

Pool of DSEs

DISCIPLINE SPECIFIC ELECTIVE COURSE– 10 (BIOMED-DSE-10) FUNDAMENTALS 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	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Fundamentals of Neuroscience BIOMED-DSE-10	4	3	-	1	Class XII Passed	Basic knowledge of Physiology, biochemistry and Cell biology	Biomedical Science

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide a comprehensive overview of the basic principles and concepts in neuroscience, including the structure and function of the nervous system, neural communication, and basic neuroanatomy.
- The paper aims to investigate the neural mechanisms underlying a particular phenomenon, such as perception, memory, learning, decision-making, or emotion.
- To prepare students to undertake further research in the area of neuroscience.

Learning outcomes

Having successfully completed this course, students shall be able:

- To understand the fundamental organization, function and development of the nervous system.
- To conceptualize and compare the role of different neurotransmitters.
- To understand the mechanisms of different disorders associated with the nervous system.
- To appreciate the principles and applications of different tools and techniques used in neuroscience.
- To proficiently explore relevant websites and databases related to latest initiatives in the field of neuroscience.

SYLLABUS OF BIOMED-DSE-10

Unit I: Introduction to Neuroscience

(10hrs)

Brief overview of Neuroanatomy: Timeline of the nervous system development, Organization of Central Nervous System (CNS), Peripheral Nervous System (PNS), Autonomic Nervous System (ANS). Meninges and Cerebrospinal Fluid (CSF), Vascular Supply of the Brain: blood brain barrier and blood CSF barrier.

Unit II: Neurochemistry and Neurophysiology

(10hrs)

Introduction to Neurochemistry, overview of synaptic transmission and cellular signaling. Neurotransmitters and their receptors: Acetylcholine, Glutamate, GABA, Dopamine, Serotonin and Epinephrine. Neuropeptides, Gut-Brain axis. Membrane potentials, Post synaptic potential and synaptic integration, Neuromuscular junctions.

Unit III: Brain and Behavior

(06 hrs)

Neuroplasticity, learning and memory, cognition, sleep, circadian rhythm, Affective immunology: emotions and Immunity

Unit IV: Diseases of the nervous system

(10hrs)

Overview of neuroinflammation, Neurochemical and molecular mechanisms of different neurological conditions: Autism, Attention Deficit Hyperactivity Disorder (ADHD), Epilepsy, Anxiety and depression, Alzheimer Disease, Parkinson Disease/ Schizophrenia, and Amyotrophic Lateral Sclerosis (ALS)

Unit V: Tools and Techniques in Neuroscience / Kaleidoscopic Dimensions of Neuroscience(09hrs)

Methods and tools to study brain and behavior: neuroimaging techniques (MRI, PET), electrophysiological studies (EEG). *In vitro* models of neurosciences including cell culture, tissue culture and animal models. Introduction to Neuroinformatics.

Practical

(30 hrs)

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

1. Gross examination of the brain and its different parts (human and animal) through videos.
2. Histology of different brain sections through permanent slides.
3. Microanatomy of neurons using virtual labs.

4. Electrophysiological studies using physiological data acquisition systems (teaching modules)
5. Exploration and extraction of information about the brain from NCBI, NIF, Allen Brain Atlas, the virtual brain, Human Connectome Project, etc.
6. Behavioral studies using virtual lab- Motor functions tests (Rotarod Test, Grip Strength Test), Cognitive Functions tests – Learning and memory related test (Water Maze, open field test, etc.)

Essential readings:

- Kandel, E. R., Koester, J. D., Mack, S.H., et al. (2021). 6th Edition. Principles of Neural Science. McGraw Hill, ISBN: 978-1259642234
- Sontheimer, H. (2021). 2nd Edition. Diseases of the Nervous System. Elsevier, ISBN: 978-0128212288
- Squire, L., Spitzer, N. C., Berg, D., et al. (2012). 4th Edition. Fundamental Neuroscience, Academic Press, ISBN: 978-0123858702
- Brady, S. T., Siegel, G. J., Albers, R. W., et al. (2011). 8th Edition. Basic Neurochemistry. Academic Press, ISBN: 0125468075
- Zigmond, M. J., Bloom, F. E., Roberts, J. L., et al. (2008). 3rd Edition. Fundamental Neuroscience. Academic Press, ISBN: 978-0123740199

Suggested readings:

- Sanes, D. H., Reh, T. A., Harris, W. A., et al. (2019). 4th Edition. Development of the Nervous system. Academic Press, ISBN: 978-0128039960
- Gilbert, S. F., & Barresi, M. J. F. (2016). 11th Edition. Developmental Biology. Sinauer Associates Inc, ISBN: 978-1605354705
- Hall, J.E. (2015). 13th Edition. Guyton and Hall textbook of Medical Physiology. Philadelphia, USA: W B Saunders and Company. ISBN-13: 978-1455770052
- Aminoff, M., Greenberg, D., Simon, R. P. (2015). 9th Edition. Clinical Neurology. McGraw Hill Education, ISBN: 978-0071841429

DISCIPLINE SPECIFIC ELECTIVE COURSE –11 (BIOMED-DSE-11) GREEN CHEMISTRY METHODS IN PHARMACEUTICAL AND INDUSTRIAL APPLICATIONS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical /Practice			
Green Chemistry Methods in Pharmaceutical and Industrial Applications BIOMED-DSE-11	4	3	-	1	Class XII Passed	Basic knowledge of organic reactions	Biomedical Science

Learning objectives

The objective of this course is to make students aware of

- The toxicity, hazard and risk of chemical substances as well as to be aware of the importance of green chemistry in today's world.
- To familiarize students with environment-friendly alternatives for the synthesis of various chemicals.
- Course will help to understand the usage of various green approaches in synthetic chemistry and their applications for sustainable development.

Learning outcomes

After studying this course students should be able to:

- Understand the twelve principles of green chemistry and gain an in-depth understanding of chemical toxicity, hazard, and associated risk.
- Learn to create non-toxic chemicals, products, and processes than current alternatives.
- Comprehend the importance of inherently safer design for accident prevention
- Understand the advantages of using catalysts and biocatalysts, use of renewable feedstocks and green solvents for environmental protection.
- Appreciate the role of green chemistry in innovatively solving environmental issues.

- Green chemistry is a mean to maximize revenues, productivity, and sustainability while producing zero waste. They are also motivated to practice green chemistry by success stories and real-life examples.

SYLLABUS OF BIOMED-DSE-11

Unit I: Introduction to Green Chemistry

(10 hrs)

Importance of Green Chemistry: Green Chemistry in nature (for example nitrogen fixation, photosynthesis, gluconeogenesis/ glycolysis), Twelve principles of green Chemistry: Prevention of waste, Atom economy, Designing less hazardous chemical synthesis, Designing safer products, Safer solvents and auxiliaries, Design for energy efficiency, Renewable resources, Reduce derivative, Use of selective catalyst, Design for degradation, You cannot control what you cannot measure, Inherently safer chemistry for accident prevention, Important environmental laws, the Pollution Prevention Act of 1990, Limitations and Obstacles in the Pursuit of the Goals of Green Chemistry.

Unit II: Conventional Chemistry vs Green Chemistry

(10 hrs)

General concept of mixing of orbitals (Hybridization), Role of various electronic effects in the modulation of reactions; Homolytic and Heterolytic cleavage. Substitution reactions (hydrolysis of alkyl halides and Hydrolysis of esters), Addition reactions (Hydrogenation of alkenes), Elimination reactions (Hoffman elimination, Decarboxylation), Rearrangement (Diels-Alder reactions), Cis-trans isomerisation of alkenes, Condensation reactions: Aldol (replacement of ethanol with solvent free reaction) and Benzoin (replacement of KCN, TPP, Thiamine HCl). Prevention of waste/by-product pollution, calculation of atom economy with reference to above reactions.

Unit III: Green Solvents

(10 hrs)

- Conventional solvents (Ethanol, Acetone, chloroform, DCM) and Green Solvents (water/buffer, supercritical fluids, ethyl lactate, Ionic liquids). Buffers (Phosphate, Acetate) and buffer action (concept of pKa), Relative acids/basic strength of organic acids and bases (aliphatic and aromatic).
- Advantages of green solvents in chemical synthesis: Supercritical CO₂ in the separation of coffee from coffee beans and perfume industry, water as a green solvent in reactions (Benzoin condensation, Hofmann Elimination, methyl benzoate to benzoic acid and Decarboxylation reaction).
- Ionic liquids: physicochemical properties, Advantages and Disadvantages (purification of complex mixtures and cost), Reactions of Ionic liquids: Imidazolium based ionic liquid for the synthesis of

antiviral drug trifluridine, hydrogenation of alkenes, Diels-Alder reaction with copper (II) bisoxazolium complex having imidazolium tag.

Unit IV: Various Approaches to Green reaction synthesis

(10 hrs)

- Enzyme-based reactions: Biocatalyst (concept of stereoselectivity and stereospecificity, and turnover number), Biocatalyst mediated synthesis of Sitagliptin drug and ethanol; Nanocatalysis (oxazole synthesis using nanocatalyst). Photocatalysis: Visible light induced Reactions (syntheses of vitamin D3, cis-trans isomerization of alkenes, waste water treatment with TiO₂).
- Microwave-assisted green approach: Principle, merits, demerits and effect of solvent; Microwave-assisted reactions: solvent-free synthesis of aspirin, Renewable starting materials: Synthesis and properties of 5-Aminolevulinic acid (DALA) from levulinic acid. Design of degradable reactions (pesticides), Inherently Safer design in chemical synthesis: Principle and Subdivision eg. Bhopal Gas Tragedy.

Unit V: Pharmaceutical and Industrial Applications for revenue, productivity and sustainability (5 hrs)

Vitamin C used in cosmetics/neutraceuticals industry: Synthesis using enzymes, commercial production of drugs/pharmaceutical product: anti-depressant drug sertraline, Removal of Drug from Waste water: Levofloxacin, an anti-bacterial drug with ZnO nanoparticles, Enzymatic synthesis of Zero Trans-Fats and Oils,

Practical:

(30 hrs)

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

1. Preparation and characterization of biodiesel from vegetable oil preferably waste cooking oil.
2. Benzoin condensation using thiamine hydrochloride as a catalyst instead of cyanide
3. Mechanochemical solvent-free synthesis of succinic anhydride/phthalic anhydride
4. Hydrolysis of esters/ esterification using green methods.
5. Solvent-free, microwave-assisted one-pot synthesis of phthalocyanine complex of copper (II).
6. Cross aldol condensation reaction using base catalyzed green method.
7. Microwave-assisted synthesis of drug/ drug intermediates (Knoevenagel reaction, Aspirin)
8. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.
9. Acetylation of primary aromatic amine using the green method.
10. Synthesis of nanoparticles using green approach.

Essential Reading:

- Matlack, A.S., Andraos. J, (2022); Introduction to Green Chemistry, 3rd Edition, CRC press (ISBN: 978-1032199429).
- Sharma, R.K.; Bandichhor, R. (2018), Hazardous Reagent Substitution, Royal Society of Chemistry. (ISBN: 978-1-78262-050-1)
- Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing. (ISBN: 978-1-78262-294-9)
- Wei Zhang, Berkeley W. Cue Jr (2012) "Green Techniques for Organic Synthesis and Medicinal Chemistry" John Wiley & Sons, Ltd (ISBN:9780470711828)
- Sharma, R.K.; Sidhwani, I.T.; Chaudhari, M.K. (2012), Green Chemistry Experiments: A monograph, I.K.International Publishing House Pvt Ltd. (ISBN: 978-9381141557)
- Kirchhoff, M.; Ryan, M.A. (2002), Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC. (ISBN: 8412-3866-9)
- Anastas, P.T.; Warner, J.C. (2000), Green Chemistry: Theory and Practice, Oxford University Press. (ISBN: 9780-198506980).
- El-Maraghy, C. M., El-Borady, O. M., & El-Naem, O. A. (2020). Effective Removal of Levofloxacin from Pharmaceutical Wastewater Using Synthesized Zinc Oxid, Graphen Oxid Nanoparticles Compared with their Combination. *Scientific Reports*, 10(1), Article 1. <https://doi.org/10.1038/s41598-020-61742-4>

Suggestive readings

- Batra. S.K; Gulati, S; Shukla, S, (2020); Practical Green Chemistry: Strategies, Tools & Experiments, Shri Kala Prakashan (ISBN: 978-9385329456)
- Sidhwani, Tucker I; Sharma, R.K, (2020); An Introductory Text on Green Chemistry: For Undergraduate Students, Wiley (ISBN: 978-8126554072)
- Benyus, J.M. (2002); Biomimicry:Innovations Inspired by nature, HarperCollins. (ISBN: 9780060533229)
- Garay,A. L; Pichon, A.; James,S.L. "Solvent-free synthesis of metal complexes" Chem Soc Rev, 2007, 36,846-855.
- James H. Clark, Duncan Macquarrie (2002); Handbook of Green Chemistry and Technology, Wiley (ISBN: 9780632057153)

DISCIPLINE SPECIFIC ELECTIVE -12 (BIOMED-DSE-12) RESEARCH METHODOLOGY**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)	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Research Methodology BIOMED-DSE-12	4	3	-	1	Class XII Passed	Basic knowledge of biology, mathematics and computers	Biomedical Science

Learning objectives

The Learning objectives of this course are as follows:

- The syllabus aims to educate students on the fundamentals of research methodology and familiarize them with the different search engines used in literature surveys.
- It will guide them in identifying research problems and developing research strategies to address them.
- The course will cover different approaches used in research, along with ethical considerations related to clinical research.
- In addition, students will learn about scientific writing and presentation skills.

Learning outcomes

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

- Develop the ability to identify a research problem, design and execute experiments, and analyze the resulting data.
- Comprehend and follow ethical guidelines for conducting research and accurately document research activities.
- Utilize various tools to write research papers and review articles effectively.
- Demonstrate effective presentation skills to communicate scientific work.

SYLLABUS OF BIOMED-DSE-12

Unit I: Introduction

(6 hrs)

Basics of research methodology: Background of research area and generation of hypothesis, Types of Research: Experimental vs Theoretical; Descriptive vs Analytical; Fundamental vs Applied; Quantitative vs Qualitative.

Unit II: Literature Review

(08 hrs)

Importance of literature review, common search engines such as NCBI, Google Scholar etc. used for literature surveys. Exploring various types of academic journals and publications fundamental to research: journals and e-books. Introduction to reference and citation management tools like Mendeley, Zotero and EndNote.

Unit III: Identifying a Research Problem and Designing of Experiment:

(10 hrs)

Identification of a research problem (any one disease of national importance: tuberculosis/leprosy/diabetes/cardiovascular disease/neurodegenerative disorders), its national and international status. Experimental strategies: number and types of replicates and control, Statistical analysis of data using MS Excel/ R-Statistical tools.

Unit IV: Methods in Biomedical Research

(08hrs)

Clinical Research and associated methodology, Epidemiology: Concepts and methods in the context of illustrative projects. Classical examples of epidemiological studies such as TB and leprosy, its challenges and limitations.

Unit V: Research Ethics and Intellectual Property

(07hrs)

Understanding research ethics and its significance in scientific writing, Plagiarism, peer-review, conflict of interest, and research misconduct. Introduction to Intellectual Property Rights (IPR) such as Patent, Trademarks, Copyright, and Trade Secrets. Importance of IPR in research and innovation.

Unit VI: Research Presentation

(06 hrs)

To write a research paper and review article. To prepare an oral and poster presentation of a research paper. Steps in writing a research grant proposal

Practical**(30 hrs)**

1. Literature survey on any one disease of national importance: tuberculosis/leprosy/diabetes/cardiovascular disease/neurodegenerative disorders
2. Creating bibliography in different formats using any available tools like Mendeley/ Zotero/ EndNote, etc.
3. Group exercise by students
 1. Writing a review article
 2. Writing a research report
 3. Powerpoint presentation
 4. Poster presentation

Essential Readings

- Walliman, N. (2017) Research Methods: The Basics, (2nd ed.), London; New York: Routledge; ISBN-10:1138693995
- Kumar, R. (2014) Research Methodology: A Step-by-Step Guide for Beginners (4th ed.), SAGE publisher; ISBN-10: 9789351501336
- The Craft of Research (Guides to writing, editing and publishing) (2008), Booth, W.C., Colomb, G.G., Williams, J.M., University of Chicago Press, 2008. (ISBN-13: 978-0226065663)

Suggestive Readings

- Research Methodology: A Step-by-Step Guide for Beginners (2010) 3rd ed., Kumar R., Pearson Education. (ISBN-13: 978-1849203012)
- Cresswell, J. (2009) Research Design: Qualitative and quantitative Approaches Thousand Oaks CA, (3rd ed.), Sage Publications
- Research in Education (2005) 10th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd. (ISBN-13: 978-0205458400)
- At the Bench: A Laboratory Navigator (2005) Barker, K., Cold Spring Harbor Laboratory Press (New York). ISBN: 978-087969708-2.
- Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers. (ISBN-13 / EAN: 9788122415223)