

COMMON POOL OF DISCIPLINE SPECIFIC ELECTIVES (DSEs)

DISCIPLINE SPECIFIC ELECTIVE (DSE-1)

credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Environmental Biochemistry	04	02	00	02	Class XII with Science	NIL

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

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

- Describe various components of the environment.
- Evaluate the local and global scale of environmental problem.
- Explain the biological, chemical and physical processes relevant to environmental problems.
- Apply the hands on experience of some quantitative and qualitative research tools gained to assess and analyse the environmental problems

Theory

Credits: 2

Total Hours- 30

Unit 1: Introduction to Environment and the Pollutants

(9 Hours)

Components of Environment - Atmosphere, Hydrosphere, Lithosphere and Biosphere. Global Warming and Climate change. Ozone depletion. 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

(7 Hours)

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

(8 Hours)

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

Unit 4: Techniques to Analyse Pollutants

(6 Hours)

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

2.3 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.

2.4 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

3. Keywords

Environment, Climate Change, ozone depletion, Waste Management, Bioremediation, Toxicity, Bioaccumulation, Bioaugmentation, Biotransformation, Detoxification, Biosensors.

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

DISCIPLINE SPECIFIC ELECTIVE (DSE-2)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biochemical Applications in Forensic Sciences	04	02	00	02	Class XII with Science	NIL

Learning Objectives

The course aims to provide an understanding of the applications of biochemistry in forensic sciences through analysis of evidence, which will help students develop analytical and problem-solving skills for real life situations. With a background of the DSC of Biochemistry, the students get an insight into a major area of application of Modern Biology. The course will keep abreast with all recent developments and emerging trends in forensic science like DNA fingerprinting, brain mapping and facial reconstruction; thus, helping interested students take up forensic science as a future course of study.

Learning outcomes

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

- Describe the fundamental concepts and principles of forensic science and their significance.
- Explain how a forensic investigation is initiated through preservation of evidences, as well as chemical, physical and biological methods of their analysis
- Identity an individual by document evaluation, fingerprints, footprints and DNA analysis and identify the accurate age, sex and identity of an individual and identify time and cause of death in a forensic investigation.
- Explain the importance of precision, reproducibility and accuracy in identification of a biological sample.
- Elaborate the methods used to analyze samples for drug testing, ink and stain testing and document and handwriting verification.
- Describe the physiology and biochemistry behind tests like Narco Analysis, polygraphy, lie detection and facial reconstruction.
- Apply the knowledge gained from hands-on-experience in some of the basic biochemical processes involved in forensic investigation.

2.2 Course Contents

Theory

Unit I: Introduction to forensic science and application of biological sciences to forensic investigation (10 Hours)

History and Development of Forensic Science, Biochemical analysis of various biological evidences: blood, semen, viscera, bite marks, and hair. Establishment of identity of individuals: fingerprints, footprints, blood and DNA. Anthropology – skeletal remains, Odontology. Time of death - rigor mortis, liver mortis, algor mortis, forensic entomology. Biochemical basis for determination of cause of death. case studies

Unit II: Application of chemical sciences to forensic investigation (6 Hours)

Detection of drugs of abuse and narcotics in biological samples, Toxicological examination of viscera, detection of petroleum products and food adulteration. Analysis of inks and their use in questioned document identification. Blood spatter analysis, Case studies

Unit III: DNA Fingerprinting (6 Hours)

Introduction to DNA and source of DNA in Forensic case work, Techniques of DNA fingerprinting-RFLP, STR, PCR, DNA fingerprinting in paternity disputes, mass disaster and other forensic case work, studying kinship by DNA profiling: Related individuals have similar DNA profiles, DNA profiling and the remains of the Romanovs. Sex identification by DNA analysis: PCRs directed at Y chromosome-specific sequences, Amelogenin gene typing. Case studies

Unit IV: Recent advances in forensics (8 Hours)

Narco analysis: theory, forensic significance, future prospect, *Brain mapping*: introduction, EEG, P-3000 wave, forensic applications, limitation of technique, *Polygraph*: Principle and technique, polygraph as forensic investigative tool, use of psychoactive drugs in forensic analysis. NHRC guidelines for polygraph test. *Facial reconstruction*: Method and technique, facial reconstruction in forensic identification, Case studies.

2.3 Practicals – 60 Hours

1. Definition, Identification and Mapping of Crime scene
2. Collection, Preservation, Packaging, and Labeling of biological evidence for their forensic investigation.
3. Preliminary and Confirmatory test for blood/semen/saliva
4. Examination of Micro Evidences: fiber, hair, pollen and soil
5. Fingerprint development from various surfaces and their microscopic and chemical examination
6. Handwriting identification based on class characteristic and individual characteristics
7. Identification of dyes, drugs and ink by TLC

8. Blood spatter analysis
9. DNA Fingerprinting: Sex determination through Y specific STRs and Maternal lineage identification through mitochondrial DNA comparisons.
10. Field trip to a forensic laboratory

2.4 Essential readings:

- James, S.H., Nordby, J.J. & Bell, S. (2014). *Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition*: Taylor & Francis. ISBN 9781439853832
- Jones, P., & Williams, R.E. (2009). *Crime Scene Processing and Laboratory Workbook First Edition*: CRC Press. ISBN 9780429249976
- Saferstein, R. (2018). *Criminalistics: An Introduction to Forensic Science, Twelveth edition*: Pearson Education. ISBN 10:0134477596, ISBN 13: 9780134477596
- Veeraraghavan, V. (2009). *Handbook of Forensic Psychology, First Edition*: Selective & Scientific Books, ISBN 13: 9788189128166.

Suggested readings:

- Lee, H., Palmbach, T. & Miller, M. (2001). *Henry Lee's crime scene handbook, First Edition*: Academic Press ISBN 9780080507989
- Parikh, C.K. (2016). *Parikh's textbook of medical jurisprudence, forensic medicine and toxicology: for classrooms and courtrooms, Seventh Edition*: CBS Publishers and Distributors. ISBN 9788123926469

3. Keywords

Forensic biology; blood spatter analysis; toxicology; narco-analysis; DNA fingerprinting; polygraph; odontology; forensic entomology.

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DISCIPLINE SPECIFIC ELECTIVE (DSE-3)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Microbiology	04	02	00	02	Class XII with Science	NIL

Learning Objectives

The course aims to trace the history of development of the discipline of Microbiology and to emphasize the existence of the immense diversity in the microbial world and maintenance of microbes under laboratory conditions. Through this course students will be introduced to the concept of different modes of gene transfer in bacteria. Further, students will be made aware about the applications of microorganisms in food and industry.

Learning outcomes

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

- Identify different types of microbes
- Perform routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, microbial growth etc.
- Carry out basic research using microbes
- Describe varied applications of microbes

2.2 Course Contents

Theory

Unit I: History and Diversity of Microbial world (8 Hours)

Spontaneous generation versus biogenesis, contributions of Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Richard Petri, Charles Chamberland, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei Winogradsky, Alexander Fleming, Elie Metchnikoff and Emil von Behring. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa. Cell-wall: Composition and detailed structure of Gram positive and Gram-negative cell walls, mechanism of Gram staining

Unit II: Microbial Nutrition, Growth and Control (6 Hours)

Nutritional types of microorganisms, growth factors, culture media- synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; influence of environmental factors on growth of microbes: effect of pH,

temperature, solute, oxygen concentration, pressure and radiations. Sterilization, disinfection and antiseptics.

Unit III: Microbial Genetics (6 Hours)

Conjugation, Transformation and Transduction. Gene mapping in Bacteria

Unit IV: Application of Microbes (10 Hours)

Basic design of fermenter, continuous and discontinuous culture. Preparation of fermented food products such as curd and cheese. Preparation of alcoholic beverages like wine and beer. Treatment of waste-water (Municipal treatment plant) and sewage. Bioremediation and biodegradation. Human microbiome: Role in health and disease. Soil Microbiome: Role in plant health

2.3 Practical: 60 Hours

1. To prepare and sterilize the culture media for the growth of microorganisms
2. To perform various culture transfer techniques: Solid to solid (streaking), liquid to solid (spreading), liquid to liquid, solid to liquid and determine CFU/ml
3. To study growth curve of bacteria
4. To study the effect of pH/temperature on the growth of bacteria
5. To perform gram staining
6. To determine the effect of antibiotics using disc diffusion test
7. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs

2.4 Essential readings:

1. Willey, J., Sherwood, L., Woolverton, C. (2017). Prescott's Microbiology (10th ed.). McGraw Hill international. ISBN 13: 9781259657573.
2. Chan, M. J., Krieg E. C. S., Pelczar, N. R. (2004) Microbiology (5th ed.). McGraw Hill International. ISBN 13: 9780094623206.
3. Pierce, B.A. (2012) Genetics - A Conceptual Approach, (6thed.), W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1
4. Cappuccin, and Sherman N., Microbiology: A Laboratory manual (10th ed.). Benjamin/ Cummings. ISBN 10 J. G.3: 9780321840226. 86

Suggested readings:

1. Madigan, M. T., Martinko J. M., & Stahl D. A., (2010) Brock Biology of Microorganisms (13th ed.). Pearson Education International. ISBN 13: 9780321649638.
2. Snustad, D.P. and Simmons, M.J. (2012) Genetics (6th ed.), John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2

4. Keywords

Microbiological Techniques, Media, Sterilization, Growth curve

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