidemiological methods, fostering critical thinking and problem-solving abilities.

Learning Outcomes

Upon completion of this course, students will achieve the following learning outcomes:

- Understand the principles of disease causation, with an emphasis on modifiable environmental factors. Students will be able to explain how various factors contribute to the development and spread of diseases, particularly focusing on the influence of the environment.
- Apply epidemiology to disease prevention and health promotion, including environmental and occupational health. Students will recognize the importance of epidemiological approaches in identifying risk factors, implementing preventive measures, and promoting health in various settings.
- Optimize the use of healthcare resources. Students will develop the skills to ensure that healthcare resources are effectively utilized by applying epidemiological knowledge to guide resource allocation, decision-making, and public health interventions.

Syllabus for GE-4

Theory
Credits 2

Total hours:30

Unit 1: Introduction to Epidemiology **3 hrs**

Definition and scope of epidemiology, Basic concepts and principles of epidemiology, Measures of disease frequency and association, Study designs in epidemiology

Unit 2: Infectious Disease Epidemiology **6 hrs**

Principles of infectious disease transmission, Outbreak investigation and response, Surveillance of infectious diseases, Vaccines and vaccine-preventable diseases, Emerging and re-emerging infectious diseases

Unit 3: Chronic Disease Epidemiology **8 hrs**

Epidemiology of non-communicable diseases: Risk factors and determinants of chronic diseases, Cardiovascular diseases, Cancer epidemiology, Diabetes epidemiology, Mental health epidemiology, Environmental and Occupational Epidemiology

Unit 4: Screening and diagnostic tests **3 hrs**

Screening test and diagnostic test, Sensitivity, specificity, Positive predictive value, Negative predictive value

Unit 5: Data collection and analysis **7 hrs**

Introduction to biostatistics and its applications in epidemiology, Sources of epidemiological data, Measures of Variability, calculation of standard deviation, standard error and Co-efficient of Variance, Statistical errors, Chi-square test, Z test, t-Test

Unit 6: Public Health and Epidemiology **3 hrs**

Introduction to public health, Role of epidemiology in public health practice, Disease prevention and control strategies, Epidemiological aspects of diseases of national importance ,Global burden of disease, Global health initiatives and organizations

Practical:

Credits: 2

Total hours: 60

1. Case-control study on a chronic disease: Design and conduct a case-control study to investigate the risk factors associated with a specific chronic disease (with given data)
2. Outbreak investigation simulation : Analyze a given simulated outbreak data, identify the source of infection, and propose control measures.
3. Sensitivity and specificity estimation: Analyze data from a diagnostic test evaluation study to estimate sensitivity, specificity, positive predictive value, and negative predictive value.

4. Collect data on vaccine coverage rates (public domain) in a population and analyze the results to assess the effectiveness of vaccination programs.
5. Hypothesis testing: Perform hypothesis tests (e.g., chi-square test, t-test) on provided datasets to analyze associations or differences between groups.
6. Field visits to nearby health care centres to understand health check-ups and collect some data on the rate of a particular disease over the past few months or years.

Essential reading

1. Aschengrau A, Seage G.R., (2013) Essentials of Epidemiology In Public Health, Jones and Bartlett Publishers, Inc; (3rd ed.) ISBN-10: 1284028911; ISBN-13:978-1284028911.
2. Sullivan. L.M. (2017) Essentials of Biostatistics in Public Health. Jones and Bartlett Publishers, Inc; (3rd ed.) ISBN-10: 1284108198; ISBN-13: 978-1284108194.

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