**DISCIPLINE SPECIFIC ELECTIVE COURSE-15 (BIOMED-DSE-15)**

**ADVANCED TECHNIQUES IN FORENSIC SCIENCE**

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

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course (if any) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| **Advanced Techniques in Forensic Science** | **4** | **2** | **0** | **2** | **XII Passed** | **Basic Knowledge of Biological Science** |

**Learning Objectives:**

- Present forensic science course is designed for students to explore how forensic scientist's work, the tools and techniques they use and how they reach the conclusions they present in court.
- This will engage students in using a creative, problem solving and inquiry-based approach to investigate the crime scene and criminal profiling.
- Questioned document analysis will help students understand the ways of determining the authenticity of various documents.
- The course aims to cover different aspects of forensic science including forensic toxicology wherein a brief introduction will be provided on commonly used poisons in criminal cases and their detection methods.
- The course will explain different methods of individualization of a person like fingerprinting, blood profiling and DNA profiling.
- The marks of injury and the type of death will be used to correlate the events that might have occurred during a crime scene.
- Forensic anthropology is very useful in cases particularly where the victim's body is found quite late after the occurrence of crime and in an unidentifiable state.

**Learning Outcomes**

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

- The students are expected to learn the management and documentation of indoor and outdoor crime scenes. Simulation of a crime scene will familiarize them with situations during a crime scene investigation.

- Major security features in various educational documents, bank notes, cheques and other essential documents of identification.
- The identification of poisons commonly used for committing crime through biochemical tests and post mortem changes.
- The methods for individualization of human beings on the basis of their blood, fingerprint and DNA.
- The clinical features of different types of injuries and death to understand the cause of death.
- Overall the course will provide a platform to the students to take up Forensic Science course at their Master's level

**SYLLABUS** **30 hours**

**Unit I : Crime Scene Investigation** **(5 Hours)**

Introduction and development of Forensic Science in India & Abroad, Pioneers in Forensic Science, 7 Principles of forensic science, Branches of forensic science. Motive of crime,*Modus operandi* and their role in criminal investigation. Methods of searching a crime scene (spiral, grid, line and quadrant search). Macro and microphotography of crime scene.Potential Evidences: Biological (blood, hair, urine, saliva, semen), physical (soil, fiber, bullet, cartridge, weapon), chemical (ink, dye, paint, explosive, drugs/alcohol) andpsychological evidences (interview, interrogation, polygraph test reports). Introduction toBhartiya Nyaya Samhita for the offences against a person.

**Unit II : Forensic Investigation of Physical Evidence** **(8 Hours)**

(a): Examination of Questioned Documents

Preliminary examination of questioned documents: Handwriting, Forgeries, Age of Document & Alterations. Introduction to various security features in important documents (like water marks, intaglio and embossed printing, microprinting, holograms etc). Examination of documents like currency notes, stamp papers, mark sheets, Passports/Visas etc. Methods of examining questioned documents (imaging with visible, UV and IR light, electrostatic detection device, Raman spectroscopy)

(b): Types of Injuries and Death

Classification of injuries into Blunt-end (abrasions, contusions and lacerations) and Sharp-end (incision, stab, fracture).Different types of deaths (natural, accidental, suicidal and homicidal), manner of death (strangulation, drowning and drug overdose), modes of death (coma, syncopeand asphyxiation) and their diagnosis. Medico-legal aspects of different types of injuries and deaths.

**Unit III: Criminal Identification** **(8 Hours)**

Introduction to Criminalistics, Means of criminal identification by:

- Fingerprinting: Fingerprint as forensic evidence (Dactylography, Dermatoglyphic, and Dactyloscopy), Fundamental principles and classification of fingerprinting(latent,patent and plastic fingerprints). Unique features of fingerprints (minutiae). Physical and chemical methods of developing fingerprints.
- Preliminary Blood Examination: Various parametersof blood as forensic evidence (blood identification, blood grouping, blood typing, and analyzing patterns of blood sputter/splashes).

- DNA Profiling: Principle, methodology and applications of DNA profiling in criminal identification. Inheritance disputes,Paternity and infidelity testing.Lineage markers, DNA databanks and their utility in various criminal investigations.

**Unit IV: Forensic Analysis of Biological Evidence (9 Hours)**

(a) : Forensic Toxicology

Importance, Role of a toxicologist, Difference between intoxicant (carbon monoxide, alcohol) andpoison (arsenic, cyanide). Classification of poisons (metallic, gaseous, volatile, non-volatile, alkaloids, pesticides, animal based and vegetable based).

(b): Forensic Anthropology

Analysis of skeletal remains. Personal identification (age, sex, stature) by bones like skull, vertebral column and pelvic. Taphonomy (fossilization) to determine the time of death.

**Practical (60 Hours)**

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

1. Drawing and documentation of an artificially created indoor/outdoor crime scene by using drawing templates and taking field notessuch as area of crime, victim's condition, all the evidences marked/acquired etc.
2. Micro and macrophotography of an artificially created indoor/outdoor crime scene and marking/labelling potential evidences such as fingerprints, murder weapon, traces of blood/hair/fiber and footprints etc.
3. Examination of important documents (currency notes, stamp papers, mark sheets, Passports/Visas) and their security features (like water marks, optically variable ink, micro-printing, intaglio printing) by oblique/UV light and digital microscopy.
4. Qualitative tests for detection of intoxicant alcohol by potassium dichromate or ceric ammonium nitrate and poison (chloroform) by aniline/pyridine based and/or arsenic by Marsh test using arsenic trioxide).
5. Determine the pattern and total ridge count (TRC) in individual fingerprints.
6. Preliminary blood analysis: detection by luminol/phenolphthaleinand blood group analysis by kits.
7. RFLP based DNA profiling using a kit (includes steps like cutting of given DNA samples by restriction enzymes, separation of fragments on gel electrophoresis and comparison of bands for finding the correct match).
8. Mini / Microsatellitebased DNA profiling; theoretical or kit based. (Students will be introduced to both southern hybridization-based method and also PCR based method).
9. Depiction of different typesof injuries and death (as covered in the theory) through various pictures and videos.
10. Estimation of age and sex of victim's body by analyzing various features of the skull (like mandible, orbits, sagittal suture etc)and pelvis(like ischiopubic ramus bridge, subpubic angle, pubic symphysis etc).
11. Use of long bones for estimation of statureof the victim's decomposed body(using length of tibia, femur and humerus for correlation with height).

12 – 15. Case study presentationsby students based on different modes of death (like strangulation, drowning, accident, blunt end injury, sharp incision, fire, firearm etc) and analysis of postmortem parameters.

**Essential Readings:**


- Archana Mahakalkar (2023). *Introduction to Basics of Forensic Anthropology (A Short-Focused Book).*Walnut Publication. ISBN-13: 978-9359110851
- Mary H. Dudley (2021) 1st Edition. *Forensic medicolegal injury and death investigation.* Florida, USA: CRC Press. ISBN-13: 978-1032097688
- Richard, S. (2019). 4th Edition. *Forensic science: From the crime scene to the crime lab.* London, UK: Pearson Education, Inc. ISBN 13: 978-0-13-480372-2
- James, S.H. Nordby, J.J. and Bell, S. (2015). 4th Edition. *Forensic science: An introduction to scientific and investigative techniques*. Florida, USA: CRC Press. ISBN-13: 978-1439853832


**Suggested Readings:**


- Bardale, R. (2024). 4thEdition. *Principles of forensic medicine and toxicology*. New Delhi: Jaypee Brothers Medical Publishers. ISBN-13**:** 978-9350254936.
- Pankaj Shrivastava *et al*. (Ed). (2023) *Textbook of Forensic Science.*Springer Singapore. ISBN: 978-981-99-1376-3