COURSES OFFERED BY DEPARTMENT OF BOTANY

Category II

Botany Courses for Undergraduate Programme of study with Botany as one of the Core Disciplines
(B.Sc. Life Sciences with Botany as one of the Core discipline)

DISCIPLINE SPECIFIC CORE (LS-BOT-DSC-05)

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		
Plant Physiology and Metabolism **LS-BOT-DSC-05**	4	2	0	2	Class XII pass with Biology/ Biotechnology	Nil

Learning Objectives:

4. To make students realize how plants function, the importance of water, minerals, phytohormones, and role of light in plant growth and development;
5. To understand mechanisms of carbon assimilation, nitrogen metabolism, phloem transport and translocation.

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

- correlate physiological and metabolic processes with functioning of the plants.
- establish the link between theoretical principles and experimental evidence.

Unit 1: Plant-water relations **03 hours**

Water potential and its components, pathway of water movement, ascent of sap (include root pressure and guttation), transpiration and its significance, stomatal movements – only ion theory.

Unit 2: Mineral nutrition **03 hours**

Classification of mineral elements: Essential elements (macro- and micronutrients) and beneficial elements, General role of essential elements, transport of ions across membrane, active and passive transport (brief account of carriers, channels and pumps).

Unit 3: Translocation in phloem **02 hours**

Composition of phloem sap, girdling experiments, Pressure Flow Model, phloem loading and unloading.

Unit 4: Plant growth regulators **04 hours**

Physiological roles and bioassays of auxins, gibberellins, cytokinins, ethylene and ABA.

Unit 5: Plant response to light and temperature **02 hours**

Photoperiodism - discovery (SDP, LDP, day neutral plants), concept of florigen; phytochrome (discovery and physiological role), vernalization.

Unit 6: Enzymes **02 hours**

Classification, Structure and properties, mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Carbon metabolism **06 hours**

Photosynthetic pigments (chlorophyll *a* and chlorophyll *b*, xanthophyll, carotene); photosystem I and II, Light reactions (electron transport and photophosphorylation), Dark reactions: C3 pathway; C4 and CAM pathways (no chemical structures); photorespiration. Metabolite pool and exchange of metabolites, synthesis and degradation of sucrose and starch.

Unit 8: Respiration **02 hours**

Basic differences in animal and plant respiration, Cyanide resistant respiration.

Unit 9: Nitrogen metabolism **04 hours**

Nitrate assimilation (NR and NiR), biological nitrogen fixation in legumes (nodulation and role of dinitrogenase) Ammonia assimilation: GS-GOGAT, reductive amination and transamination.

Unit 10: Stress physiology in plants **02 hours**

ROS, RNS and anti-oxidative defence strategies.

Practicals **60 hours**

- Determination of osmotic potential of plant cell sap by plasmolytic method.
- To study the effect of the environmental factor light on transpiration by excised twig.
- Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
- To study the activity of catalase and study the effect of pH on the activity of enzyme.
- To Study Hill's reaction.
- To study the effect of light intensity on O_2 evolution in photosynthesis.
- Comparison of the rate of respiration in any two parts of a plant.
- To separate photosynthetic pigments by paper chromatography.
- Bolting / Effect of auxins on rooting.
- To demonstrate the delay of senescence by cytokinins/ effect of ethylene on fruit ripening

20. To study the phenomenon of seed germination (effect of light and darkness).
21. To demonstrate Respiratory Quotient (RQ)

Suggested Readings:

- Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development, International 6th edition, Oxford University Press, Sinauer Associates, New York, USA.
- Bajracharya, D. (1999). Experiments in Plant Physiology: A Laboratory Manual, Narosa Publishing House, New Delhi.
- Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition, Wiley India Pvt. Ltd, New Delhi.

Additional Resources:

- Jones, R.,Ougham, H., Thomas,H.,Waaland, S. (2013). *The molecular life of plants.* Chichester, England: Wiley-Blackwell.
- Kochhar, S.L. & Gujral, S.K. 2020. Plant Physiology: Theory and Applications, 2nd Edition. Cambridge University Press, UK.
- Bhatla, S.C., Lal, M.A. (2018). *Plant Physiology, Development and Metabolism.* Singapore: Springer.

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

DISCIPLINE SPECIFIC ELECTIVES (BOT-DSE-06)

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		
Natural Resource Management **BOT-DSE-06**	4	2	0	2	Class XII pass with Biology/ Biotechnology	**Nil**

Learning Objectives:

- Natural Resources are materials from earth which support life and significantly meet the needs of people. The paper aims to describe the different types of natural resources and their management. Students will study about the importance of each natural resource and how and why they are threatened in current times. They will also be taught about sustainably using our resources

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

13. understand the different resources available in nature
14. learn the importance of each resource along with the threats to these resources
15. gain an in-depth understanding of management of these resources and also restoration of natural ecosystems
16. study the importance of sustainable practices
17. gain an insight into various initiatives taken the world over to save our natural resources.
18. understand the concept of clean energy and management of waste

Unit 1: Natural Resources **01 Hours**
Definition, fundamental concepts and types

Unit 2: Sustainable Utilization **04 Hours**
Concept, goals, approaches (economic, ecological, socio-cultural)

Unit 3: Land Resources **06 Hours**
Forests (definition, threats, management); Agricultural practices and their impact; Soil degradation (causes, management and remediation/restoration strategies)

Unit 4: Water Resources **04 Hours**

Freshwater, Marine, Estuarine, Wetlands – Threats and Management

Unit 5: Biological Resources **03 Hours**
Biodiversity – Levels, Significance, Threats, Management

Unit 6: Energy **02 Hours**
Clean energy strategies – Solar, Wind, Hydro, Tidal, Geo-thermal, Bio-energy

Unit 7: Climate Change **04 Hours**
Impact, adaptation and mitigation (Land, Soil, Water, Biodiversity, Air)

Unit 8: Contemporary practices **04 Hours**
EIA, GIS, Energy Audits, Waste Management, Ecosystem Restoration, Carbon footprint

Unit 9: National and International Initiatives **02 Hours**
International Solar Alliance; Ramsar Convention; Basel Convention; Carbon Neutral Goals; Net-zero Coalition; Clean Development Mechanism; CAMPA (Compensatory Afforestation Fund Management and Planning Authority); Carbon Credits; REDD+ project, Renewable Energy Certificates

Practicals **60 hours**

5. Comparison of pH (pH meter) and salinity (Electrical Conductivity) of various soil samples.
6. Comparison of field capacity of various soil samples.
7. Comparison of pH (pH meter) and TDS (TDS meter) of various water samples.
8. Comparison of salinity (titrimetric method) of various water samples.
9. Calculation and comparison of BOD and COD of various water samples from given data.
10. Comparison of species diversity in various communities by Shannon-Wiener Index.
11. Measurement of dominance of woody species by DBH method in the college campus.
12. Project (any one of the following):
    6. Rainwater harvesting (site visit)
    7. Ecological restoration (site visit)
    8. Energy audit
    9. Seed germination and seedling growth in garden and contaminated soils
    10. Composting
    11. Any other
13. Field visit/s to any degraded ecosystem (landfill, polluted water body, invaded forest) or any ongoing restoration project site.

Suggestive readings:

- Vasudevan, N. (2006). Essentials of Environmental Science. New Delhi, India: Narosa Publishing House.
- Singh, J. S., Singh, S.P. and Gupta, S.R. (2006). Ecology, Environment and Resource

Conservation. New Delhi, India: Anamaya Publications.
- Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. New Delhi, India: Prentice Hall of India Private Limited.

Additional resource:

10. https://moef.gov.in/en/division/forest-divisions-2/campa/compensatory-afforestation-fund-management-and-planning-authority-campa/
11. https://www.un.org/en/climatechange/net-zero-coalition
12. https://www.recregistryindia.nic.in/
13. https://static.investindia.gov.in/National%20Policy%20on%20Biofuels.pdf
14. https://cri.nccf.in/
15. https://www.investindia.gov.in/team-india-blogs/carbon-financing-india
16. https://www.un-redd.org/
17. Ecosystem Restoration for People, Nature and Climate https://wedocs.unep.org/bitstream/handle/20.500.11822/36251/ERPNC.pdf
18. Managing Ecosystems In The Context Of Climate Change Mitigation: A review of current knowledge and recommendations to support ecosystem-based mitigation actions that look beyond terrestrial forests https://www.cbd.int/doc/publications/cbd-ts-86-en.pdf
19. Jordan III, W. R., Gilpin, M. E., Aber, J. D. (1987). Restoration Ecology: a synthetic approach to ecological research. Cambridge, Great Britain: Cambridge University Press.

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

- End semester University Theory Examination Presentations by Individual Student/ Group of Students

Keywords: Carboxylic acids and derivatives, amines and diazonium salts, heterocyclic compounds

SEMESTER –V

Course Code DSC 14 – CHEMISTRY- V
Course Title: Coordination Chemistry and its application in biological systems

Total Credits: 04 (Credits: Theory-02, Practical-02)
Total Lectures: Theory- 30, Practical-60

Objectives: The course introduces the students to basics of coordination chemistry and which are of immense importance to biological systems, qualitative and quantitative analysis, catalysis, medicines, paints and pigments etc. Nomenclature, isomerism, bonding in coordination compounds has been dealt with in sufficient detail along with special emphasis on important coordination compounds in the biological system.

Learning Outcomes:

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

- Understand terms: ligand, denticity of ligands, chelate, coordination number.
- Systematically name coordination compounds.
- Discuss the various types of isomerism possible in Octahedral and Tetrahedral 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.
- Explain the meaning of the terms Δo., Δt, pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
- Explain magnetic properties and colour of complexes on basis of Crystal Field Theory
- Understand reaction mechanisms of coordination compounds and differentiate between kinetic and thermodynamic stability.
- Discuss the application of coordination compounds in the biological systems such as Heamoglobin, myoglobin and some enzymes

Unit 1: Introduction to Coordination compounds — Lectures: 06

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. Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Unit 2: Bonding in coordination compounds **Lectures:14**

Valence Bond Theory (VBT): Salient features of theory, concept of inner and outer orbital complexes, 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 Δ, 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,

Unit 3: Thermodynamic and Kinetic aspects of Metal Complexes **Lectures: 06**

A brief outline of thermodynamic and kinetic stabilities of metal complexes and factors affecting the stability. Substitution reactions of square-planar complexes – Trans effect: cisplatin and transplatin

Unit 4: Application of coordination compounds in biological systems **Lectures: 04**

Haemoglobin, Myoglobin, carboxypeptidase, carbonic anhydrase

PRACTICALS: **Credits: 02**

(Laboratory periods: 60)

1. Estimation of Mg^{2+} by direct complexometric titrations using EDTA.
2. Estimation of Zn^{2+} by direct complexometric titrations using EDTA.
3. Estimation of Ca^{2+} by direct complexometric titrations using EDTA.
4. Estimation of total hardness of a given sample of water by complexometric titration.
5. Determination of the composition of the Fe 3+ - salicylic acid complex / Fe 2+ -1, 10-
6. phenanthroline complex in solution by Job's method.
7. 6. Determination of the composition of the Fe 3+ - salicylic acid complex / Fe 2+ -1,10-phenanthroline complex in solution by mole ratio method.
8. Preparation of the following inorganic compounds:
    a. Tetraamminecopper(II) sulphate
    b. Potassium trioxalatoferrate(III) trihydrate
    c. Chrome alum
    d. *Cis*- and *trans*-Potassium diaquadioxalatochromate(III)
9. Any suitable experiment (other than the listed ones) based upon complexation 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. Cotton, F.A.; Wilkinson, G.; Gaus, P.L. **Basic Inorganic Chemistry**, 3rd Edition, Wiley India.
5. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
6. Greenwood, N.N.; Earnshaw, A. (1997), **Chemistry of the Elements**, 2nd Edition, Elsevier.

Practical:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989),**Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.
2. Marr, G.; Rockett, B.W. (1972), **Practical Inorganic Chemistry**, Van Nostrand Reinhold.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.

Assessment Methods:

- Presentations by Individual Student/ Group of Students
- Class Tests at Periodic Intervals.
- Written assignment(s)
- End semester University Theory Examination

Keywords: Crystal field theory, Dq, CFSE, Nomenclature, Valence bond theory, Crystal field theory, Magnetic properties, 18 electron rule, metal carbonyls, hapticity

Teaching Learning Process:

- Conventional chalk and board teaching
- Class interactions and discussions
- Power point presentation on important topics.
- Teaching Learning process is largely student focused
- Engaging students in cooperative learning.

Assessment Methods:

- Presentations by Individual Student/ Group of Students
- Class Tests at Periodic Intervals.
- Written assignment(s)
- End semester University Theory Examination Presentations by Individual Student/ Group of Students

Keywords: Polynuclear hydrocarbons, Pharmaceutical compounds, UV-visible spectroscopy; IR spectroscopy.

Course Code: DSE – 6: CHEMISTRY
Course Title: Biomolecules-I
Total Credits: 04 (Credits: Theory-02, Practical-02)
Total Lectures: Theory- 30, Practical-60

Objectives: This course aims to introduce the learner to the fascinating chemistry of some biomolecules, *i.e.* carbohydrates, nucleic acids and lipids that work within biological systems. The basic concept of heredity is imparted through replication, transcription and translation processes.

Learning outcomes:

On completion of this course, the students will be able to:
• Understand and demonstrate how structure of biomolecules (carbohydrates, nucleic acids and lipids) determine their reactivity and biological functions.
• Understand the concept of heredity through replication, transcription and translation processes

Unit 1: Chemistry of Carbohydrates **Lectures:10**

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 the configuration of glucose (Fischer proof), the cyclic structure of glucose. Haworth projections. The cyclic structure of fructose. The linkage between monosaccharides: structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Unit 2: Nucleosides, Nucleotides and Nucleic Acids **Lectures:10**

Components of Nucleic acids: Adenine, guanine, thymine, cytosine and uracil (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), structure of polynucleotides; structure of DNA (Watson-Crick model) and RNA (types of RNA), difference between DNA and RNA, genetic code, biological roles of DNA and RNA: replication, transcription and translation.

Unit-3: Lipids **Lectures:10**

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins.

Properties, functions and biochemical functions of steroid hormones.

PRACTICALS: **Credits: 02**

(Laboratory periods: 60)

1. Preparation of osazone of glucose, fructose and Maltose (Comparing the time of formation of the two and the shape of crystals using microscope).
2. Identification of given carbohydrates as
    a. Reducing and Non-reducing
    b. Monosaccharide and Disaccharide
    c. Aldose and Ketose
3. Estimation of glucose by Fehling's solution.
4. Determination of the iodine number of oil.
5. Determination of the saponification number of oil.
6. Identification and separation of mixture of sugars by paper chromatography.
7. Isolation of DNA from cauliflower/ onion.
8. Determination of total sugar content by ferricyanide method (volumetric/colorimetric method).

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. **Organic Chemistry**, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Berg, J. M.; Tymoczko, J. L.; Stryer, L. (2002), **Biochemistry**, W. H. Freeman.

4.Devlin, T.M. (2010),**Textbook of Biochemistry with Clinical Correlation**, Wiley**.**

5. Satyanarayana, U.; Chakrapani, U. (2017), **Fundamentals of Biochemistry**, Books and Allied (P) Ltd.

6. Lehninger, A.L; Nelson, D.L; Cox, M.M. (2009), **Principles of Biochemistry**, W. H. Freeman.

Practical:

1. Dean, J.R.; Jones, A.M.; Holmes, D;, Reed, R.; Jones, A.Weyers, J. (2011),**Practical skills in chemistry**, Prentice-Hall.

2. Wilson, K.; Walker, J. (2000), **Principles and techniques of practical biochemistry**, Cambridge University Press.

3. Gowenlock. A.H. (1988), **Varley's Practical Clinical Biochemistry**, CRC Press.

4. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume II**, I K International Publishing House Pvt. Ltd., New Delhi.

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:

Students' evaluation 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 voice.

Keywords: Carbohydrates, Nucleic acids, Concept of heredity, Lipids

BSc. (Life Science) -
Zoology Component (Semester - V)

DISCIPLINE SPECIFIC CORE COURSE-15 (Zoo-LS-DSC-15):– Evolutionary Ecology

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		
Evolutionary Ecology Zoo-LS-DSC-15	04	02	Nil	02	Passed Class XII with Chemistry/ Biology/ Biotechnology	Basic concept of Ecology

Learning Objectives

The learning objectives of this course are as follows:

- to explore the interface of ecological and evolutionary forces that leads to the diversity of the form.
- to understand the function, and behaviour among animals.
- to impart an understanding of the evolutionary origin and drivers of biological variation and diversity, including the significance of genetic variation, natural selection, and genetic drift.
- to unravel the evolution of animals, sexual selection, the evolution of mating systems, animal interactions, reaction norms and plasticity.
- to learn about co-evolution between species and ecology from a phylogenetic perspective and compares evolutionary processes behind reproductive and ecological adaptations.
- to understand how communities and species interact with their environment at large spatial and temporal scales.

Learning Outcomes

By studying this course, students will be able to

- better understand the diverse relationships that the organisms have in the environment.
- analyze the patterns of distribution of animals in different regions and ecosystems.
- gain insight to the major events in history of life and major theories of evolution.
- know the fundamental concepts of natural selection, speciation, mass extinction and macro-evolution.
- explain the characteristics, dynamics, and growth of populations.
- appreciate the characteristics of the community, ecosystem development and climax theories.
- gain knowledge about the relationship of the evolution of various species and the environment they live in.

SYLLABUS OF DSC- 15

UNIT- 1: Introduction to Evolutionary Ecology **3 hrs**

Introduction to the concepts of evolution and ecology and the relationship, evolutionary theories and origin of life, Levels of ecological hierarchy, heritability, natural selection, fitness and adaptation; Types of selection, Ecological adaptations of animals to their environment.

UNIT- 2: Population Ecology **7 hrs**

Group attributes- Density, natality, mortality, dispersal and dispersion, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Population growth- Exponential and logistic growth, Life history traits - r and K selection. Population regulation - Density dependent and independent. Population interactions: Positive and negative interactions.

UNIT- 3: Community Interactions **6 hrs**

Characteristics of community- species richness, dominance, diversity and abundance. Community organisation – habitat, niche, guilds, and dominant species. Interspecific interactions with examples. Species diversity indices. Types of ecological succession. Characteristics of climax community, Concept of keystone, flagship, umbrella species with examples.

UNIT- 4: Processes of Evolutionary Change and Species Concept **7 hrs**

Natural selection and its types, Genetic drift, Artificial selection. Species concept, Isolating mechanisms, Modes of speciation (Allopatric, Sympatric, Parapatric and Peripatric), Adaptive radiation/macroevolution (Darwin finches).

UNIT- 5: Coevolution **4 hrs**

Introduction to coevolution; types of coevolution (pairwise coevolution, diffuse coevolution, and gene-for-gene coevolution); Co-evolutionary interactions (Coevolution of competitors, Predator-prey coevolution, Host-parasite coevolution, Coevolution of mutualists); Evolutionary equilibria. Approaches to examine coevolution; Co-speciation and diversification.

UNIT- 6: Macroecology **3 hrs**

Introduction to macroecology: patterns and constraints; macroecological datasets; statistical patterns of abundance, distribution and diversity; Allometry: metabolism, body size and temperature; Macroecology of humans; Conservation macroecology: assessing, prioritizing, and quantifying biodiversity at large scales; Extinction dynamics.

Practical: **60 hrs**

(Laboratory periods: 15 classes of 4 hours each)

1. Study of the phytoplankton and zooplankton: Collection of specimens from an ecosystem (pond/river/lake/forest/garden) to study its biotic and abiotic components.
2. Measurement of temperature, turbidity/penetration of light, determination of pH, Dissolved Oxygen content (Winkler's method), chlorides, hardness, Chemical Oxygen Demand, free CO_2.
3. Gause's Principle with laboratory and field examples, Lotka-Volterra equation-significance in competition; Lotka-Volterra equation, functional and numerical responses in Predation.
4. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
5. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
6. Catch, mark and recapture technique for finding the population size.
7. Study of homology, analogy and homoplasy from suitable specimens.
8. Construction of cladograms based on morphological characters.
9. Study and verification of Hardy-Weinberg Law by Chi-square analysis
10. Project report based on the visit to natural history museum/National Park/Biodiversity Park/Wildlife Sanctuary.

Essential/recommended readings

1. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Ed. Evolutionary Biology, Oxford University Press
2. Zimmer C. and Emlen D. J., (2013) 1st Ed. Evolution: Making Sense of Life, Roberts & Co.
3. Hall, B.K. and Hallgrimson, B. (2013) Evolution; 5th Edition, Jones and Barlett Publishers.
4. Chapman, J., and Reiss, M. (2012). Ecology Principles and Applications; Cambridge University Press.
5. Miller, T., and Spoolman, S. (2008) 12th Edition Environmental Science- Problems, Concepts and Solutions; Thomson Brooks/Cole.
6. Odum, E. P. and Barrette, G. W. (2008) Fundamentals of Ecology; 5th Indian edition; Brooks/Cole

Suggestive readings

1. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
2. Ridley, M. (2004). Evolution. III Edition, Blackwell publishing.
3. Southwood, T. R. E., & Henderson, P. a. (2000). Ecological Methods, 3rd Edition; Blackwell Science Ltd. (Vol. 278, Issue 5705).

DISCIPLINE SPECIFIC ELECTIVES (DSE-11): Basics of Neuroscience

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	Dept offering the course
		Lecture	Tutorial	Practical			
Basics of Neuroscience Zoo-DSE- 11	**04**	**03**	**Nil**	**01**	**Passed Class XII with Biology/ Biotechnology**	**Concept of functioning of nervous system**	**Zoology**

Learning Objectives

The learning objectives of this course are as follows:

- to understand the structure and function of the nervous system at the molecular, cellular, and systems levels.
- to provide an in-depth understanding of neuronal excitability, signal generation and propagation, synaptic transmission, post-synaptic mechanisms of signal integration, and neural plasticity.
- to gain an insight into how membrane excitability elicits functional effects in individual neurons and neuronal networks and how different parts of the brain control various behavioural patterns by releasing neurohormones/neuropeptides.
- to have a thorough knowledge of neuroimaging techniques and a comprehensive understanding of the kinds of information each technique provides about the brain.
- to gain knowledge about the neural mechanism and pathogenesis of common neurodegenerative disorders such as Alzheimer's, Parkinson's disease etc.

Learning Outcomes

By studying this course, students will be able to:

- understand the fundamentals of neuroscience, key concepts, and the relationship between the nervous system and behaviour/cognition.
- comprehend the neural basis of sleep, emotions, learning and memory and related aspects of cognition.
- have a detailed understanding of how different neuroimaging techniques are used to assess brain function and explore questions in clinical and behavioural neuroscience.
- explore potential developments to current research, design, execute and communicate a substantive research project in the field of neuroscience or its application.

SYLLABUS OF DSE- 11

UNIT- 1 Introduction to Nervous System **6 hrs**

Origins of Neuroscience; Neuron doctrine; Classification of the nervous system.

UNIT- 2 Structure of the Brain **5 hrs**

Gross anatomy of the human brain, Meninges, ventricular System, Blood-brain Barrier, Cranial nerves.

UNIT-3 Cellular and Molecular Neurobiology **10 hrs**

Classification of neurons; Structure of prototypical neuron; Electrophysiology of membrane potentials-resting and action potentials, generation, and propagation; Ion Channels and Membrane Ion Currents; Types of Synapses, synaptic transmission and integration; Post synaptic potentials - EPSPs and IPSPs; tripartite synapse.

UNIT- 4 Neurotransmitters **4 hrs**

Types of neurotransmitters; transmitter-gated channels; neurotransmitter receptors Ionotropic and metabotropic receptors; G-protein coupled receptors and effectors.

UNIT- 5 Cognitive and Behavioural Neuroscience **10 hrs**

Neurobiology of visual perception; Molecular basis of learning and memory: Classification ofmemory, amnesia, case of H.M. (Henry Malaison); Synaptic plasticity, Long-term potentiation (LTP), Long-term depression (LTD); Memory consolidation.

UNIT-6 Neurophysiology of Sleep **4 hrs**

Neurophysiology of sleep and wakefulness, electroencephalogram rhythms (EEG).

UNIT- 7 Neuroimaging and Neuropathology **6 hrs**

Computed Tomography Scan (CT), Magnetic Resonance Imaging (MRI), functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET); Neurological disorders (in brief)- Epilepsy, Schizophrenia; Aetiology and Molecular pathogenesis - Parkinson's, Alzheimer's.

Practical **(30 hrs)**

(Laboratory periods: 15 classes of 2 hours each)

1. Study of brain coordinates using stereotaxis instrument (video demonstration).
2. Study of *Drosophila* nervous system using GFP reporter system.
3. Study of anatomy of mammalian brain (from slaughter house or) using brain models (Medical anatomical teaching models, graphics, videos etc., can be used).
4. Histological study of neurons and myelin sheath (Nissl and Luxol Fast Blue staining).
5. Study of novelty, anxiety, and spatial learning in mice.
6. Histological study of the cerebellum and spinal cord by H&E stain and cerebral cortex by Nissl stain.

7. Study of neurodegenerative diseases (Parkinson's and Alzheimer's) with the help of brainscan images or brain tissue images.

Essential/recommended readings

1. Purves, D. et al., (2017) Neuroscience, VI Edition. Oxford University Press.
2. Bear, M. F., Connors, B. W. and Paradiso, M. A. (2016). Neuroscience: Exploring the Brain. IV Edition. Philadelphia: Wolters Kluwer.
3. Squire, L., Berg, D., Bloom, F. E., du-Lac, S., Ghosh, A., Spitzer, N. C. (2012) Fundamental Neuroscience, IV Edition, Academic Press Publications.
4. Kandel, E.R., Schwartz, J.H. and Jessell, T.M. (2000) Principles of Neural Science. IVEdition, McGraw-Hill Companies.

Suggestive readings

1. Carter, R. (2014). The Human Brain Book. D. K. Publishers.
2. Stephan M. Stahl (2000) Essential Psychopharmacology- Neuroscientific Basis and Practical Applications. II Edition. Cambridge University Press.
3. Ramachandran, V. S. and Blakeslee, S. (1998). Phantoms in the Brain: Probing the Mysteries of the Human Mind. William Morrow, New York.

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